

June 16, 1953

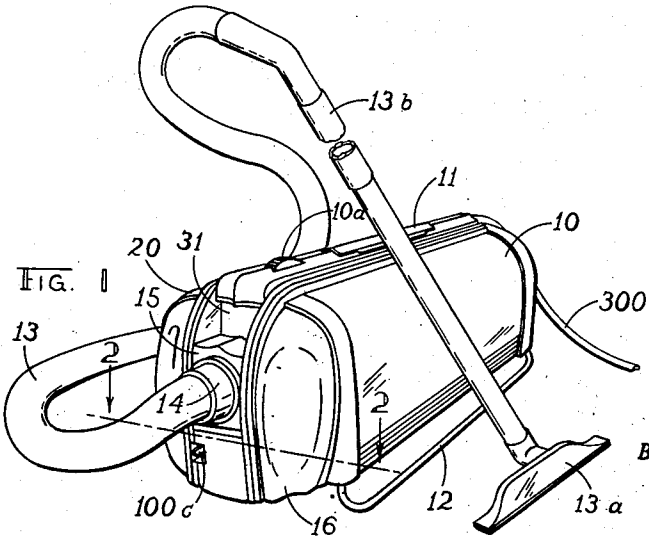
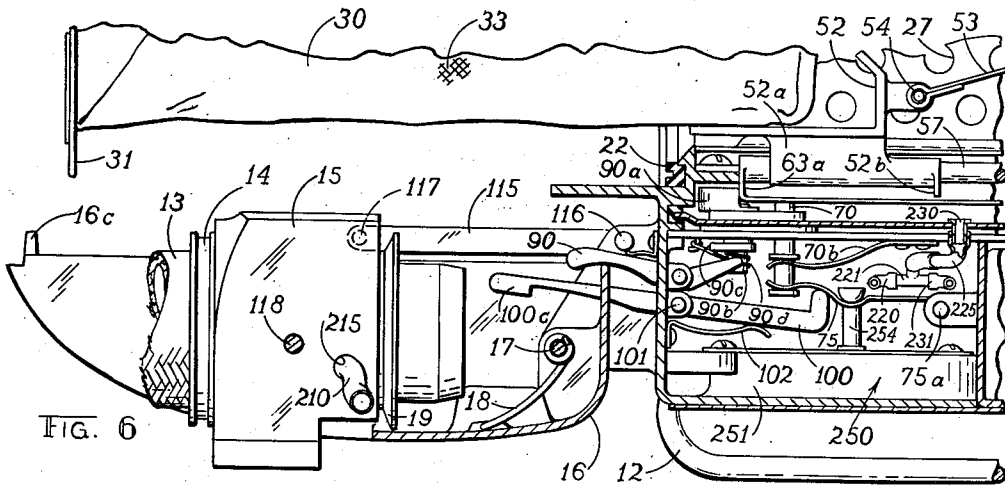
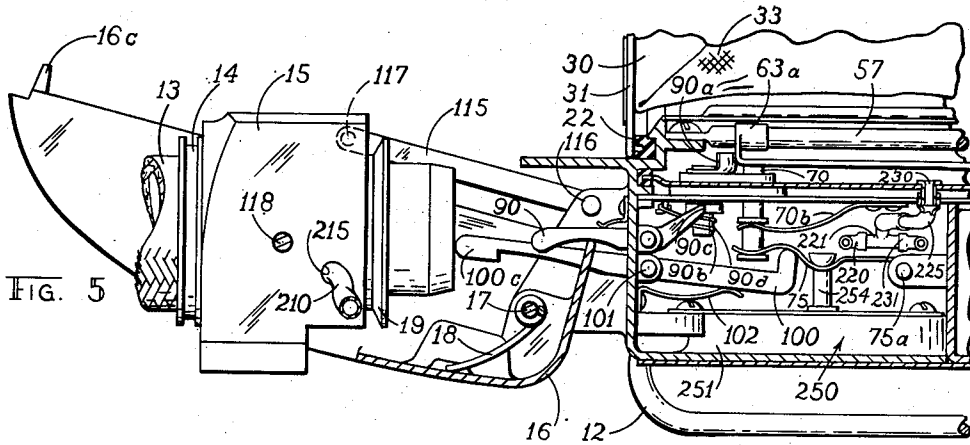
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2,642,151

