Feb. 2, 1954 A. H. BEEDE 2,667,943

VACUUM CLEANER

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Fig. 4.

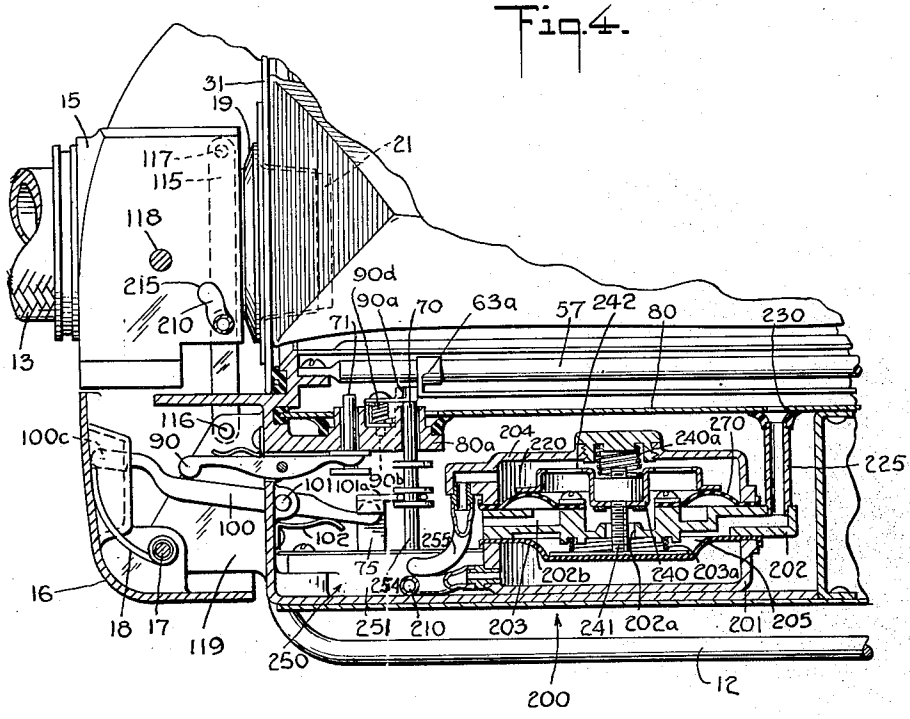
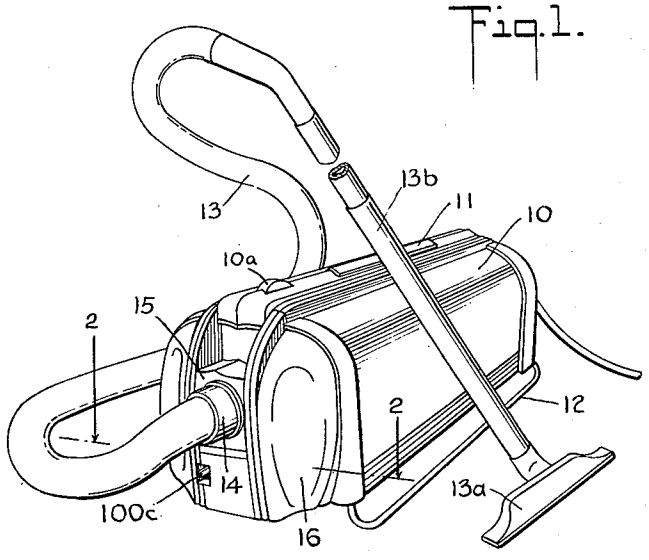


Fig. 1.



