April 15, 1952 J. B. KIRBY 2,592,710

SWEEPER TYPE VACUUM CLEANER HAVING AUTOMATIC NOZZLE ADJUSTMENT

Filed Jan. 26, 1948 4 Sheets-Sheet 1

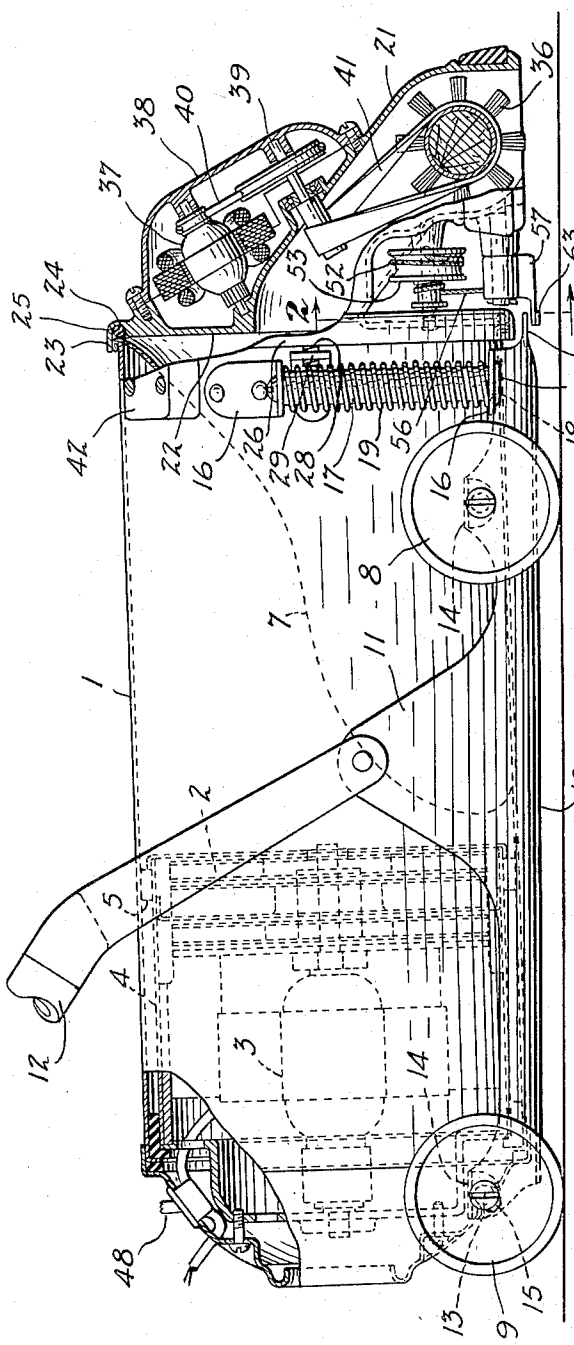

Fig. 1

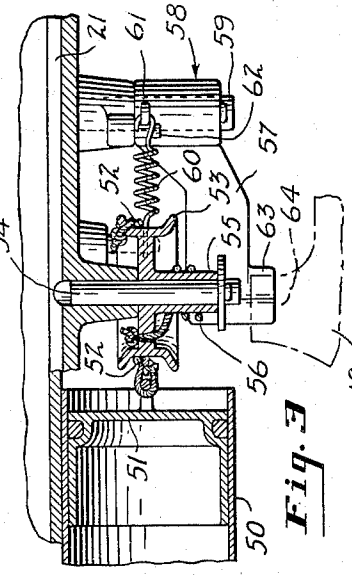

Fig. 3

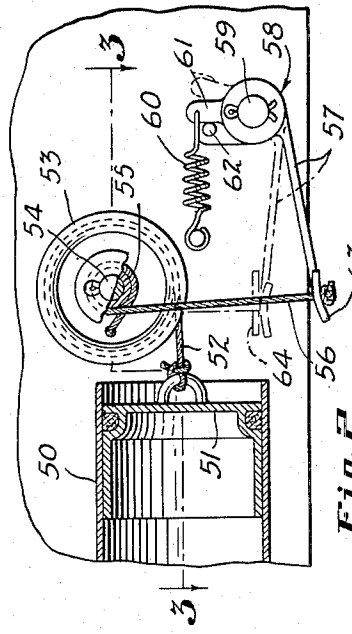

Fig. 2

INVENTOR

James B. Kirby

BY

Evans + McCoy

ATTORNEYS

April 15, 1952 J. B. KIRBY 2,592,710

SWEEPER TYPE VACUUM CLEANER HAVING AUTOMATIC NOZZLE ADJUSTMENT

Filed Jan. 26, 1948 4 Sheets-Sheet 2

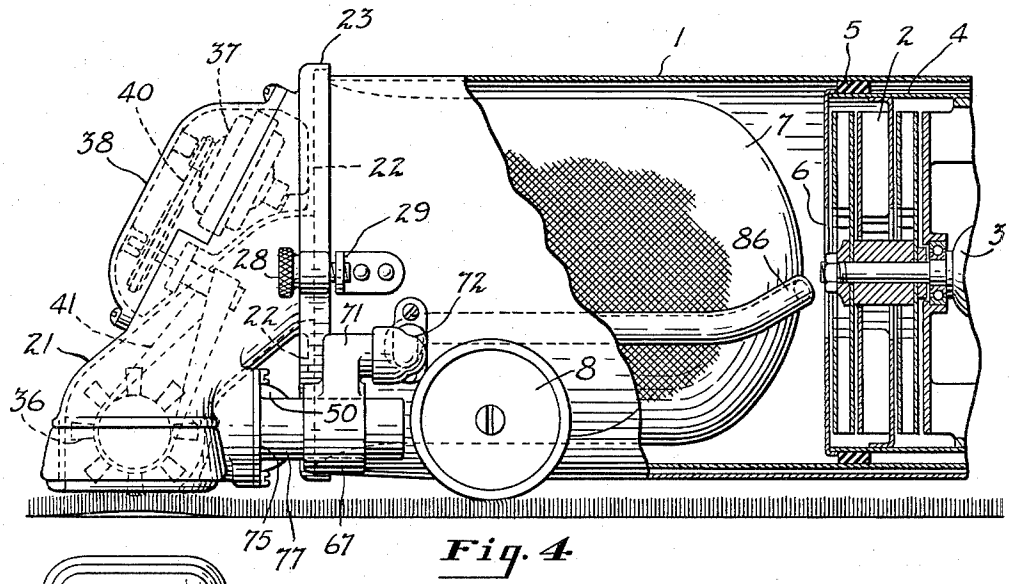

Fig. 4

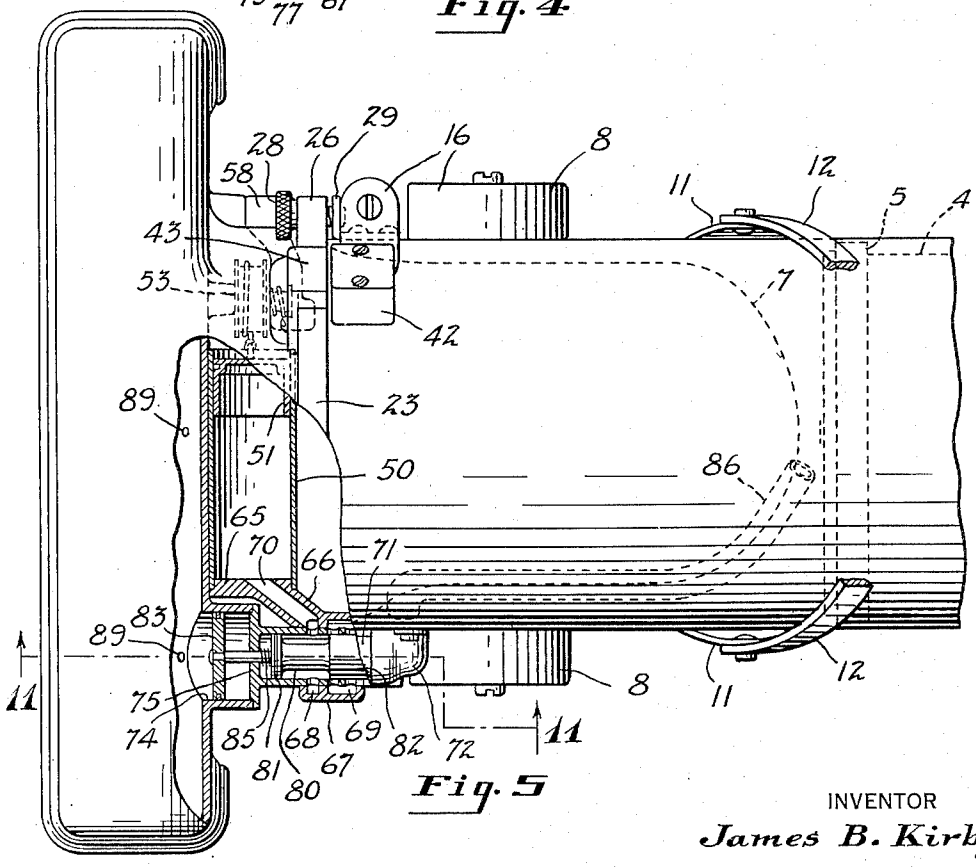

Fig. 5

INVENTOR
James B. Kirby
BY
Evans & McCoy
ATTORNEYS

April 15, 1952 J. B. KIRBY 2,592,710

SWEEPER TYPE VACUUM CLEANER HAVING AUTOMATIC NOZZLE ADJUSTMENT

Filed Jan. 26, 1948 4 Sheets-Sheet 3