VACUUM CLEANER WITH BAG EJECTOR

Filed May 11, 1951

4 Sheets-Sheet 1



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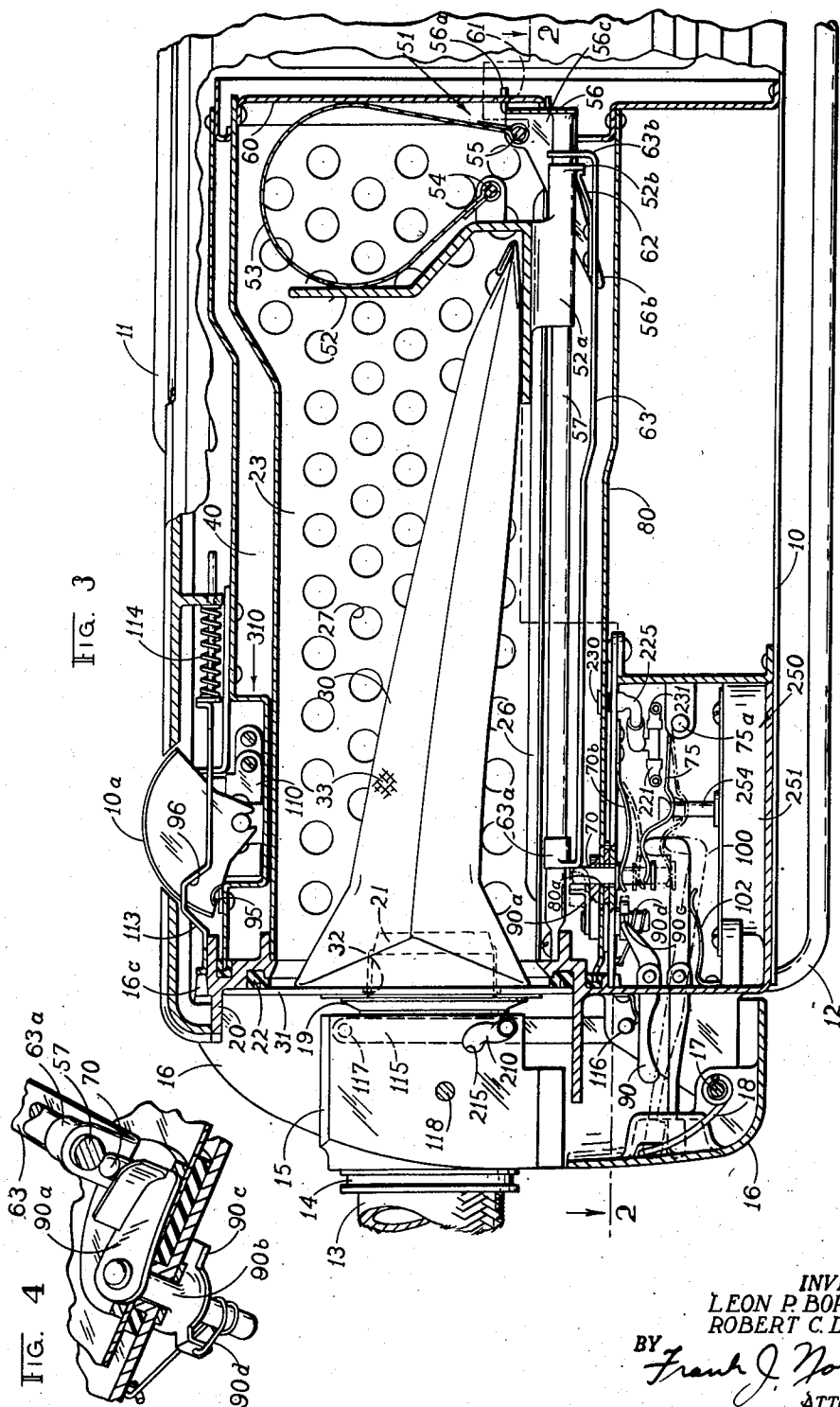
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VACUUM CLEANER WITH BAG EJECTOR

