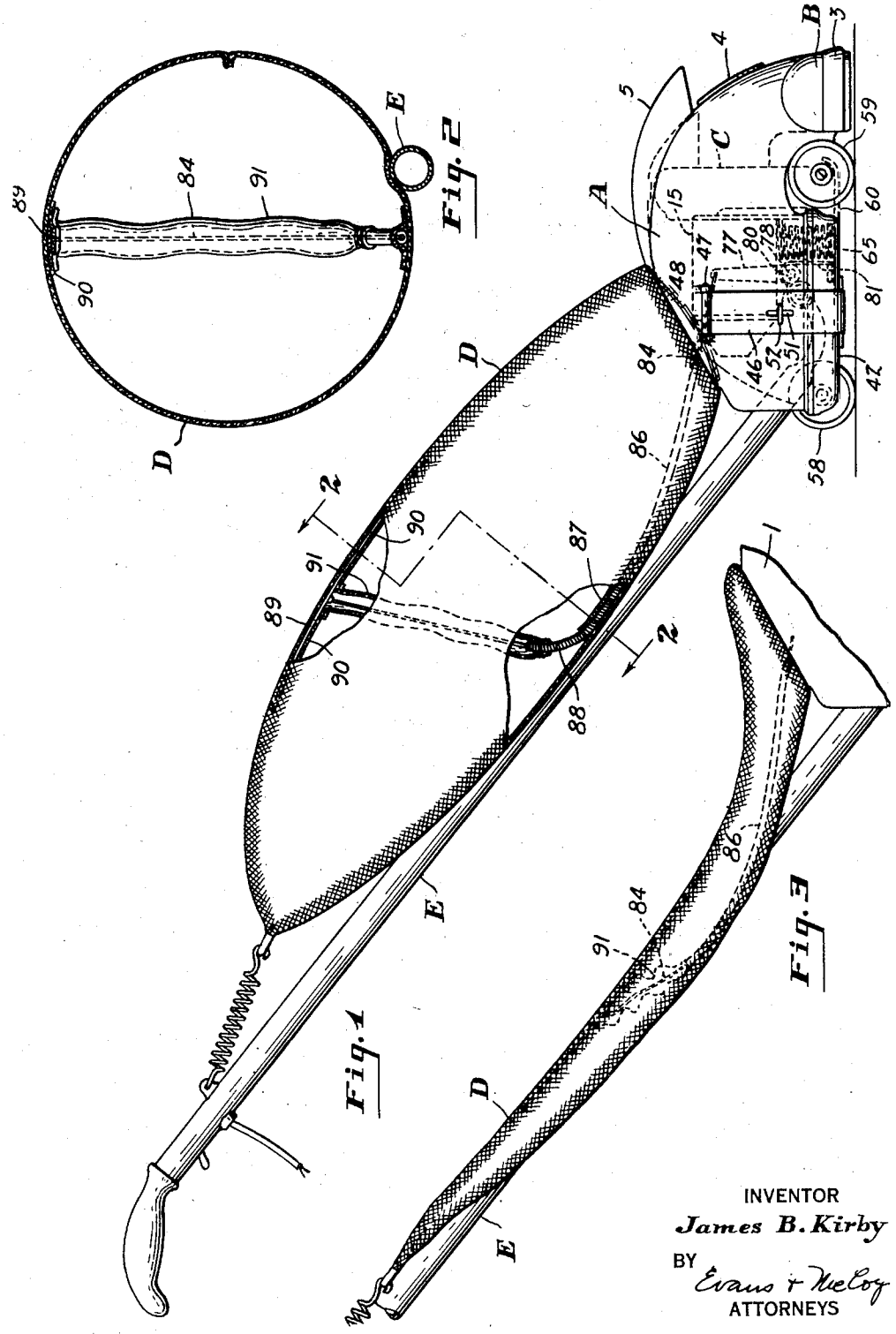
June 5, 1951 J. B. KIRBY 2,555,887

AIRFLOW CONTROLLED NOZZLE ADJUSTMENT FOR VACUUM CLEANERS

Filed July 15, 1944 3 Sheets-Sheet 1



INVENTOR
James B. Kirby
BY *Evans & McCoy*
ATTORNEYS

June 5, 1951 J. B. KIRBY 2,555,887

AIRFLOW CONTROLLED NOZZLE ADJUSTMENT FOR VACUUM CLEANERS

Filed July 15, 1944 3 Sheets-Sheet 2

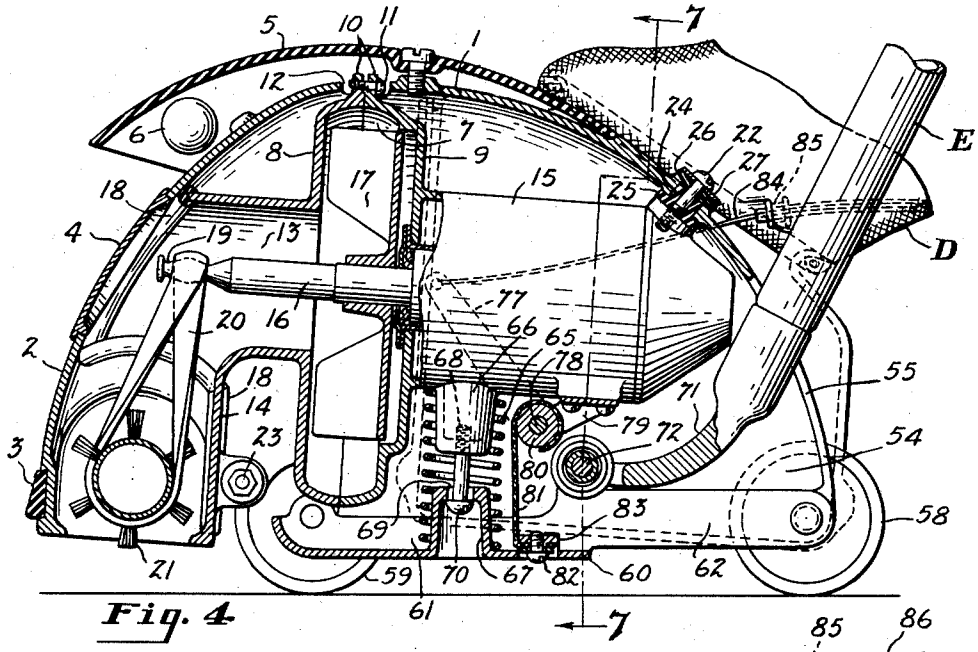


Fig. 4

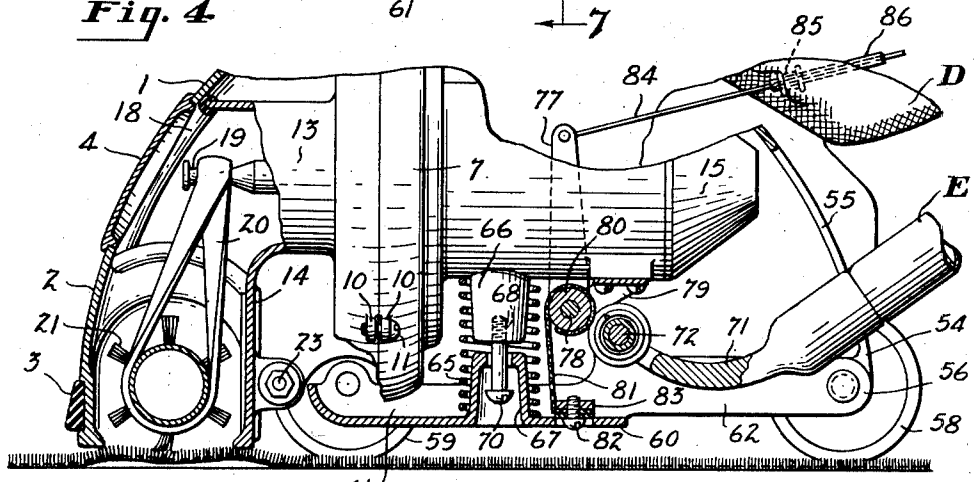


Fig. 5

INVENTOR
James B. Kirby
BY
Evans + Mecoy
ATTORNEYS

June 5, 1951 J. B. KIRBY 2,555,887