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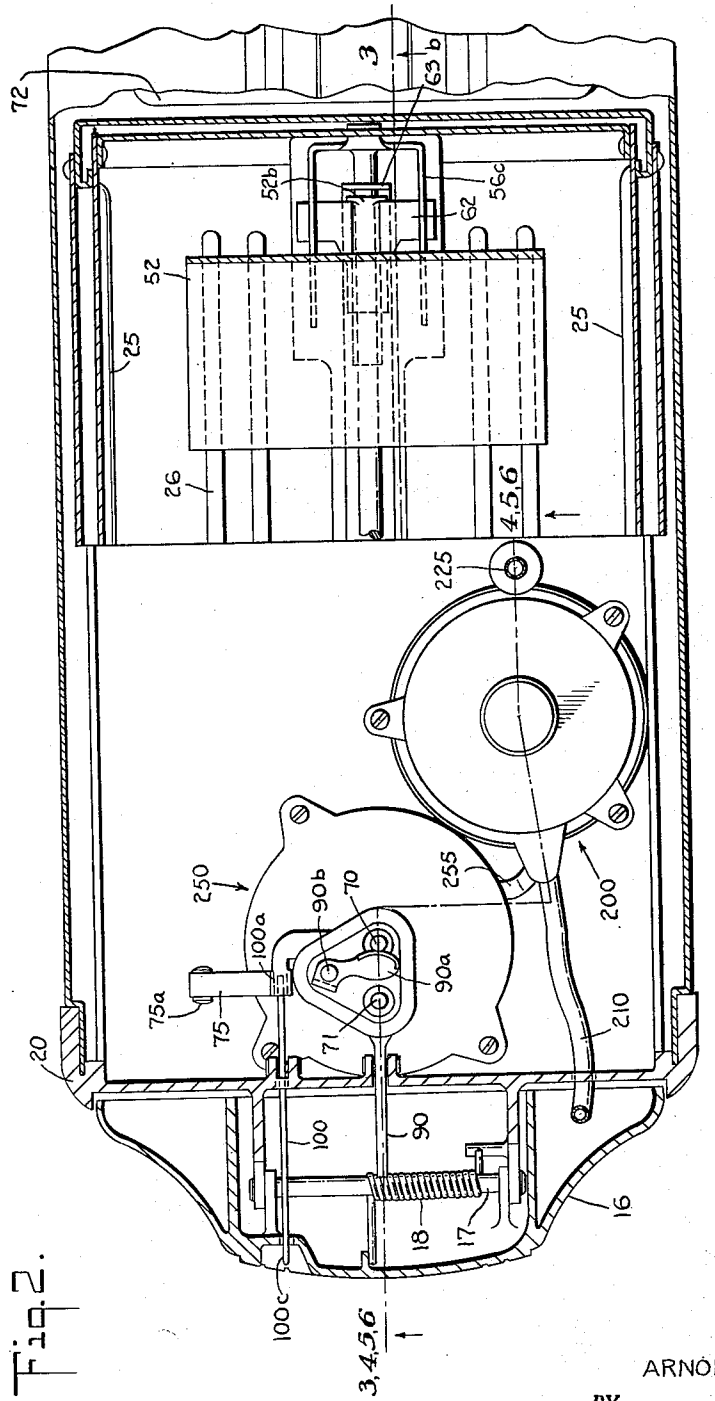


Fig. 2.

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VACUUM CLEANER

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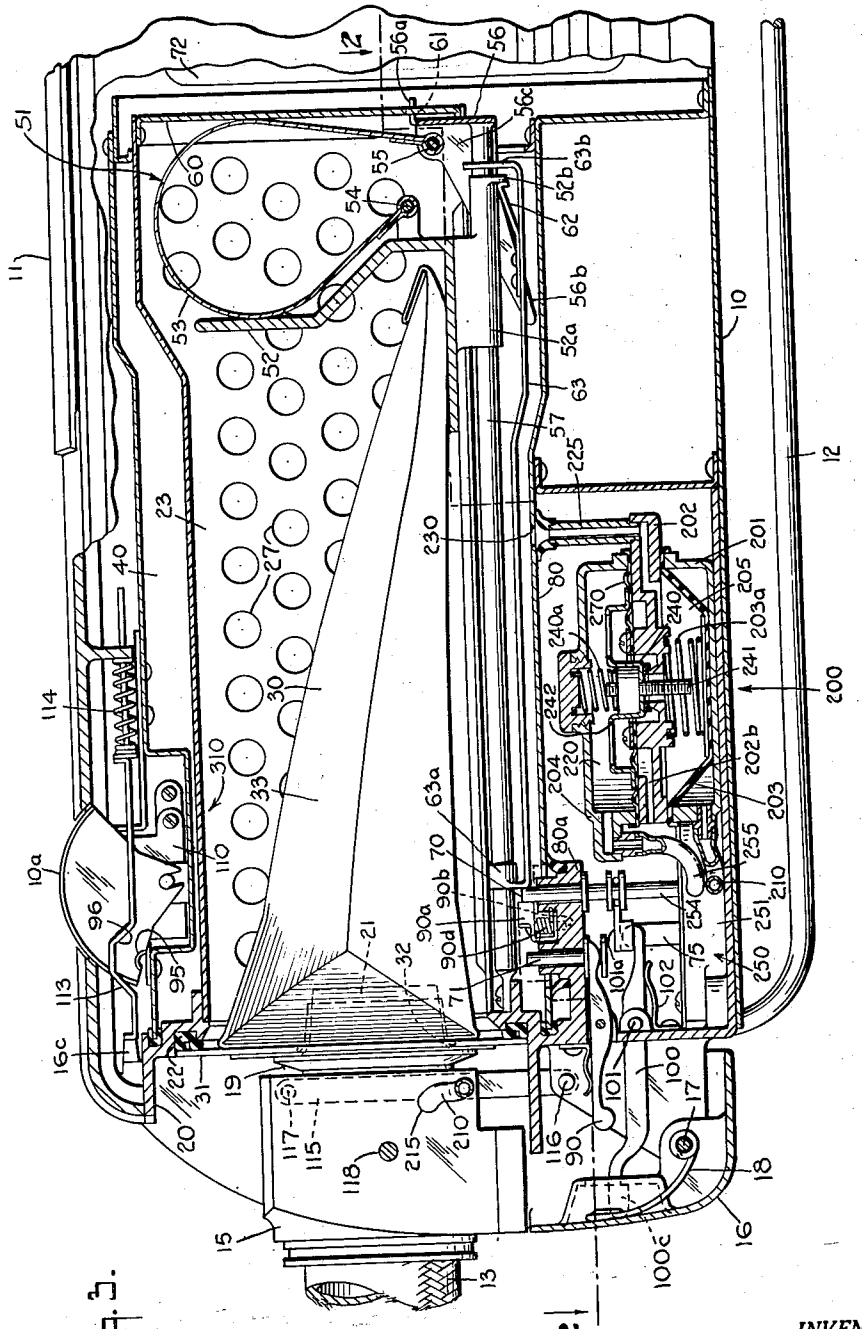


Fig. 3.