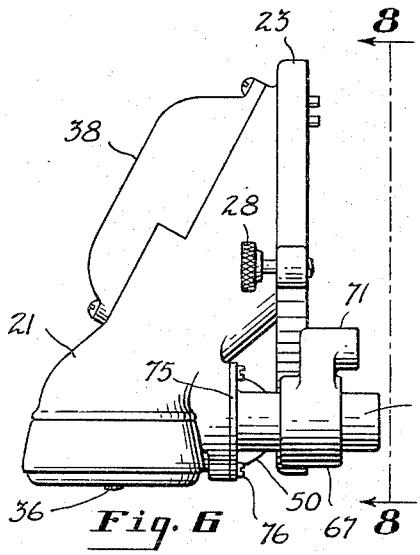

Fig. 6

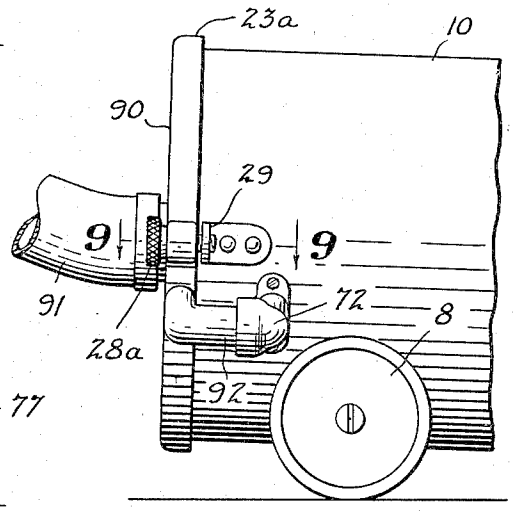

Fig. 7

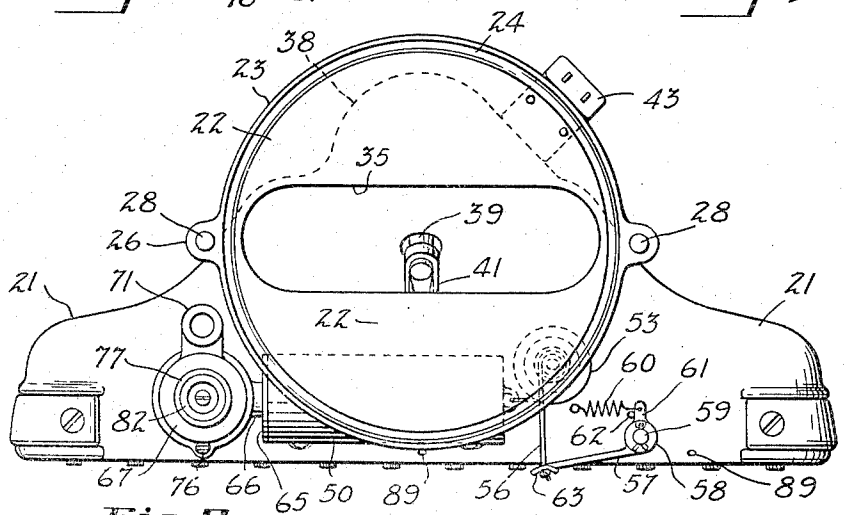

Fig. 8

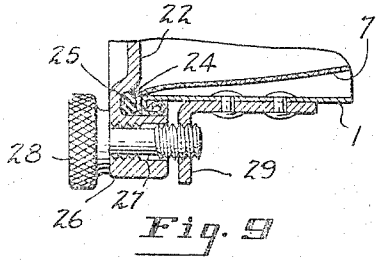

Fig. 9

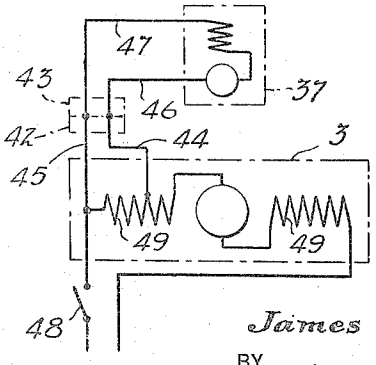

Fig. 10

INVENTOR
James B. Kirby
BY
Evans & McCoy
ATTORNEYS

April 15, 1952 J. B. KIRBY 2,592,710

SWEEPER TYPE VACUUM CLEANER HAVING AUTOMATIC NOZZLE ADJUSTMENT

Filed Jan. 26, 1948 4 Sheets-Sheet 4

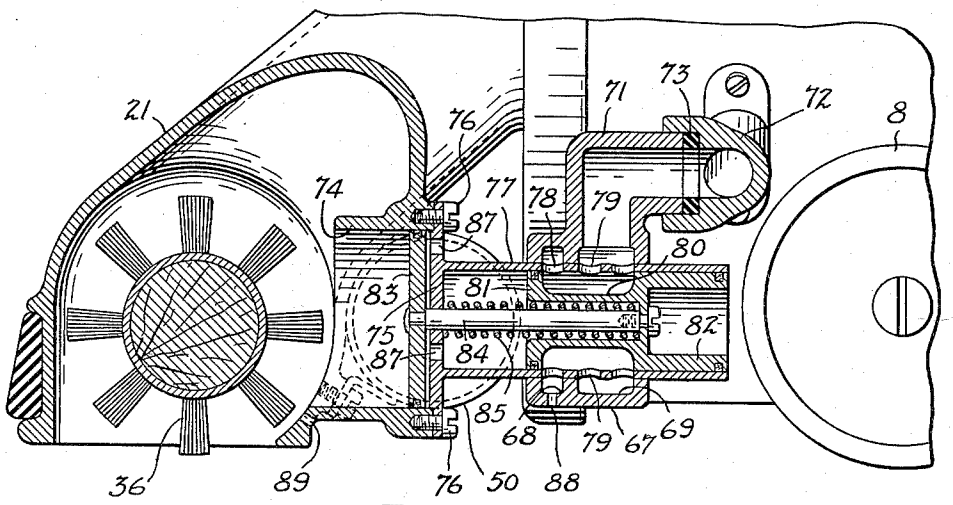

Fig. 11

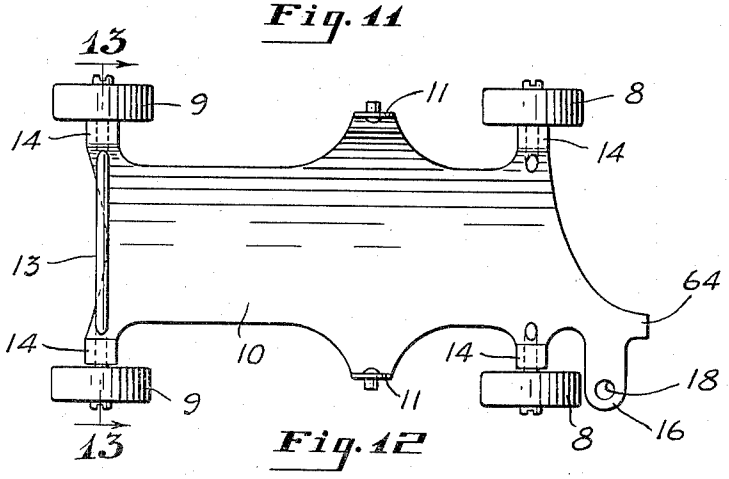

Fig. 12

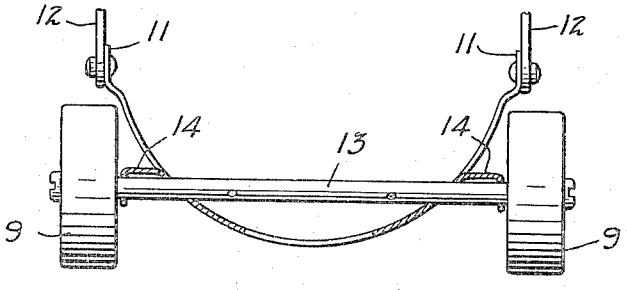

Fig. 13

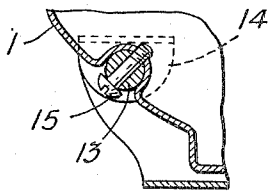

Fig. 14

INVENTOR
James B. Kirby
BY
Evans & McCoy
ATTORNEYS

Patented Apr. 15, 1952 2,592,710

UNITED STATES PATENT OFFICE

2,592,710

SWEEPER TYPE VACUUM CLEANER HAVING AUTOMATIC NOZZLE ADJUSTMENT

James B. Kirby, West Richfield, Ohio

Application January 26, 1948, Serial No. 4,386

7 Claims. (Cl. 15—319)

1

The present invention relates to sweeper type suction cleaners having automatic nozzle adjustment and particularly to a cleaner of the character referred to that is convertible from a sweeper type cleaner to a tank type suction hose cleaner.

The invention has for an object a simple and positive means for automatically adjusting the nozzle to its cleaning position and for maintaining the nozzle in its cleaning position during operation of the cleaner.

The invention has for a further object to provide an actuator for the floor nozzle that is so connected with the suction creating means that the nozzle is automatically moved to its cleaning position when the suction creating means is started into operation and the exertion of downward pressure upon the nozzle during operation of the cleaner is dependent upon the pressure existing within the suction nozzle.

A further object of the invention is to provide a cleaner in which dust separating means is interposed between the suction nozzle and fan casing and in which a pneumatic nozzle adjusting motor is provided that is operated by the suction existing between the dust separator and the fan inlet.

A further object is to provide a pneumatic nozzle adjusting motor that is controlled by means of a valve that is movable in response to variations in pressure within the nozzle.