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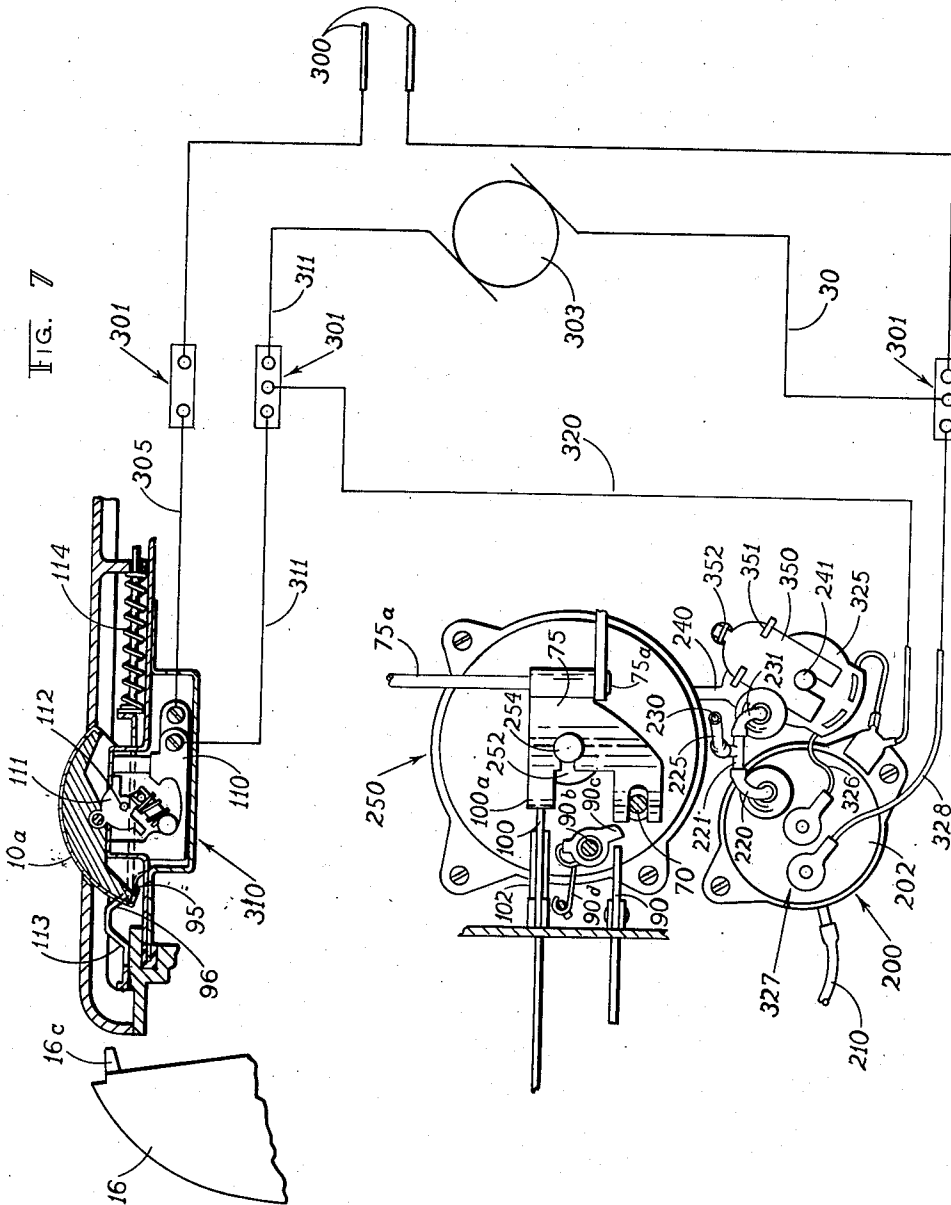
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VACUUM CLEANER WITH BAG EJECTOR

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VACUUM CLEANER WITH BAG EJECTOR

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5 Claims. (Cl. 183—62)

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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, utilizing a simple mechanical release means to effect the necessary steps.