AIRFLOW CONTROLLED NOZZLE ADJUSTMENT FOR VACUUM CLEANERS

Filed July 15, 1944 3 Sheets-Sheet 3

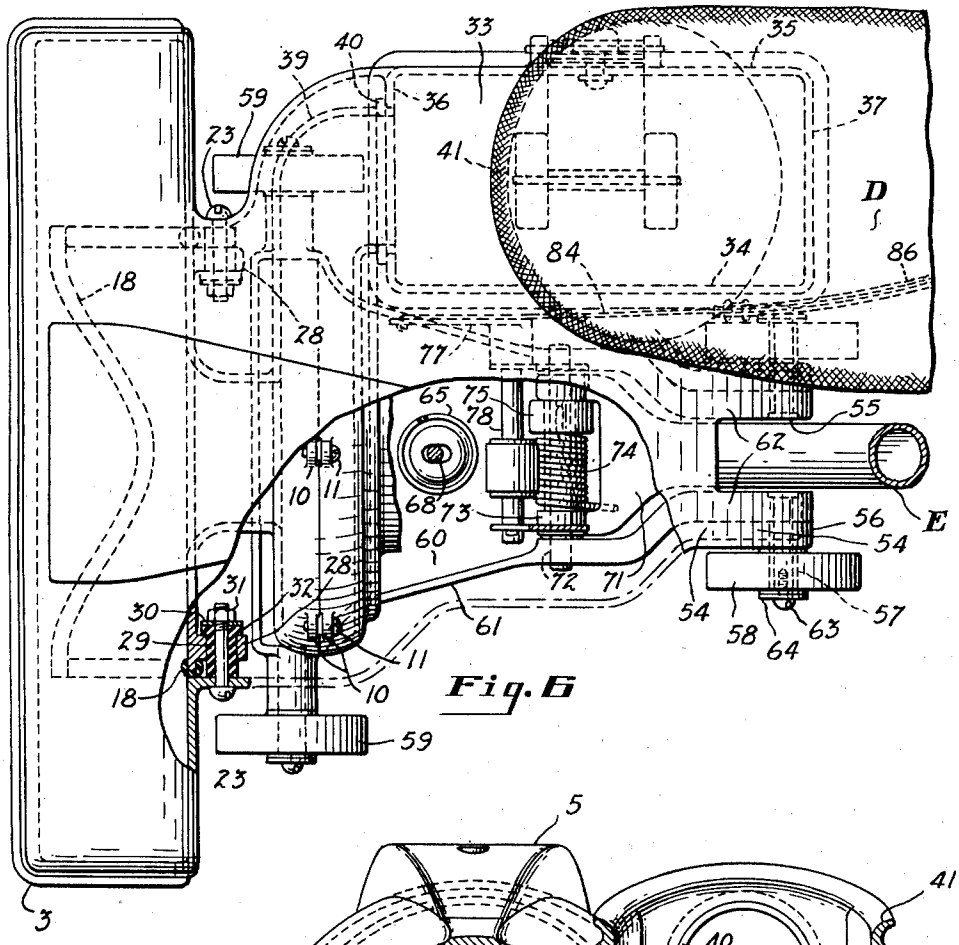


Fig. 6

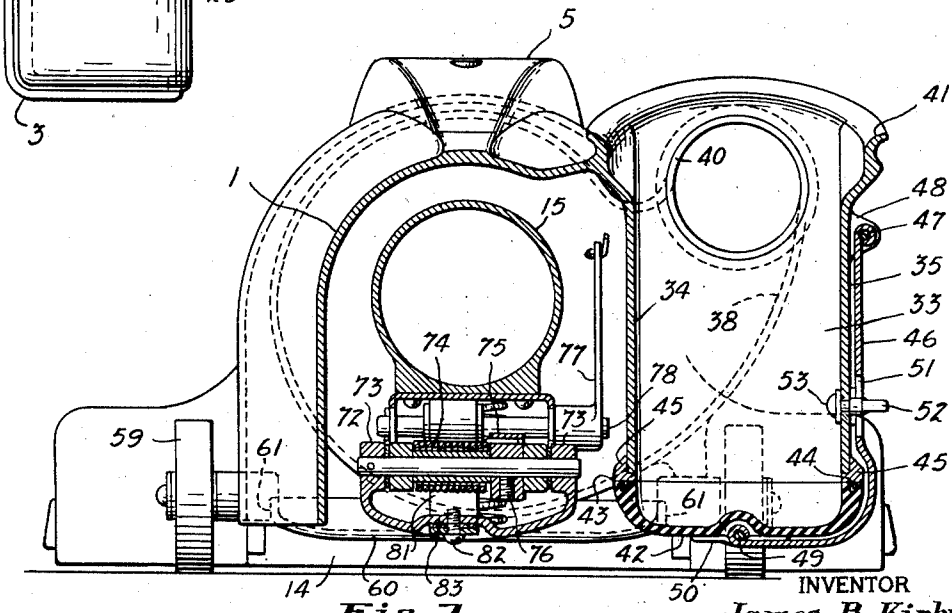


Fig. 7

INVENTOR
James B. Kirby
BY
Evans & McCoy
ATTORNEYS

Patented June 5, 1951 2,555,887

UNITED STATES PATENT OFFICE

2,555,887

AIRFLOW CONTROLLED NOZZLE ADJUSTMENT FOR VACUUM CLEANERS

James B. Kirby, West Richfield, Ohio

Application July 15, 1944, Serial No. 545,044

12 Claims. (Cl. 15—319)

1

This invention relates to an improved automatic nozzle positioning device for vacuum cleaners by which the nozzle is automatically moved from an elevated position to an effective operating position when the cleaner is started into operation and by which the nozzle is automatically retained in proper operating position during operation of the cleaner. The invention of the present application is disclosed generically in each of my copending applications Serial No. 453,174, August 1, 1942 and Serial No. 482,567, April 10, 1943 which were abandoned after the filing of this application.