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

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

Figure 1 is a side elevation of a cleaner embodying the invention with parts broken away and shown in section;

Fig. 2 is a fragmentary section taken on the line indicated at 2—2 in Fig. 1 with the nozzle in elevated position;

Fig. 3 is a section taken on the line indicated at 3—3 in Fig. 2;

Fig. 4 is a fragmentary side elevation of a forward portion of the cleaner looking toward the side opposite that shown in Fig. 1, with the nozzle in cleaning position;

Fig. 5 is a top plan view of the forward portion of the cleaner with a portion broken away and shown in horizontal section;

Fig. 6 is a side elevation showing the floor nozzle detached from the housing;

Fig. 7 is a side elevation showing a cap and suction hose detachably secured to the housing,

2

from which the floor nozzle has been detached;

Fig. 8 is a rear elevation of the detached floor nozzle viewed as indicated at 8—8 in Fig. 7;

Fig. 9 is a fragmentary section taken on the line indicated at 9—9 in Fig. 7;

Fig. 10 is a wiring diagram showing the fan motor and brush motor circuits;

Fig. 11 is a vertical section taken on the line indicated at 11—11 in Fig. 5;

Fig. 12 is a plan view of the cleaner supporting carriage;

Fig. 13 is a section taken on the line indicated at 13—13 in Fig. 12; and

Fig. 14 is a fragmentary vertical section through the rear axle of the carriage showing the attachment of the housing to the axle.

Referring to the accompanying drawings, the cleaner of the present invention has an elongated tubular housing 1 in which is mounted a multiple stage fan 2 that is driven by an electric motor 3 that is mounted within the housing 1 to the rear of the fan 2. The fan 2 has a casing 4 that is provided with an exterior sealing ring 5 engaging the interior of the housing 1, so that the fan casing forms a partition intermediate the ends of the housing, the fan casing 4 being mounted in the rear portion of the casing so as to provide an elongated suction compartment between the fan casing and the forward end of the housing and a motor compartment between the fan and the rear end of the housing. The fan casing has a central inlet 6 and discharges rearwardly through the motor compartment. A filter bag 7 has an open end at the forward end of the housing with its edge portion folded over the forward end of the tubular wall of the housing so that air drawn into the fan must pass through the filter bag.

The housing 1 is supported on a carriage having front and rear wheels 8 and 9 that are connected by a sheet metal body 10 that is transversely curved to correspond to the curvature of the housing 1 and that has upwardly extending side portions 11 to which a conventional handle 12 is attached. The rear wheels 9 are rotatably mounted upon an axle 13 rigid with the housing and free to turn in flanges 14 formed integrally with the body 10 of the carriage.

The rear end of the housing 1 is detachably secured to the axle 13 by suitable means such as screws 15, as shown in Fig. 15. Since the axle 13 is free to turn in the flanges 14 of the carriage body, it provides a pivotal connection between the rear end of the housing 1 and the supporting carriage.

Adjacent its forward end the housing 1 has a bracket 16 attached to one side thereof and this bracket has a vertical tube 17 attached thereto that extends through a hole 18 formed in the carriage body 10. A coil spring 19 surrounds the tube 17 and is interposed between the car-

riage body 10 and the bracket 16. The spring 19 serves to normally hold the housing in an elevated position with respect to the carriage and the upward movement of the housing is limited by a finage 20 on the lower end of the tube 17 that engages the under side of the carriage body 10.

A floor nozzle 21 is detachably secured to the forward end of the housing 1, the nozzle 21 having an integral closure portion 22 that provides a detachable head for the housing 1, the closure portion 22 having a peripheral flange 23 that fits over the edge portion of the filter bag 7 on the exterior of the housing 1 at its forward end. The closure member 22 carries a sealing ring 24 that is mounted in an annular recess 25 in the closure member and that bears against the end of the tubular housing to provide a fluid tight seal and clamp the filter bag. Any suitable detachable fastening means may be employed for securing the nozzle 21 to the housing. As herein illustrated the flange 23 of the closure portion of the nozzle carries diametrically opposite bosses 26 each provided with an aperture 27 to receive a screw 28 that engages a threaded aperture in a lug 29 attached to the exterior of the housing 1. By tightening the screws 28 the sealing ring 24 is clamped against the end of the tubular housing will to clamp the filter bag and provide a seal.

The closure portion 22 of the nozzle 21 is provided with an opening 35 that communicates with the nozzle 21 so that a suction conduit is provided from the nozzle inlet through the nozzle and housing 1 to the fan 2, the filter bag 7 providing a dust separator in the conduit between the nozzle and fan.

Within the nozzle 21 there is mounted a rotatable brush 36 that is driven by means of a small low voltage electric motor 37 that is mounted in a housing formed by means of a cap 38 detachably secured to the upper portion of the nozzle. The motor 37 drives the brush 36 through a countershaft 39 journaled in and extending through the nozzle wall, the countershaft 39 being driven by the motor at a speed less than that of the motor through a round belt 40, and the brush 36 being driven from the countershaft 39 by means of a suitable belt 41. Current is supplied to the motor 37 through a suitable socket 42 attached to the housing and a plug 43 attached to the flange 23 of the detachable nozzle. The socket 42 and plug 43 provide connection between wires 44 and 45 in the housing 1 and wires 46 and 47 in the nozzle 21 that lead to the motor 37.