It is a further and important object hereof to provide automatically and sequentially positioned holding means for setting a releasing device into its operating position.

Another object is to provide a simple relatch preventing device which assures dust bag ejection.

A still 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 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;

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

Figure 4 is a perspective view of the ejector

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restraining and releasing pin in its normal operating position;

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

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; and Figure 7 is a wiring diagram including some of the pneumatic controls.

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 (electrically actuated, pneumatically actuated, mechanically actuated, etc., etc.), which sequence when once initiated culminates finally in the ejection of the dust-filled bag from the cleaner housing.

In a preferred embodiment, the differential pressure diaphragm actuates a switch which closes a circuit for energizing an electromagnetically actuated armature or solenoidal unit. The armature or plunger of the electromagnetic device in turn opens a valve for admitting suction from the motor fan unit to actuate a second diaphragm which, operating through a series

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of linkages, (1) makes possible the selective positioning of a member which thereafter is in condition to prevent relatching and for subsequent operation and release of its newly assumed ejector restraining and latching function; and (2) in timed relation therewith this second diaphragm substantially simultaneously, or shortly 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 substantially fully opened position then actuates mechanical means which releases the previously selectively positioned member whereupon the ejector mechanism for actually discharging the bag is free to act, and 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 13a and wand 13b 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 front body ring 20 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. 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 10a 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

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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-imperious, 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 mounted therein.

The dust 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 52a 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 56a 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 52b, Fig. 2, and shown more clearly in Fig. 3. Lug 52b is integral with plate 52 and sleeve 52a 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 56b, Fig. 3, of the cam bracket portion 56c of rear mounting member 56 and towards the end of its travel, spring latch 62 slips under the bottom edge of depending lug 52b 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 63a, Figs. 3, 4, 5 and 6, and at the other by apertured upwardly bent end portion 63b, 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

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70, Fig. 4, biased to latching position by leaf spring 70b, projects through an opening formed in base plate 80. Pin 70 is adapted by axial movement to be withdrawn from its latch bar restraining position (Fig. 3 in full and Fig. 4) to its latch bar releasing position (shown in phantom in Fig. 3 and in a later position Fig. 5).

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 to its withdrawn position (shown in phantom, Fig. 3) by latch release arm 75 fulcrumed at 75a and actuated by link 254. The withdrawal of pin 70 releases for counterclockwise rotation pin retaining finger 90a, Fig. 4, which, in the form of a lever arm fulcrumed on shaft 90b and affixed thereto to move as a unit with pawl or restraining lug 90c, functions to prevent relatching of latch bar 63 by pin 70. The entire pin retaining unit, 90c, etc., is spring biased to effect this movement by spring 90d (see phantom view, Fig. 3, and perspective view, Fig. 4). 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), and transmitted through link 254.

Terminal latch bar restraining and releasing finger 90a is held in restraining position 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 effecting actuation of lever 90 through contact with the edge of assembly 16 (see Figs. 5 and 6). Thus the above-mentioned selective positioning of pin 70 results in the superpositioning of retaining finger 90a (see phantom view, Fig. 3) 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 16 actuates the free end of lever arm 90 to effect the releasing of lug 90c, unit 90a, etc., and thus 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 90c by lever arm 90 is subsequently effected upon the opening of the front assembly 16 to its full extent, since pin 70 most likely will not have been selectively positioned (withdrawn) to latch bar releasing position, therefore 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. An-

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other 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 90c serves as an auxiliary safety latch preventing the release of ejector 51 and the compression and jamming of the bag 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 trigger action (above described) which must be previously effected by suitable control mechanism, namely the actuation of the pneumatically operated device 250 (see phantom view, Figs. 3 and 4).

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 100a, Figs. 2 and 7, formed as a part of latch release arm 75, tripping the latch 100 to release member 15 (see phantom view Fig. 3).