The present invention has for its object to provide a vacuum cleaner that has a suction nozzle normally yieldably supported in an elevated position where the nozzle inlet is substantially unobstructed and that is provided with means for opposing the upward thrust on the nozzle with a downward thrust that is sufficient to automatically lower the nozzle into cleaning position when the cleaner is started into operation and that decreases as the rate of flow of air through the cleaner is decreased due to restriction of the nozzle opening by a carpet or other surface being cleaned so that the opposed forces acting on the nozzle are balanced and the nozzle is automatically maintained in an effective operating position.

A further object of the invention is to provide a vacuum cleaner in which a counterbalanced nozzle is moved downwardly by means of an actuator that is operated by the thrust or impact of air passing through the cleaner.

A further object of the invention is to utilize the pressure of the air at the discharge outlet of the cleaner, for exerting a downward thrust on a counter-balanced nozzle.

Another object of the invention is to utilize a diaphragm such as a flexible air filter subjected to the impact of air passing through the cleaner for maintaining a thrust on the nozzle that varies with the rate of flow of air through the cleaner.

It is also an object of the invention to provide means for automatically balancing a suction nozzle in such a manner as to automatically maintain the nozzle in an effective operating position with respect to the surface being cleaned.

With the above and other objects in view, the invention may be said to comprise a vacuum cleaner as illustrated in the accompanying drawings hereinafter described and particularly set forth in appended claims, together with such variations and modifications thereof as will be apparent to one skilled in the art to which the invention pertains.

2

Reference should be had to the accompanying drawings forming a part of this specification, in which

Fig. 1 is a side elevation of a cleaner embodying the invention, showing the filter bag inflated as in operation,

Fig. 2 is a section taken on the line indicated at 2—2 in Fig. 1,

Fig. 3 is a side elevation of the filter bag showing the same deflated,

Fig. 4 is a central vertical longitudinal section through the suction head showing the nozzle in elevated position,

Fig. 5 is a side elevation of the suction head with the outer housing broken away and with the nozzle and portions of the supporting chassis in section,

Fig. 6 is a top plan view of the suction head with a portion of the outer housing broken away to show parts of the head adjusting mechanism, and

Fig. 7 is a transverse section taken on the line indicated at 7—7 in Fig. 4.

The device of the present invention is applicable to vacuum cleaners of various designs and as herein illustrated is shown applied to a vacuum cleaner of a well known type having a wheel supported suction head A including a suction nozzle B and a suction creating mechanism C and a filtering bag D supported on an operating handle E. The suction head A has a housing 1 that encloses the mechanism C and that has a wide front wall 2 that forms the front of the suction nozzle B. The wall 2 has a rubber buffer strip 3 attached thereto adjacent its lower edge, and may be provided with a central opening closed by means of a detachable cap 4. A suitable curved shield or reflector 5 is detachably secured to the top of the housing 1 and provides a housing for an electric light 6. A fan casing 7 composed of front and rear sections 8 and 9 that have abutting edges provided with outwardly projecting lugs 10 which are secured together by bolts 11 is mounted within the housing 1. The upper portion of the fan casing projects into an opening 12 in the top of the housing 1 beneath the shield 5. The fan casing 7 has a forwardly extending inlet forming part 13 that opens to the fan casing centrally thereof and has its forward end abutting against the interior of the wall 2. The forward end of the housing 1 is flared as shown in Figs. 6 and 7 to form the front and end portions of the suction nozzle B, and the forward end of the inlet 13 is flared and shaped to conform to the interior of the nozzle forming portion of the housing. The outer portion of the inlet is open on its

under side and has an integral depending flange 14 that bridges the space between the side walls of the housing 1 below the fan inlet and forms the rear wall of the suction nozzle B. The suction nozzle B extends across the front end of the housing 1, the bottom edges of the flange 14 and the bottom edges front and side walls of the housing forming the nozzle rim. A motor casing 15 which may be integral with the rear section 9 of the fan casing, is alined axially with the fan casing and motor shaft 16 extends from the casing 15 axially through the fan casing inlet and carries a fan 17 within the casing 7. The suction creating mechanism C comprises the fan and motor which form a unit detachably mounted in the housing 1. Sealing strips 18 of rubber or the like may be mounted upon the edges of the inlet forming part 13 for engagement with the interior of the housing 1. The shaft 16 may carry a pulley 19 to drive a belt 20 for operating a rotary brush 21 mounted in the suction nozzle B.