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VACUUM CLEANER

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Fig. 5.

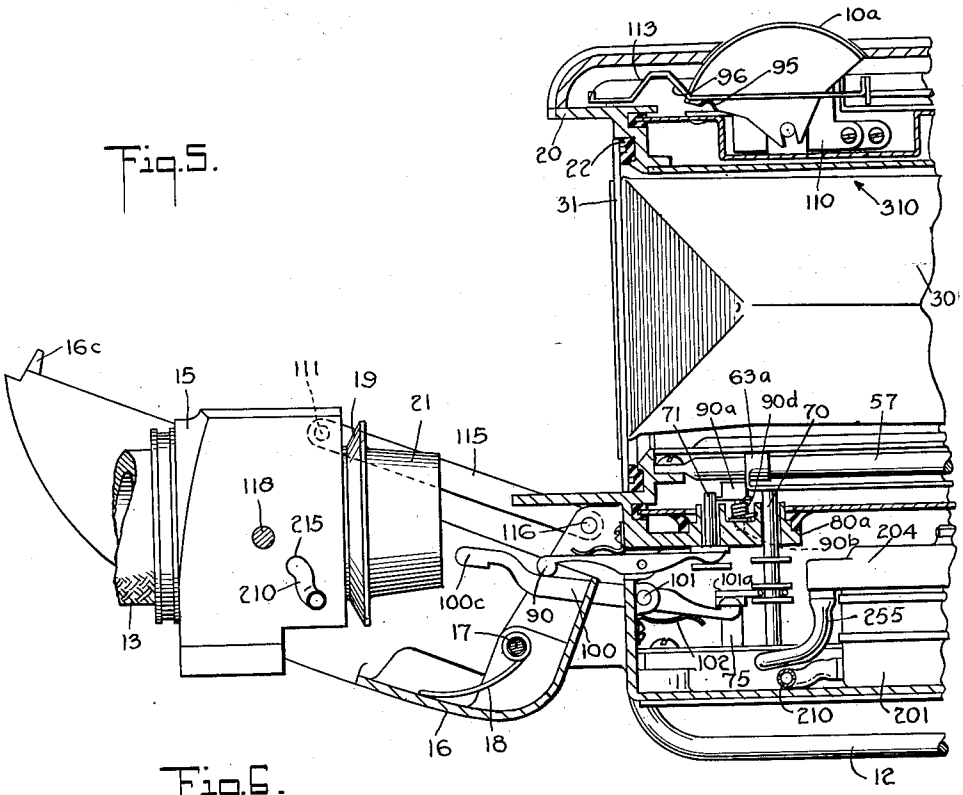
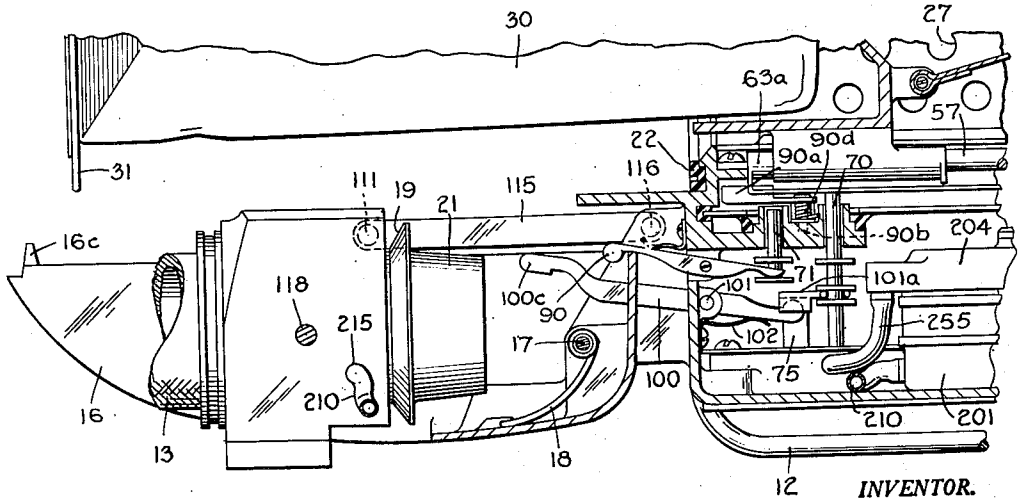


Fig. 6.