The parallel linkage of the hose coupling assembly 15 to the front ring 20 is most clearly seen in Figs. 2, 3, 5 and 6. There, link 115 pivoted at 116 to front ring 20 and at 117 to hose coupling assembly 15 forms one link in the parallel linkage while cover 16 fulcrumed at 17 to front ring 20 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 7, of the conventional toggle snap switch type through rocker arm 111, Fig. 7, pivoted at 112. 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. 7, 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. 7, to release slide 113 and inclined surface 96, Fig. 7, actuates a lug 95 on switch button 10a and moves rocker arm 111, Fig. 7, counterclockwise 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 pneumatic system comprises a pressure differential measuring control device 250, Figs. 2 and 7, having a lower casing and an upper casing 202, separated by a diaphragm. The space in the lower casing below the diaphragm is connected by communicating conduit 210, Figs. 2, 3, 7, 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 220, Figs. 2 and 7, T-shaped coupling 221 and common conduit 225 to opening 230, Figs. 2 and 3, etc., and 7, on the clean side of the dust bag. The remaining connection from the T-shaped coupling communicates by means of conduit 231, Fig. 7, with one side of valve 240 comprising valve stem 241 biased normally to closed position by a spring 352. When valve 240 is open it communicates high suction to the interior of pneumatically operating triggering device 250, comprising a lower casing 251, Figs. 3, 5, 6, sealed by diaphragm 252, Figs. 2, 7, biased to distended or upward position by a

spring and capable of actuating tripping mechanism through link member 254.

The electrical system for energizing the motor fan unit and the electrical controls are clearly shown in diagrammatic form in Fig. 7. Vacuum cleaner electrical cord 300 conveys current from the house lines at 110 volts to terminal strips 301 within the cleaner housing from which one line 302 goes to motor 303, the other line goes to motor 303 through a circuit including line 305 on-and-off switch 310, line 311 and line 313. The circuit for energizing the electrical controls comprises line 320, solenoid 325, line 326, switch 327 of pressure differential pneumatic control unit 200, and line 328 to the house circuit through the cleaner cord 300. The switch 327 of pressure differential pneumatic control unit 200 includes a biasing spring which may also serve as a conducting element and for maintaining the switch normally open between the terminals 327.

In detail and particularly with respect to the operation of the pneumatic and electrical controls and referring especially to Fig. 7 where details of structure are illustrated, the force exerted on the pressure differential membrane of switch 200 progressively increases with continued dust collection, until it attains sufficient value to actuate switching means 327 and complete a circuit by closing contacts therein and thereby energize electromagnet 325. The armature 350 of solenoid 325 fulcrumed at 351 and biased by spring 352 to hold valve 240 closed, then opens valve 240 allowing high suction to operate diaphragm 252 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. 3, phantom view) and then later by the underside of superpositioned latch bar 63 (see Fig. 5 where finger 90a, cam 90c, etc., have been interposed to effect a terminal latch bar restraining mechanism). The actual triggering of terminal latch bar retaining finger 90a, cam 90c, etc., is subsequently effected by the more substantial movement or more complete opening of cover 16 which finally actuates lever 90 (Fig. 6) to release cam 90c. 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, lever arm 100a, Figs. 2 and 7, 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. 7, 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. 7, thereby deenergizing the motor fan unit. Thereafter the front cover continues its opening movement and after moving substantially 90°, mechanical triggering mechanism comprising lever 90 releases latch bar retaining finger 90a, 90b, etc. (see Fig. 6), releasing the bag ejector mechanism 51 through a previously traced series of steps, allowing the bag ejector plate 52, Figs. 2 and 3, 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 pin spring 70b) 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.

What we claim is:

1. In a vacuum cleaner, a housing enclosing a dust bag compartment, an opening in said compartment, a dust bag insertable into said compartment through said opening and being formed with an inlet aperture, an inlet conduit for communicating with said aperture, releasable means for movably securing said conduit to said housing, means for ejecting said dust bag, restraining means for preventing operation of said bag ejecting means, latching means for holding said restraining means in bag retaining position, a selectively movable member settable to a position preventing relatching of the restraining means by said latching means, means responsive to the establishment of a predetermined pressure difference between the inside and outside of said dust bag for setting said selectively operable member to said above-mentioned position, and means responsive substantially simultaneously with the setting of said selectively operable member for releasing said conduit securing means.