Current for operating the main motor 3 is controlled by means of a suitable switch 48 at the rear end of the housing 1 through which current is delivered to the windings 49 of the motor 3. As shown in Fig. 10, current for operating the low voltage motor 37 is taken from one of the windings 49 of the main motor which serves as a transformer.

The housing 1 with its attached floor nozzle 21 is normally held by the spring 19 above its normal working position, preferably at a substantial distance above the floor surface so that the nozzle does not interfere with free travel of the cleaner over a floor surface when it is not being operated.

Means is provided for automatically moving the housing 1 and nozzle 21 downwardly to the proper cleaning position when the suction fan 2 is started into operation. The nozzle actuating means is an auxiliary motor that is energized substantially simultaneously with the energization of the fan driving motor 3 and that is so connected to the carriage and nozzle that when energized it applies a downward thrust to the nozzle to move it to cleaning position. The auxiliary nozzle adjusting motor is preferably a pneumatic motor so connected with the fan 2 that the differential air pressure required for its operation is created by the fan. As herein illustrated, the nozzle actuating motor is a suction motor comprising a cylinder 50 attached to the rear wall of the nozzle 21 and a movable piston 51. The piston 51 is connected by a cable 52 to a drum 53 adjacent the inner end of the cylinder 50, the cable 52 being attached to the piston 51 and wound on the drum 53, which is rotatably mounted on a shaft 54 attached to the rear wall of the nozzle 21. The drum 53 has a projecting hub 55 that forms a second drum of smaller diameter upon which is wound a cable 56 that is attached to the hub 55 and to an arm 57 of a lever 58 mounted to turn on a horizontal pivot 59 attached to the rear wall of the nozzle.

The cylinder 50 is preferably disposed horizontally and the cables 52 and 56 are so wound on the drums 53 and 55 that the cable 56 and arm 57 are moved upwardly when the piston 51 is moved outwardly away from the drum 53. The lever 58 is actuated in a direction to move the arm 57 downwardly and apply tension to the cable 56 by means of a spring 60 that is attached at one end to the nozzle 21 and at its opposite end to a short upwardly extending arm 61 of the lever 58, the downward movement of the arm 57 being limited by a stop pin 62 in the path of the arm 61. The arm 57 of the lever has a lateral extension 63 that is engageable with the under side of a projecting portion 64 of the carriage body 10 when the arm 57 is moved upwardly in opposition to the spring 60, so that the pull on the cable 56 exerts a downward thrust on the nozzle 21 to move it downwardly in opposition to the spring 19. The spring 60 serves to normally retain the piston 51 near the inner open end of the cylinder 50 that is adjacent the drum 53 in which position of the piston the nozzle is held by the spring 19 in its elevated position. When the nozzle 21 is removed from the housing 1, the spring 60 serves to hold the piston 51 in the position which it occupies when the nozzle is in its elevated position, so that when the nozzle is reattached to the housing the actuating piston 51 and lever arm 57 will be in proper position for applying downward thrust to the nozzle.

At its outer end the cylinder 50 has a head 65 that is provided with an integral extension 66 that is formed to provide a valve annulus 67 that has spaced internal grooves 68 and 69. The head 65 is provided with a passage 70 opening to the interior of the cylinder and to the grooves 68. The extension 65 has a tubular elbow portion 71 providing a passage that communicates with the groove 69. The upper end of the elbow portion 71 extends horizontally and is received in a fitting 72 attached to the housing 1 through which communication is established with the suction fan. To seal the connection between the fitting 72 and the elbow 71, a suitable sealing ring 73 is provided within the fitting for engagement with the end of the elbow 71.

The rear wall of the nozzle 21 has a cylinder 74 formed integrally therewith that opens to the interior of the nozzle and that is axially alined with the valve annulus 67. At the outer end of the cylinder 74 a closure member 75 is attached

to the nozzle by suitable means such as screws 76. The closure member 75 has a tubular member 77 integral therewith that fits within the valve annulus 67 and that is provided with openings 78 circumferentially spaced around the the tubular member and registering with the groove 68, and similarly arranged openings 79 that register with the groove 69. Within the tubular member 77 a valve spool 80 is slidably mounted, the spool 80 being provided with spaced plungers 81 and 82 that are spaced apart a distance sufficient to receive the openings 78 and 79 between them.

Within the cylinder 74 there is mounted a movable diaphragm or piston 83 that is connected by means of a rod 84 with the valve spool 80, the piston 83 being normally held against the closure member 75 by means of a coil spring 85 of the desired pressure exerting characteristics surround the rod 84 and interposed between the closure member 75 and the valve 80. The spring 85 serves to normally hold the piston 83 and valve spool 80 in the position shown in Fig. 11, in which position the cylinder 50 is in communication with the interior of the housing 1 through the passage 70, grooves 68, openings 78 and 79, grooves 69, elbow 71 and the fitting 72.