The suction creating unit is secured to the housing 1 by means of a bolt 22 attaching the rear end of the motor housing 15 and two bolts 23 attaching the ends of the flange 14 to the side walls of the housing 1. A rubber sleeve 24 on the bolt 22 fits in the bolt receiving opening of the housing 1 and has a flange 25 at its inner end that is interposed between the motor housing and the housing 1. A rubber washer 26 is interposed between the outer face of the housing 1 and a metal washer 27 bearing against the head of the bolt 22. The bolts 23 extend through the side walls of the housing 1 and through lugs 28 on the flange 14 and a rubber sleeve 29 on each bolt 23 fits in the bolt receiving opening of the lug 28. The sleeve 29 has one end in engagement with the inner face of the housing 1 and its opposite end is engaged by a metal washer 30 that is held in place by a nut 31 on the bolt, the sleeve 29 having a flange 32 interposed between the washer 30 and the lug 28. The rubber sleeves 24 and 29 associated with the attaching bolts 22 and 23 and the sealing strips 18 serve as vibration damping elements preventing the transmission of vibrations set up in the suction creating mechanism to the housing 1.

The housing 1 has a dust collecting chamber 33 formed integrally therewith at one side thereof rearwardly of the fan casing. The chamber 33 is of rectangular form with vertical inner and outer side walls 34 and 35 and vertical front and rear walls 36 and 37. The fan casing 7 has a tangential outlet 38 that extends laterally in front of the front wall 36 of the chamber 33 and which has a rearwardly projecting end portion 39 that discharges into the chamber 33 through an opening adjacent the top of the wall 36, said outlet 38 being enclosed within a portion of the housing in front of the wall 36. A flanged ring 40 of rubber is interposed between the end 39 of the fan casing outlet and the rim of the opening in the wall 36, which serves as a cushion to prevent transmission of vibrations from the fan casing to the housing and as an air seal. At the top of the chamber 33 the housing has a circular opening surrounded by an outwardly curved attaching flange 41 to which the filtering bag D is detachably secured. The bottom of the chamber 33 is closed by means of a receptacle 42 that has a flat top edge 43 grooved to receive a sealing strip 44 and engageable with the bottom edges of the walls 34, 35, 36 and 37 which are widened by means of a band 45 secured to said walls and having its bottom edge underlying the bottom

edges of the walls. The receptacle 42 is supported for movement into and out of chamber closing position by means of an angle shaped plate 46 having its upper end connected by a hinge pin 47 to lugs 48 on the outer wall 35 adjacent the top thereof and its lower end bent inwardly and connected by a hinge pin 49 to lugs 50 secured to the bottom of the receptacle 42 centrally thereof. The plate 46 is provided with a vertically elongated slot 51 to receive the T head 52 of a latch pin 53 rotatably mounted in the wall 35. When the plate 46 is released by turning the head 52 into alinement with the slot 51, the plate 46 may be swung laterally to carry the receptacle 42 clear of the housing 1 where it may be dumped by swinging it about the hinge pin 49.

The housing 1 has inset closely spaced side wall portions 54 at its rear end and a vertical slot 55 between the said side wall portions 54 that receives the operating handle E. Bosses 56 are formed in the wall portions 54 in which outwardly projecting tubular axles 57 are rigidly secured. Rear supporting wheels 58 are rottably mounted on the axles 57. The suction head is pivoted to swing vertically about the axis of the rear wheels 58, the nozzle carrying front end of the head being movable vertically with respect to front supporting wheels 59 which are mounted behind the nozzle adjacent the ends thereof. The wheels 59 are mounted upon the wide forward end of a bottom plate 60 that is shaped to conform substantially to the open bottom of the housing 1 rearwardly of the nozzle. The plate 60 has side flanges 61 that project past the rear ends of the plate and provide parallel arms 62 that fit between the bosses 56 of the housing side walls. Bolts 63 extend through the arms 62 bosses 56 and tubular axles 57 to pivotally attach the bottom plate 60 to the rear end of the housing, the bolts 63 carrying washers 64 at their outer ends for retaining the wheels 58 on the axles 57.

A spring 65 interposed between the bottom plate 60 and the under side of the motor housing 15 normally holds the suction head A and nozzle B in an elevated position as shown in Fig. 4. The spring 65 is a coil spring mounted on upper and lower positioning stop lugs 66 and 67 formed on the housing 15 and plate 60. The upward movement of the head A is limited by means of a bolt 68 threaded in the upper lug 66, extending through a hole 69 in the lug 67 and having a head 70 that engages lug 67 to limit the upward movement of the head. The extent of vertical movement of the head may be increased or decreased by adjusting the bolt 68.