2. In a vacuum cleaner, a housing enclosing a dust bag compartment, an opening in said compartment, a dust bag insertable into said compartment through said opening and being formed with an inlet aperture, an inlet conduit for communicating with said aperture, releasable means for movably securing said conduit to said housing, means for ejecting said dust bag, restraining means for preventing operation of said bag ejecting means, latching means for holding said restraining means in bag retaining position, a selectively movable member normally inoperative but selectively settable to a position preventing relatching of the restraining means by said latching means and conditioning said member for restraining said bag ejecting means and upon subsequent release permitting operation of said bag ejecting means, means responsive to the establishment of a predetermined pressure difference between the inside and outside of said dust bag for setting said selectively operable member to said above-mentioned releasing position, means responsive substantially simultaneously with the setting of said selectively operable member for releasing said conduit securing means, and further means responsive to the further movement of said conduit for effecting the release of said selectively operable member to eject said dust bag.

3. In a vacuum cleaner, a housing enclosing a dust bag compartment, an opening in said com-

partment, a dust bag insertable into said compartment through said opening and being formed with an inlet aperture, an inlet conduit for communicating with said aperture, releasable means for movably securing said conduit to said housing, means for ejecting said dust bag, restraining means for preventing operation of said bag ejecting means, a selectively movable member settable to a position preventing relatching of the restraining means and conditioning said member for restraining said bag ejecting means and upon subsequent release permitting operation of said bag ejecting means, a slidable restraining bar having a latch at one end and at the other end an abutment arrested by said restraining means, release of said abutment by said first-mentioned restraining means conditioning said member for restraining said bar and preventing the first-mentioned restraining means from relatching said bar, means responsive to the establishment of a predetermined pressure difference between the inside and outside of said dust bag for setting said selectively operable member to said above-mentioned position, means responsive substantially simultaneously with the setting of said selectively operable member for releasing said conduit securing means, and further means responsive to the further movement of said conduit for effecting the release of said selectively operable member to eject said dust bag.

4. In a vacuum cleaner, a housing enclosing a dust bag compartment, an opening in said compartment, a dust bag insertable into said compartment through said opening and being formed with an inlet aperture, an inlet conduit for communicating with said aperture, releasable means for movably securing said conduit to said housing, means for ejecting said dust bag, restraining means for preventing operation of said bag ejecting means, latching means for holding said restraining means in bag retaining position, a selectively movable spring biased cam member settable to a position preventing relatching of the restraining means by said latching means, a movable restraining bar having said restraining means at one end and at the other end an abutment arrested by said latching means, release of said abutment by movement of said latching means conditioning said member for restraining said bar and preventing the latching means from relatching said bar, pneumatic means responsive to the establishment of a predetermined pressure difference between the inside and outside of

said dust bag for setting said selectively operable cam member to said above-mentioned position, means responsive substantially simultaneously with the setting of said selectively operable cam member for releasing said conduit securing means, and further means responsive to the further movement of said conduit for effecting the release of said selectively operable cam member to eject said dust bag.

5. In a vacuum cleaner, a housing enclosing a dust bag compartment, an opening in said compartment, a dust bag insertable into said compartment through said opening and being formed with an inlet aperture, an inlet conduit for communicating with said aperture, releasable means for movably securing said conduit to said housing, means for ejecting said dust bag, restraining means for preventing operation of said bag ejecting means, latching means for holding said restraining means in bag retaining position, a selectively movable spring biased cam member settable to a position preventing relatching of the restraining means by said latching means, a movable restraining bar having restraining means at one end and at the other end an abutment arrested by said latching means, release of said abutment by movement of said latching means conditioning said member for releasably restraining said bar and preventing the latching means from relatching said bar, pneumatic means responsive to the establishment of a predetermined pressure difference between the inside and outside of said dust bag for setting said selectively operable cam member to said above-mentioned position, means responsive substantially simultaneously with the setting of said selectively operable cam member for releasing said conduit securing means, and further means responsive to the further movement of said conduit for effecting the release of said selectively operable cam member to eject said dust bag, and additional means responsive to the still further movement of said movable restraining bar for returning said cam member substantially to its original position whereby said latching means is released from its cam restrained position.

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