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UNITED STATES PATENT OFFICE

2,667,943

VACUUM CLEANER

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Application November 13, 1951, Serial No. 256,100

12 Claims. (Cl. 183—37)

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This invention relates to a vacuum or suction type cleaner having automatic controls. More particularly, it embraces an automatically conditioned tank type cleaner having self-contained control mechanisms for removing accumulated dirt in packaged form readied for immediate disposal. With this cleaner the dirt entrained in the incoming air suction stream is collected in a porous disposable bag located within the cleaner and when the collected dirt effects a predetermined change in the operating efficiency of the cleaner, the latter automatically shuts itself off and disposes of the dirt filled bag by ejecting the latter from the cleaner.

It is a major object of this invention to provide a new and improved vacuum cleaner having automatic means for disposing of dust and dirt by ejecting from the cleaner a self-sealing porous and disposable paper bag filled with dust and dirt separated from the suction air stream during normal operation of the cleaner.

It is a further and important object hereof to provide completely automatic means for effecting the operation of such a dust bag ejecting device upon the attainment of a predetermined condition or status of operation within the cleaner.

A still further object is to provide a vacuum cleaner which has a large dust collecting capacity and which operates at a substantially uniform efficiency.

A further object of this invention is to provide a device which avoids the inconveniences present in the conventional suction type of vacuum cleaning device using the customary cloth or paper dust bag which periodically necessitates indiscriminate removal or replacement in order to maintain a semblance of efficient operation, such bag removal steps being heretofore effected manually and with considerable difficulty and discomfiture to the operator.

Still another object of this invention is to provide completely pneumatic means for initiating and effecting the automatic operation of such a dust bag ejecting device.

Still other and further objects will be disclosed hereinbelow or will become evident to those skilled in the art after a careful study of the following description together with the appended drawings wherein:

Figure 1 is a perspective view of the complete cleaner as seen from the air intake end, together with its conventional hose, wand and nozzle;

Figure 2 is a horizontal sectional view taken on the line 2—2 of Fig. 1 and more clearly shown as taken on the line 2—2 of Fig. 3;

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Figure 3 is a vertical sectional view taken on the line 3—3 of Fig. 2;

Figure 4 is a vertical sectional view taken on the line 4—4 of Fig. 2 showing the front assembly partially in section;

Figure 5 is a vertical sectional view taken on the line 5—5 of Fig. 2 showing the front assembly partially released; and

Figure 6 is a vertical sectional view taken on the line 6—6 of Fig. 2 showing the front assembly completely released, the pivoted restraining latch having been released and the dust bag ejected preparatory to falling on the floor.

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 in the ejection of the dust-filled bag 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. This results in a continuous and progressively increasing force being exerted upon a pressure differential measuring 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 with the clean side of the dust bag, the chamber on the other side of the diaphragm being connected to an opening communicating with 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 steps pneumatically actuated, mechanically actuated, electrically actuated, etc., etc., which sequence when once initiated culminates finally in the ejection of the dust-filled bag from the cleaner housing and the deenergization of the motor fan unit.

In a preferred embodiment, the differential pressure diaphragm actuates means which in turn opens a valve for admitting suction from the motor fan unit to actuate a second 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 ejector restraining latch; and (2) in timed relation therewith this second diaphragm substantially simultaneously, or thereafter, 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. Continued travel of the conduit towards fully opened position then actuates mechanical means which removes a restraining member from the path of the previously selectively positioned member thereby permitting the latter to move the additional amount necessary to release the ejector restraining latch for actually releasing the bag ejector mechanism for dust bag ejection, whereupon the dust-filled bag is expelled from the cleaner housing and deposited upon the floor. During these dust conduit releasing steps, the timely breaking of the motor fan circuit results in a progressive deceleration of the motor speed and consequently the air suction stream also progressively decreases to a value at which highly effective bag ejection is more readily attained.

Thus in accordance with this preferred embodiment of the invention, automatic dust bag ejection is effected by mechanical means, after being initiated by a tripping mechanism including a pressure differential measuring device which actuates a responsive triggering apparatus. The pressure differential measuring device is conditioned for operation by apparatus utilizing the air pressure difference built up within the cleaner casing by dust layers collected in the dust bag. The pressure difference is established between the inside and outside of the dust collecting bag, increases progressively with continuing dust collection, and is communicated therefrom by appropriate conduit means throughout the dust collecting process.

Referring now more particularly to the drawings, vacuum cleaner housing **10**, Fig. 1, is a hollow casing having a handle **11**. 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 **13***a* and wand **13***b* together with a suitable flexible hose **13**, and connecting coupling **14** fitted into a movable hose coupling assembly **15** which is anteriorly mounted by parallel linkage including front end assembly **16**. Front assembly **16**, Figs. 2, 3 is hinged at **17** to base casting **119** and biased to open position by spring **18**; assembly **16** effects with casing **10** an air tight seal formed by rubber sealing ring member **19**, cardboard disc **31**, Fig. 3, 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. 3, 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 **20**, 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, reinforced by lateral stiffening plates **25** and base rods **26**, is substantially rectangular in cross-section and is thus adapted to take a bag of substantially similar but slightly smaller cross-section **30**, Figs. 3 and 6.