Within the housing 1 a tube 86 extends from the fitting 72 to a point between the rear end of the filter bag 7 and the inlet 6 of the fan casing, where a high vacuum exists during operation of the cleaner due to the air flow impeding action of the filter bag, the tube 86 and passages through the fitting 72 and extension 66 of the cylinder head providing a separate conduit connecting the fan and nozzle actuating motor through which the air flow is independent of the air flow through the conduit connecting the suction nozzle with the fan.

The closure member 75 is provided with openings 87 which establish atmospheric pressure on the outer face of the piston 83 so that the piston 83 will be drawn inwardly by suction created within the nozzle 21 during operation of the cleaner whenever that suction is sufficient to overbalance the spring 85. When the cleaner is started into operation the air is simultaneously drawn through the nozzle 21 into the housing 1 and through the filter bag into the fan casing, and from the cylinder 50 through the valve 80 and tube 86 to the fan inlet. The suction in the cylinder 50 causes the piston 51 to be drawn toward the head 65, operating the drum 53 to swing the arm 57 upwardly into engagement with the under side of the body 10 and exert a downward thrust on the nozzle 21 which moves the nozzle in opposition to its spring 19 downwardly to cleaning position. When the flow of air into the nozzle 21 is impeded by the close proximity of the nozzle inlet to the floor surface, suction is created within the nozzle 21 which overbalances the spring 85 and draws the piston 83 inwardly, moving the plunger 82 toward the position in which it cuts off communication between the suction chamber and the cylinder 50.

In order to normally prevent movement of the valve spool 80 to a position where communication between the tube 86 and cylinder 50 is completely closed and to prevent continued exertion of a downward pressure against the floor covering in the event that the piston 83 is moved too far by suction within the nozzle, a bleed hole 88 is provided in the valve annulus 67 leading to the groove 68 so that air at atmospheric pressure can flow into the cylinder 50 to relieve the vacuum acting upon the piston 51 and permit the spring

19 to slightly lift the nozzle and carpet for more effective cleaning action. If the suction grip of the nozzle 21 on the carpet should be broken sufficiently to permit the spring 16 to move the nozzle away from the carpet, the valve 80 will be instantly opened so that air would be again drawn from the cylinder 50 to actuate the piston 51 and again move the nozzle downwardly to its cleaning position.

In normal operation the forces exerted on the nozzle by the cylinder 50 and spring 19 are balanced and the nozzle is instantaneously responsive to variations in the pressure within the cylinder 50 so that the nozzle is maintained in effective cleaning position while passing over worn or uneven portions of a carpet.

In order to provide the high vacuum desirable when the cleaner is used as a tank cleaner, the fan 2 is preferably of a capacity such that it may under some conditions create a higher suction in the nozzle 21 than is desirable and, to avoid this difficulty small air inlet openings 89 may be provided in the nozzle 21 above its opening lower end so that an increasing quantity of air is drawn through the openings 89 instead of through the nozzle opening in which the brush is mounted as the vacuum in the nozzle is increased and creation of an undesirably high vacuum is prevented.

The nozzle 21 is held in place on the housing 1 by means of the quickly releasable screws 28 so that it can be quickly and easily detached from the housing, and the cylinder 50 with its extension forming the valve casing 67 and elbow 71 is removable with the nozzle, the elbow 71 being removable from the fitting 72 upon horizontal forward movement of the nozzle. The nozzle 22 is replaceable by a closure member 90, which as shown in Fig. 8, carries a suction hose 91 and has a flange 23*a* corresponding to the flange 23 of the nozzle 21 that carries screws 23*a* corresponding to the screws 23 so that it can be locked to the housing in the same manner as the nozzle 21. The closure member 90 is preferably provided with a plug 92 to close the fitting 72 to prevent leakage of air into the housing through the fitting 72 during operation of the cleaner with the suction hose.

It is to be understood that variations and modifications of the specific devices 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 suction cleaner comprising a carriage, a suction creating fan on said carriage, a floor nozzle mounted for vertical movement on said carriage from its cleaning position to an elevated position, a spring normally holding the nozzle in its elevated position, a pneumatic motor having an air chamber provided with a movable piston connected to said nozzle to impart a downward movement thereto, separate conduits connecting said nozzle and said air chamber to said fan, a valve in said conduit connecting the fan to said chamber for controlling pressure on said piston, a diaphragm subjected on one side to atmospheric pressure and on the other to pressure within the nozzle and responsive to changes in air pressure within said nozzle, and means connecting said diaphragm to said valve to move the same to decrease or increase the downward thrust on said nozzle as the suction within said nozzle is increased or decreased.