The handle E is underslung and movable in the vertical slot 55 of the housing and between the arms 62 connecting the bottom plate to the rear end of the housing, the handle having a curved forked lower end 71 that pivots on a transverse shaft 72 carried by bosses 73 integral with the side flanges 61 of the plate 60 and located rearwardly of but near the center of gravity of the head A. In order to prevent forward tipping of the head A when it is lifted off the floor by means of the handle E, a coil spring 74 is provided on the shaft 72 that has one end engaging the end portion 71 of the handle and the other end engaging a collar 75 on the shaft 72 that is adapted to be turned to tighten the spring and having a set screw 76 for securing it in adjusted position to the shaft.

The device of the present invention is designed to automatically impose a downward thrust up-

on the housing 1 and suction nozzle B carried thereby in opposition to the spring 65 to move the nozzle downwardly when the cleaner is started into operation and to so regulate the downward thrust that it is balanced by the spring 65 when the suction nozzle is in an operative position.

The present invention contemplates the exertion of a downward thrust upon the suction nozzle that is controlled by the air flowing through the cleaner in such a way as to maintain a downward thrust in opposition to the spring 65 which increases and decreases with the flow of air through the cleaner so that the nozzle will automatically seek the position where the upward and downward forces acting upon the nozzle are balanced and remain in a position effective for cleaning during operation of the machine.

Suitable means is provided for applying a downward thrust to the nozzle carrying housing 1 in opposition to the spring 65. As herein shown an upwardly extending lever arm 77 is attached to a shaft 78 journaled in a bracket 79 attached to the under side of the motor housing 15. The shaft 78 carries a drum 80 to which is attached the upper end of a strap 81 which is connected at its lower end by means of a bolt 82 to an integral raised portion 83 of the bottom plate 60. When the lever arm 77 is moved rearwardly the drum 80 is turned in a direction to wind the strap 81 on the drum and pull the nozzle B downwardly toward the floor surface.

When the cleaner is started into operation a force is exerted upon the lever 77 sufficient to move the nozzle A from its elevated position shown in Fig. 4 toward the surface to be cleaned. The actuation of the lever 77 is automatically controlled by the air flowing through the cleaner in such manner that the force applied to the lever varies with the rate of flow of air through the cleaner so that restriction of the nozzle opening reducing the rate of flow of air will reduce the force exerted on the lever 77 until the said force is balanced by the spring 65. Such restriction occurs when the nozzle reaches its operating position after which the nozzle is maintained automatically at the position where the restriction of the nozzle is such as to provide the flow of air necessary to maintain the balance of forces acting upon the nozzle. The automatically controlled force is preferably applied to the lever 77 by means of an actuator that is subjected to the thrust or impact of air flowing through the cleaner. As herein shown, the filtering bag D which is inflated by the impact or thrust of air passing through the cleaner during its operation, functions as an actuating diaphragm, the lever arm 77 being connected to the bag D by means of a cable 84 to which tension is applied upon inflation of the filtering bag.

The cable 84 passes through a rubber sealing grommet 85 in the flexible wall of the filtering bag adjacent the end of the bag attached to the housing 1 and is guided along one wall of the bag through an elongated flexible conduit 86 that is secured against the wall of the bag by means of a cloth strip 87 that is sewed to the bag on opposite sides of the guide conduit. The flexible guide conduit extends a short distance beyond the outer end of the cloth strip 87 to provide a flexible elbow portion 88 and the cable 84 extends from the flexible end portion of the conduit 86 diametrically across the interior of the filtering bag, to an anchoring member 89 that is attached to the interior of the bag at a point diametrically opposite the elbow 88. In order to prevent dimpling of the bag, the anchoring member 89 is preferably an elongated member such as a leaf spring which has greater rigidity than the fabric wall of the bag but which can bend to conform to the curvature of the inflated bag, the member 89 being secured in place by means of cloth retaining strips 90 that form pockets for the ends of the spring on opposite sides of the point of attachment of the cable thereto. In order to prevent entry of dirt into the flexible guide conduit 86 the portion of the cable 84 extending across the interior of the filtering bag is enclosed in a collapsible cloth tube 91 attached at one end to the elbow portion 88 of the guide conduit and at its opposite end to the interior of the filtering bag.

When the suction creating mechanism B is started into operation, air is drawn rapidly through the relatively unrestricted opening of the nozzle B and instantly inflates the filtering bag D. The inflation of the bag D exerts a strong pull on the cable 84, causing the housing 1 and suction nozzle B to be instantly moved downwardly toward the floor by means of the cable 84. When the nozzle reaches its operating position, the flow of air into the open bottom of the suction nozzle is impeded because of the restriction of the nozzle opening so that the rate of flow of air through the cleaner is reduced and the thrust or impact of the air on the interior of the filtering bag D is reduced and the pull on the cable 84 decreases until a balance is effected between the thrust exerted through the cable 84 and the thrust exerted by the spring 65.