Dust bag **30**, Fig. 3, comprises a dust receptacle of paper or similarly air-pervious, dust-impervious, material **33** 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**, Figs. 2 and 3, in order to permit free passage of suction air current therethrough and into chamber **40**. The suction air current then passes to the rear of the vacuum cleaner housing **10** containing the motor fan compartment which has a conventional fan and motor unit **72**, Figs. 2 and 3, mounted therein.

The dust bag ejector mechanism **51**, Figs. 2 and 3, for operating the bag ejector plate **52** includes a flat or leaf spring **53**, which can be bowed or folded back on itself, Fig. 3, into fully flexed (loaded) condition by pushing back the ejector plate **52** into its latching position. Dust bag ejector plate **52** is hingedly attached by pin **54** to the front end of flat spring **53**, Figs. 3 and 6, while the rear or fixed end of flat spring **53** is hingedly attached by pin **55**, Fig. 3, to rear mounting member **56**. Ejector plate **52** is slidably mounted by sleeve **52***a* on guide rod **57** which maintains plate **52** oriented correctly throughout its region of travel. The rear wall **60** of dust bag receiving compartment **23** is affixed to the rear end of perforated inner housing **23** and has a slot **61** cut therein to receive a tongue **56***a* which rigidly supports rear mounting member **56** of the ejector mechanism **51**. Suitable bulkheads are provided within the outer housing **11** to adequately support and align inner housing member **23**.

The ejector plate **52** of ejector mechanism **51**, is held in spring loaded position by releasable latching means which engages a depending lug **52***b*, Fig. 2, and shown more clearly in Fig. 3. Lug **52***b* is integral with plate **52** and sleeve **52***a* and engages spring latch **62** when plate **52** is pushed back into loaded position, see Fig. 3. Spring latch **62** is affixed at one end to latch bar **63**, and moves over a limited range therewith while simultaneously travelling down the inclined edge **56***b*, Fig. 3, of the cam bracket portion **56***c* of rear mounting member **56** and towards the end of its travel, spring latch **62** slips under the bottom edge of depending lug **52***b* whereupon ejector mechanism **51** is released to effect dust bag ejection. Latch bar **63** is slidably mounted on guide rod **57**, at one end by sleeve **63***a*, Figs. 3, 4, 5 and 6, and at the other by apertured upwardly bent end portion **63***b*, Figs. 2 and 3.

The particular details of one embodiment for a restraining mechanism adapted to control the movement of latch bar **63** is clearly shown in Figs. 4, 5 and 6 especially when considered together with Figs. 2 and 3. In these figures, preliminary latch bar restraining and releasing pin **70**, Fig. 4, biased to latching position by the upwardly biased diaphragm of pneumatically operated means **250**, projects through an opening formed

in base plate shelf 80a. Pin 70 is adapted by axial movement to be withdrawn from its latch bar restraining position (Fig. 3) to its latch bar releasing position (shown in Fig. 4).

The above latch bar restraining and releasing pin 70 for controlling operation of the ejector mechanism is operated by cooperative association with appropriate selectively operable triggering mechanism. Thus, pin 70, is adapted to be selectively moved from its normal position (shown in Fig. 3) to its withdrawn position (shown in Fig. 4) by the downward movement of extension link 254 integral with pin 70 and attached at its lower end to the diaphragm of pneumatically operated means 250. The withdrawal of pin 70 releases for counterclockwise rotation pin retaining finger 90a, Figs. 2, 3 and 4, which, in the form of a lever arm fulcrumed on shaft 90b and affixed thereto to move as a unit functions to prevent relatching of latch bar 63 by pin 70. The entire pin retaining unit, 90a, etc., is spring biased to effect this movement by spring 90d. This selective withdrawal of pin 70 is effected by automatic triggering initiated by pneumatically actuated means 250 (described below and in considerably more detail in patent application Serial No. 140,394, filed January 25, 1950).

Terminal latch bar restraining and releasing finger 90a is held in restraining position by the upwardly extending end of pin 71 biased by one end of lever 90 and is moved to releasing position (shown in Fig. 6) only by the further substantial movement stages of the opened front end assembly 16 and/or parallel linked hose coupling assembly 15 which effects the actuation of lever 90 through contact with the edge of assembly 16 (see Figs. 5 and particularly 6). Thus the above-mentioned selective positioning of pin 70 results in the superpositioning of retaining finger 90a (see view Fig. 4) above pin 70 to retain the latter in releasing position out of the path of latch bar 63. In this position lever 90 will be capable when the edge of front end assembly 16 actuates the free end of lever arm 90 to effect the withdrawal of pin 71 and the releasing of unit 90a for further clockwise rotation, and then enable flat spring 53 to effect the additional movement of latch bar 63 necessary to cause spring latch 62 to release lug 52b and effect bag ejection, Fig. 6.

With this particular latching device for restraining the ejector mechanism 51, plate 52 is held in loaded position until assembly 16 and/or assembly 15 have undergone a substantial movement. Assembly 16 is held closed by latch 100, Figs. 2, 3, 5 and 6; latch 100 is fulcrumed at 101 and biased to latching position by spring 102.