2. A suction cleaner having a carriage, a suc-

tion creating means including a fan on said carriage, a suction nozzle mounted on said carriage for vertical movement from its cleaning position to an elevated position, means for yieldably holding said nozzle in its elevated position, a pneumatic motor for moving said nozzle downwardly to its cleaning position, separate conduits connecting said nozzle and said motor to said fan to draw air through said nozzle and to operate said motor upon operation of said fan, a valve for opening and closing the conduit to said motor, means for yieldably holding said valve in its open position, a member carried by the nozzle and movable in response to a predetermined reduction in pressure within the nozzle, and means connecting said member to said valve to close the valve upon said predetermined reduction of pressure in the nozzle.

3. A suction cleaner comprising a carriage, a housing movably mounted on the carriage, a sweeper nozzle detachably secured to an end of the housing, said housing and nozzle being movable from an elevated position to a cleaning position, means for yieldably holding the housing and nozzle in elevated position, suction creating means including a fan within said housing, a suction motor carried by said nozzle and operatively connected to the carriage for applying a downward thrust to the housing and nozzle to move the same downwardly, a conduit carried by the housing and communicating with the fan inlet, a conduit on the nozzle connected to said motor and detachably connected to said housing conduit, a valve in said nozzle conduit for controlling the flow of air therethrough to increase or decrease the downward thrust on said housing and nozzle, and means including a member carried by the nozzle and movable in response to variations in pressure within the nozzle for actuating said valve to increase or decrease the downward thrust exerted on said housing and nozzle as the pressure within said nozzle increases or decreases.

4. A suction cleaner having a supporting carriage, a nozzle supported for vertical movement on said carriage, means yieldably supporting said nozzle above its cleaning position, a fan, a suction conduit connecting said nozzle to said fan, a dust separator in the conduit between the nozzle and fan, a suction motor, a duct connecting said motor to the portion of said suction conduit between said separator and fan to apply suction to said motor upon operation of said fan, means connecting said motor to said nozzle for exerting a downward thrust on the nozzle to lower the same to its working position, a movable controller for varying the thrust applied by said suction motor to said nozzle, a member carried by said nozzle and movable in response to the decrease in the air pressure within said nozzle caused by the restriction of air flow through the nozzle when the nozzle is in working position, and means connecting said member to said controller for decreasing the thrust of said motor upon movement of said member.

5. A suction cleaner having a supporting carriage, a nozzle supported for vertical movement on said carriage, means yieldably supporting said nozzle above its cleaning position, a fan, a suction conduit connecting said nozzle to said fan, a dust separator in the conduit between the nozzle and fan, a suction motor, a duct connecting said motor to the portion of said suction conduit between said separator and fan to apply suction to said motor upon operation of said fan, means connecting said motor to said nozzle for exerting a downward thrust on the nozzle to lower the same to its working position, a valve controlling the suction applied to said motor, a member carried by said nozzle and movable in response to a predetermined decrease of pressure within said nozzle, and means connecting said member to said valve to decrease the suction applied to said motor upon said predetermined decrease of pressure in said nozzle.

6. A suction cleaner having a supporting carriage, a nozzle supported for vertical movement on said carriage, means yieldably supporting said nozzle above its cleaning position, a fan, a suction conduit connecting said nozzle to said fan, a dust separator in the conduit between the nozzle and fan, a suction motor, a duct connecting said motor to the portion of said suction conduit between said separator and fan to apply suction to said motor upon operation of said fan, means connecting said motor to said nozzle for exerting a downward thrust on the nozzle to lower the same to its working position, a valve controlling air flow through said duct, a port admitting air to said duct between said motor and said valve, a member carried by said nozzle and movable in response to a predetermined decrease in pressure within the nozzle, and means connecting said member to said valve to move the same in a direction to decrease air flow through said duct upon said predetermined decrease in pressure within the nozzle.

7. A suction cleaner having a supporting carriage, a fan, a motor driving said fan, a nozzle through which air is drawn by the fan mounted on said carriage for movement from an upper position where air flow through the nozzle is substantially unobstructed to a lower cleaning position where the air flow is obstructed and a suction is maintained within the nozzle, means yieldably supporting said nozzle in said upper position, an auxiliary motor connected to said nozzle to exert a downward thrust thereon, means for energizing said auxiliary motor substantially simultaneously with the fan driving motor to move said nozzle to cleaning position, a diaphragm subjected on one side to atmospheric pressure and on the other to the pressure of the air within said nozzle and movable only in response to a predetermined suction within said nozzle, a movable controlling element for varying the downward thrust exerted by said motor on said nozzle, and means connecting said diaphragm to said controlling element to move the same to decrease or increase said downward thrust as the suction in said nozzle is increased or decreased.

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
1,912,386	Replogle	June 6, 1933
1,925,354	White	Sept. 5, 1933
1,954,416	Leathers	Apr. 10, 1934
1,983,566	Replogle	Dec. 11, 1934
2,055,734	Sparklin	Sept. 29, 1936
2,289,711	Kirby	July 14, 1942
2,343,227	Sellers	Feb. 29, 1944

FOREIGN PATENTS

Number	Country	Date
564,459	Great Britain	Sept. 28, 1944