When the cleaner is operating upon a bare floor surface, the housing 1 may be balanced with the opening of the suction nozzle at a slight distance above the floor surface, at which just sufficient air is admitted into the suction nozzle to apply the distending force to the filtering bag D necessary to balance the force of the spring 65. The nozzle may thus be maintained automatically in an effective cleaning position with respect to a bare floor by the balanced forces exerted by the spring and by air flowing through the cleaner. The downward movement of the nozzle B is preferably limited by suitable stops on the plate 69 and the suction head A such as the lugs 66 and 67 at a point where the rim of the nozzle B is slightly above the floor surface. If desired the lowermost position of the nozzle may be that at which the nozzle operates effectively upon a bare floor surface, in which case the nozzle will be held by the filtering bag in its lowermost position when operating upon a bare floor.

In operating upon a carpet, the portion of the carpet immediately beneath the nozzle A will be drawn up against the open bottom of the nozzle by the suction and automatically lifted off the floor surface as shown in Fig. 5 when the nozzle is lowered. The reduction in the flow of air through the cleaner due to engagement of the carpet with the nozzle reduces the downward thrust being applied to the nozzle through the filtering bag so as to establish a balance between the upward force of the spring 65 and the downward forces acting upon the nozzle with the nozzle in an effective operating position, which balance is thereafter automatically maintained. If the grip of the suction nozzle on the carpet should at any instant be released, the rush of air into the nozzle will instantly move the nozzle

downwardly to again establish the suction between the nozzle and the carpet.

By employing a large area of a filter as a diaphragm subjected to the thrust or impact of the air stream passing through the cleaner, downward movement may be imparted to a nozzle that is held by a relatively strong spring at a substantial distance above the floor, such a spring being capable of exerting a substantial lifting force upon a carpet that is being held by suction against the nozzle opening.

By employing the dirt discharge chamber 33 and attachable receptacle 42, the filtering bag D may be emptied while it is attached to the housing and without disturbing the connection between the filtering bag and the nozzle actuating mechanism.

Since the position of the nozzle is controlled by the air flowing through the cleaner and varies as may be necessary to maintain a balance between the forces acting upon the nozzle, close adjustment of control elements is not necessary.

It is to be understood that variations and modifications of the specific device herein shown and described for purposes of illustration, may be made without departing from the spirit of the invention.

What I claim is:

1. A vacuum cleaner comprising a support, a nozzle carried by said support and vertically movable relative thereto, means to cause a flow of air in one direction through the cleaner, means exerting a lifting force on said nozzle sufficient to overcome the gravitational force acting thereon and tending to raise the nozzle from the surface undergoing cleaning, and means in said flow of air movable in response to air impact and operatively connected to said nozzle to lower the nozzle toward said surface.

2. In a vacuum cleaner a support, a nozzle carried by said support and vertically movable relative thereto, means to effect a flow of air through the cleaner, actuating means operably connected to the nozzle and adapted to be moved in one direction to lower the nozzle and in an opposite direction to raise the nozzle, movable air impact means in said flow of air connected to said actuating means to move the same in a direction to lower said nozzle, and spring means exerting a lifting force on said nozzle sufficient to overcome the gravitational force acting thereon.

3. In a vacuum cleaner, a casing having an air inlet and an air outlet, air propelling means in said casing for drawing air through said inlet and discharging air through said outlet, a support, a suction nozzle connected to said inlet and mounted on said support for vertical movement toward and away from a floor surface, means for exerting a force upon said nozzle that opposes and overbalances the gravitational force acting upon said nozzle and normally holds the nozzle in an elevated position in which entry of air into the nozzle inlet is substantially unimpeded, and means actuated by air discharged by said air propelling means and connected to said nozzle to exert a downward thrust thereon to cause said nozzle to automatically move toward the floor surface to an operative position where the nozzle inlet is restricted and the downward thrust is reduced, whereby a balance of forces is established that retains the nozzle in operative position during operation of said air propelling means.

4. In a vacuum cleaner, a casing having an air inlet and air outlet, air propelling means in said

casing for drawing air through said inlet and discharging air through said outlet, a support, a suction nozzle connected to said inlet and mounted on said support for vertical movement toward and away from a floor surface, means for exerting a force upon said nozzle that opposes and overbalances the gravitational force acting upon said nozzle and normally holds the nozzle in an elevated position in which the nozzle opening is substantially unobstructed, a movable element in the path of air moved by said propelling means and actuated by the impact of air, and means connecting said movable element to said nozzle to move the same in opposition to said over-balancing force.