The cleaner housing 10 may be opened for inspection of the bag and its contents, however, without necessarily ejecting the dust bag by manually lifting the externally protruding end 100c of latch 100, Figs. 1, 2 and 3, thereby releasing the front end assembly 16. Then even though the release of pawl 90a by lever arm 90 is subsequently effected upon the opening of front end assembly 16 to its full extent, 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 ejector 51 from discharging the dust bag. Normal position of pin 70 thus serves as an auxiliary safety latch preventing the dust bag in either full or empty condition from being ejected upon merely manually opening the front assembly 16. Another feature of this double latching mechanism is that with the front assembly 16 closed, spring

latch 62 cannot be released but on the contrary remains in restraining position with respect to lug 52b and together with pawl 90a serves as an auxiliary safety latch preventing the release of ejector 51 and thus prevents the compression and jamming of the bag 30 within the housing since latch bar 63 must first be released by the withdrawal of restraining pin 70. This latter step necessitates the selective positioning and restraining of pin 70 from relatching by the triggering action (above described) which must be previously effected by suitable control mechanism, namely the actuation of the pneumatically operated device 250 (see Fig. 4 and Fig. 5).

It is to be noted that pneumatically operated device 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 retaining latch 100 by actuating arm 75, Figs. 2 and 3, formed as a part of latch release device fulcrumed at 75a, tripping the latch 100 to release member 16.

The parallel linkage of the hose coupling assembly 15 to the front ring 20 is most clearly seen in Figs. 3, 5 and 6. There, link 115 pivoted at 116 to base casting 119 and at 117 to hose coupling assembly 15 forms one link in the parallel linkage while cover 16 fulcrumed at 17 to base casting 119 and at 118 to hose coupling assembly 15 forms the other link.

Button 10a, Fig. 3, on the upper front surface of housing 10 operates a circuit make and break switch 110, Figs. 3 and 5 of the conventional toggle type snap switch. This button 10a is locked in off position when cover 16 is open by pressure exerted by a sliding mechanism 113 biased to the left, Fig. 3, by spring 114. Thus, although button 10a may be used to start and stop the motor fan unit while the cover 16 remains closed, the opening of cover 16 with the circuit closed causes a lug 16c, Fig. 5, to release slide 113 and inclined surface 96, Fig. 5, actuates a lug 95 on switch button 10a and moves button 10a forward thereby opening the toggle switch circuit, stopping the motor fan unit and otherwise deenergizing the unit.

The electrical and pneumatic control units are operatively interrelated. The pneumatically operated device 250 consists of a large upwardly spring biased diaphragm which is operatively connected to the high suction side of the vacuum cleaner chamber 40 by conduit 255, the top chamber 220, perforations 242 in the supporting ring of valve 240, center opening 202a in casing 202, upper chamber 205 of a pressure differential measuring device (see Figs. 3 and 4) and conduit 225 to the opening 230 in the inner sealed chamber 80.

The pneumatic system includes a pressure differential measuring device (lower half of 200 below casing 202) which initiates the lifting of valve 240 and combined therewith is an auxiliary valve lifting membrane 270 (upper half of 200 above casing 202) which completes the opening of valve 240 and holds it open until power diaphragm 250 completes its work. The lower half of unit 200 comprises a pressure differential measuring control device, Figs. 3 and 4, having a lower casing 201 and an upper casing 202, separated by a diaphragm 203. The space in the lower casing below diaphragm 203 is connected by communicating conduit 210, Figs. 2, 3, 4, etc., to opening 215, Figs. 3, 5, 6, on the dirty or dust collecting side of the dust bag, while the space in the

upper casing above the diaphragm is connected by communicating conduit 225, Figs. 2, 3 and 4, to opening 230, Figs. 3 and 4, on the clean side of the dust bag.

The upper half of unit 200 comprises an auxiliary valve lifting device having a lower casing 202 and an upper casing 204, separated by a diaphragm 270 having a fixed periphery and a fixed perforated center portion through which valve 240 moves. Valve 240 is biased normally to closed position by a spring 240a. Valve stem 241 is adjustable to various heights for initiating its opening by diaphragm 203. When valve 240 is opened it communicates high suction to the interior of pneumatically operating triggering device 250, comprising a lower casing 251, Figs. 3, 4, 5, 6, sealed by a diaphragm biased to distended or upward position by a spring and capable of actuating tripping mechanism through link member 254. With this device, membrane 270 (open on its lower surface to the atmosphere through opening 202b and subject upon the opening of valve 240 to high suction on its upper surface) assures the completion of the operating cycle including the release of pin 70 and the cover closure member 100 by maintaining valve 240 in wide open position through a lifting action exerted on the outer edges of valve supporting ring 242 by the upwardly distended diaphragm 270 (see Fig. 4).

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 shown in Fig. 3, under the biasing action of springs 203a and 240a, respectively.

The electrical system for energizing the motor fan unit 72, Figs. 2 and 3, and the electrical controls are of the conventional form and hence need not be specifically described.

In detail and particularly with respect to the operation of the pneumatic and electrical controls and referring especially to Figs. 3, 4, etc., where details of structure are illustrated, the force exerted on the pressure differential membrane 203 progressively increases with continued dust collection, until it attains sufficient value to open valve 240 slightly by lifting stem 241 whereupon high suction is applied to the upper surface of diaphragm 270 and permits atmospheric pressure to hold valve 240 open. This allows high suction to operate pneumatically functioning device 250 which in turn through link 254 and latch pin release arm 75, etc., selectively positions pin 70 so that pin 70 is prevented from relatching, first by pin retaining finger 90a (see Fig. 4) and then later by the under side of superpositioned latch bar 63 (see Fig. 5 where finger 90a, pin 71, etc., have been interposed to effect a terminal latch bar restraining mechanism). The actual triggering of terminal latch bar retaining finger 90a, pin 71, etc., is subsequently effected by the more substantial movement or more complete opening of cover 16 the edge of which finally actuates lever 90 (Fig. 6) to release pin 71. This frees latch bar 63 for further forward travel, causes latch spring 62 to ride down the inclined edge 56b of cam bracket 56c to release lug 52b holding ejection plate 52.

Substantially simultaneously with the withdrawal of pin 70, lever arm 75, Figs. 2, 3 and 4, trips cover releasing latch 100 which holds cover assembly 16 closed against spring tension. The release of cover 16 first breaks a circuit at the

contact points of switch 310, Fig. 3, by lug 16c releasing sliding mechanism 113 which latter is biased by spring 114 to throw switch 310 to off position, Fig. 3, and especially Fig. 5, thereby de-energizing the motor fan unit. Thereafter the front cover continues its opening movement and after moving substantially 90°, mechanical triggering mechanism comprising lever 90 withdraws pin 71 releasing latch bar retaining finger 90a, 90b, etc. (see Fig. 6), releasing the bag ejector mechanism 51 through a previously traced series of steps, and allowing the bag ejector plate 52, Figs. 3 and 6, to push the bag forward and throw the bag and its contained dirt out of the cleaner casing.

The ejector plate 52 moves forward and outward when released until arrested by the extended length of flat spring 53, Figs. 3 and 6. The momentum of the moving dust-filled bag causes it to continue onward in its own trajectory out of the cleaner casing after which it comes to rest on the floor.

The reloading or repositioning of ejector mechanism 51 so as to ready the cleaner for the insertion of a clean bag (see Fig. 3) is effected by pushing ejector plate 52 manually all the way back into the cleaner housing until lug 52b passes over and beyond the restraining edge of spring latch 62; then, by continuing the backward travel of ejector plate 52, depending lug 52b strikes upwardly extending portion 63b of latch bar 63 and the entire latch bar 63 is moved sufficiently far back so as to allow pin 70 (biased upwardly by the power diaphragm spring) to rise until the forward end of latch bar 63 is securely held against pin 70 (see Fig. 3).

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

I claim:

1. In a vacuum cleaner, a casing having an opening, a movable cover for said opening, releasable means for retaining said cover closed, means for producing flow of air through said casing, a dust separating member in said casing in the path of air flow therethrough, pneumatic means for operating said cover releasing means, valve means for controlling said pneumatic means, a member movable in response to difference in pressure at opposite sides of said dust separating member, and means for mechanically transmitting motion of the second mentioned member to said valve to actuate the latter.

2. In a vacuum cleaner, a casing having an opening, means for producing flow of air through said casing, a dust separating member in said casing in the path of air flow therethrough, spring biased means for ejecting said dust separating member from said casing through said opening, releasable means for retaining said spring biased means, pneumatic means for operating said releasable spring biased means, valve means for controlling said pneumatic means, and a member movable in response to difference in pressure at opposite sides of said dust separating member, said valve being directly actuated by movement of the movable member.

3. In a vacuum cleaner, a casing having an opening, a movable cover for said opening, releasable means for retaining said cover closed, means for producing flow of air through said casing, a dust separating container in said casing in the path of air flow therethrough, spring biased

means for ejecting said container through said opening, releasable means for retaining said spring biased means, pneumatic means for operating both of said releasable means, valve means for controlling said pneumatic means, and a member movable in response to difference in pressure at opposite sides of said dust separating container, said valve being mechanically actuated by movement of the movable member.

4. In a vacuum cleaner, a casing having an opening, a movable cover for said opening, releasable means for retaining said cover closed, means for producing flow of air through said casing, a dust separating member in said casing in the path of air flow therethrough, pneumatic means for operating said cover releasing means, valve means for controlling said pneumatic means, means responsive to difference in pressure at opposite sides of said dust separating member for initiating the opening of said valve means, and pneumatically operable means for maintaining said valve means in open position.

5. In a vacuum cleaner, a casing having an opening, means for producing flow of air through said casing, a dust separating member in said casing in the path of air flow therethrough, spring biased means for ejecting said dust separating member from said casing through said opening, releasable means for restraining said spring biased means, pneumatic means for operating said releasable spring biased means, valve means for controlling said pneumatic means, means responsive to difference in pressure at opposite sides of said dust separating member for initiating the opening of said valve means, and pneumatically operable means for maintaining said valve means in open position.