5. In a vacuum cleaner, a casing having an air inlet and an air outlet, air propelling means in said casing for drawing air through said inlet and discharging air through said outlet, a suction nozzle connected to said inlet and mounted for vertical movement toward and away from a floor surface, a floor-engaging support for the nozzle connected to said nozzle for vertical movement with respect thereto, a spring interposed between said support and nozzle and exerting an upward thrust on the nozzle sufficient to overbalance the gravitational force acting upon said nozzle and hold the nozzle in an elevated position in which the nozzle opening is substantially unobstructed, and means for opposing said spring with a force exerted by air discharged by said air propelling means to cause the nozzle to automatically move toward the floor surface to an operative position with respect thereto where the nozzle inlet is restricted and said force diminished, whereby a balance of forces is established that retains the nozzle in operative position during operation of said air propelling means.

6. In a vacuum cleaner, a casing having an air inlet and an air outlet, air propelling means in said casing for drawing air through said inlet and expelling air through said outlet, a suction nozzle connected to said inlet, a floor-engaging support for said nozzle connected to the nozzle for vertical movement with respect thereto, a spring interposed between the support and nozzle for normally holding the nozzle in an elevated position, a pressure chamber communicating with the casing outlet, and means actuated by the air pressure in said chamber for moving the nozzle to operative position.

7. In a vacuum cleaner, a casing having an air inlet and an air outlet, an inflatable filtering bag connected to said outlet, means for drawing air through said inlet and expelling air through said bag, a support, a suction nozzle mounted for vertical movement on the support and connected to the casing inlet, means acting on said nozzle to normally yieldably hold the same in an elevated position, and means operably connecting said inflatable bag to said nozzle for exerting a downward thrust on said nozzle upon inflation of the bag.

8. In a vacuum cleaner, a casing having an air inlet and an air outlet, a flexible filter connected to said outlet and movable by the impact of air discharged through said outlet, a support, a suction nozzle mounted for vertical movement on said support and connected to the casing inlet, a spring acting on said nozzle to normally hold the same in an elevated position, and means operably connecting said filter to said nozzle for moving said nozzle downwardly in opposition to said spring upon a movement of the filter by the impact of the air thereon.

9. In a vacuum cleaner, a casing having an air inlet and an air outlet, an inflatable filtering bag connected to said outlet, a normally closed dust chamber connected to said outlet and through which dust may be discharged from the interior of said bag, a support, a suction nozzle mounted for vertical movement on said support and connected to said inlet, a spring for normally holding said nozzle in an elevated inoperative position, and means operably connecting said inflatable bag to said nozzle for moving the nozzle downwardly in opposition to said spring upon inflation of said bag.

10. In a vacuum cleaner, a casing having an air inlet and an air outlet, air propelling means in said casing for drawing air through said inlet and expelling air through said outlet, a support, a vertically movable suction nozzle carried by said support and connected to the casing inlet, means connected to said nozzle for normally overbalancing the weight thereof and yieldably holding the same in an elevated position above a floor surface, and power transmitting means operated by air discharging through said outlet and connected to said nozzle to move the same downwardly.

11. A vacuum cleaner comprising a support a vertically movable nozzle on the support, a fan for creating suction in the nozzle to hold a carpet against the nozzle, a spring exerting an upward force on the nozzle sufficient to lift the nozzle

with a carpet held by suction against the nozzle, and power transmitting means operated by air under pressure delivered by the fan urging said nozzle downwardly in opposition to said spring.

12. A vacuum cleaner having a support, a suction nozzle mounted for vertical movement thereon, means for yieldably holding the nozzle in an elevated position, a flexible filter for cleaning air passing through the cleaner, said filter being movable by the impact of air passing therethrough, and means operably connected said flexible filter to said nozzle for moving said nozzle downwardly upon movement of the filter.

JAMES B. KIRBY.

REFERENCES CITED

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

UNITED STATES PATENTS

Number	Name	Date
1,519,192	Dempsey	Dec. 16, 1924
1,925,354	White	Sept. 5, 1933
1,995,084	Wiehle	Mar. 19, 1935
2,055,734	Sparklin	Sept. 29, 1936
2,198,888	Snyder	Apr. 30, 1940
2,230,113	Hein	Jan. 28, 1941
2,283,831	Taylor	May 19, 1942
2,291,250	Nielsen	July 28, 1942
2,300,938	Lang	Nov. 3, 1942
2,343,227	Sellers	Feb. 29, 1944