6. In a vacuum cleaner, a casing having an opening, a movable cover for said opening, releasable means for retaining said cover closed, means for producing flow of air through said casing, a dust separating container in said casing in the path of air flow therethrough, spring biased means for ejecting said container through said opening, releasable means for restraining said spring biased means, pneumatic means for operating both of said releasable means, valve means for controlling said pneumatic means, means responsive to difference in pressure at opposite sides of said dust separating container for initiating the opening of said valve means, and pneumatically operable means for maintaining said valve means in open position.

7. In a vacuum cleaner, a casing having an opening, a movable cover for said opening, releasable means for retaining said cover closed, means for producing flow of air through said casing, a dust separating member in said casing in the path of air flow therethrough, pneumatic means for operating said cover releasing means, valve means for controlling said pneumatic means, a first membrane movable in response to difference in pressure at opposite sides of said dust separating member, a mechanical member for opening said valve in response to movement of said difference pressure membrane, and a second membrane responsive to the opening of said valve for maintaining said valve in open position.

8. In a vacuum cleaner, a casing having an opening, means for producing flow of air through said casing, a dust separating member in said casing in the path of air flow therethrough, spring biased means for ejecting said container from said casing through said opening, releasable means for restraining said spring biased means, pneumatic means for operating said releasable spring biased means, valve means for controlling said pneumatic means, a first membrane movable in response to difference in pressure at opposite sides of said dust separating member, a mechanical member for opening said valve in response to movement of said difference pressure membrane, and a second membrane responsive to the opening of said valve for maintaining said valve in open position.

9. In a vacuum cleaner, the combination comprising a casing having an opening, a movable cover for said opening, releasable means for holding said cover in closed position, means for producing a flow of air through said casing, a dust bag in said casing in the path of said air flow for separating entrained dirt from said air, releasable means for ejecting said dust bag, mechanically operable triggering means operable for placing the ejecting means in condition for operation, pneumatically operable diaphragm means for operating said triggering means and said cover releasing means, valve means for controlling said pneumatically operable means, differential air pressure responsive means operative upon the attainment of a predetermined pressure difference between the inside and outside of the dust bag for initiating the opening of said valve means, pneumatically operable diaphragm means for maintaining said valve means in open position, and means responsive to the substantially complete opening of said cover for releasing the means for ejecting said dust bag whenever said ejecting means has been placed in condition for operation.

10. In a vacuum cleaner, the combination comprising a casing having an opening, a movable cover for said opening, releasable means for holding said cover in closed position, means for producing a flow of air through said casing, a dust bag in said casing in the path of said air flow for separating entrained dirt from said air, pneumatically operable diaphragm means for operating said cover releasing means, valve means for controlling said pneumatically operable means, said valve means including a casing, a partition dividing said casing into a first and a second chamber, said partition being formed with a valve port, a first diaphragm in said first chamber, means for communicating suction from the means for producing flow of air to the side of said first diaphragm adjacent said port, means for communicating suction from a point in said conduit to the opposite side of said first diaphragm, a second diaphragm in said second chamber, a valve member movable by said second diaphragm and cooperating with said valve port, a stem extending from said valve member through said port for actuation by said first diaphragm to displace said valve member from said port to thereby communicate the pressure on one side of said first diaphragm to the proper side of said second diaphragm to cause movement of said second diaphragm in the direction which moves said valve member away from said port whereby suction is communicated to said pneumatically operable means.

11. In a vacuum cleaner, a casing having an opening, a movable cover for said opening, means for producing flow of air through said casing, a dust separating member in said casing in the path of air flow therethrough, an inlet conduit for introducing air into said dust separating member, pneumatic means for opening said cover, valve means for controlling said pneumatic means, a

member movable in response to the difference in pressure existing between a point in said conduit and a point between said dust separating member and said means for producing flow, and means for mechanically transmitting motion of the second mentioned member to said valve to actuate the latter.

12. In a vacuum cleaner, a casing having an opening, a movable cover for said opening, releasable means for holding said cover in closed position, means for producing flow of air through said casing, a dust separating member in said casing in the path of air flow therethrough, an inlet conduit for introducing air into said dust separating member, pneumatically operable diaphragm means for operating said cover releasing means, valve means for controlling said pneumatically operable means, said valve means including a casing, a partition dividing said casing into a first and a second chamber, said partition being formed with a valve port, a first diaphragm in said first chamber, means for communicating suction from the means for producing flow of air

to the side of said first diaphragm adjacent said port, means for communicating suction from a point in said conduit to the opposite side of said first diaphragm, a second diaphragm in said second chamber, a valve member movable by said second diaphragm and cooperating with said valve port, a stem extending from said valve member through said port for actuation by said first diaphragm to displace said valve member from said port to thereby communicate the pressure on one side of said first diaphragm to the proper side of said second diaphragm to cause movement of said second diaphragm in the direction which moves said valve member away from said port whereby suction is communicated to said pneumatically operable means.

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Number	Name	Date
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