Jan. 22, 1952 J. B. KIRBY 2,583,054

AUTOMATIC NOZZLE ADJUSTING DEVICE FOR VACUUM CLEANERS

Filed April 22, 1946 3 Sheets-Sheet 1

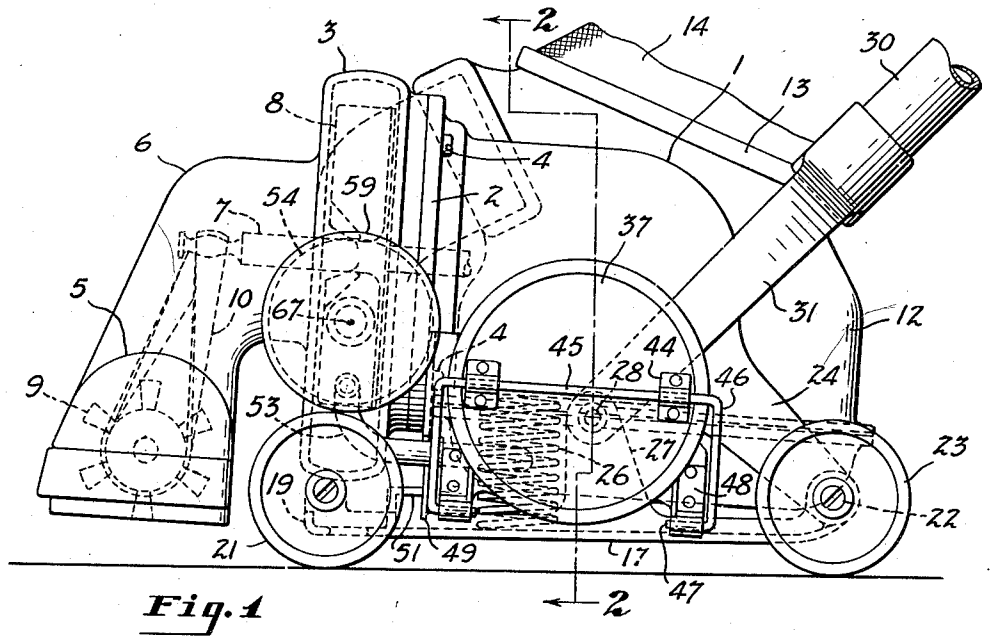

Fig. 1

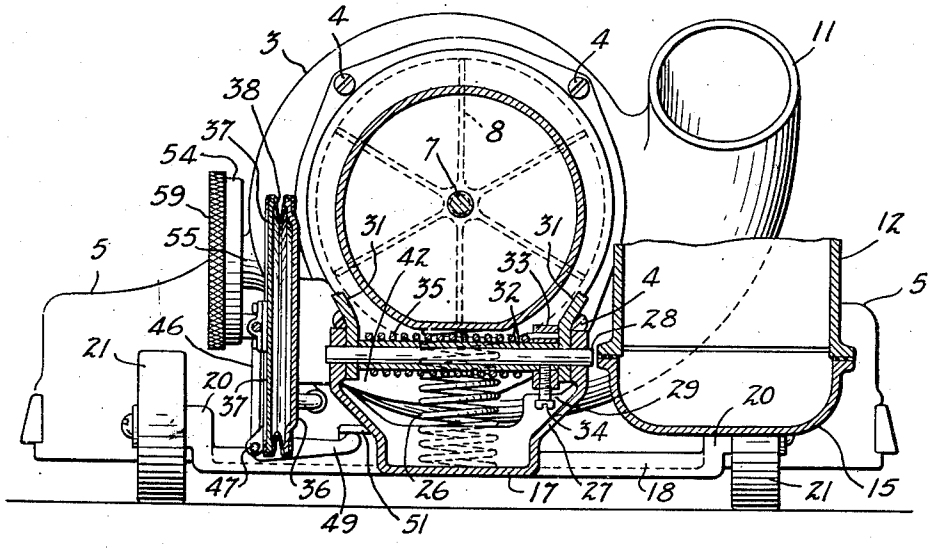

Fig. 2

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Filed April 22, 1946 3 Sheets-Sheet 2

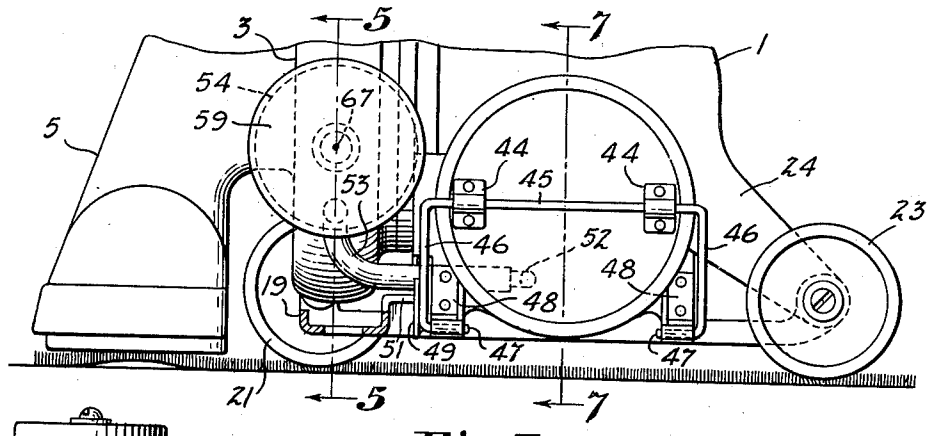

Fig. 3

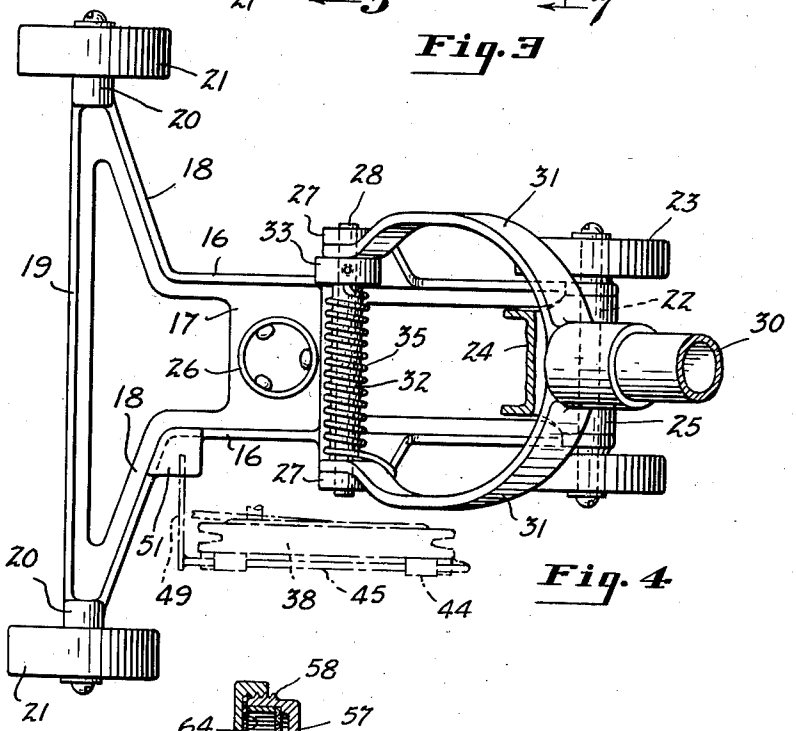

Fig. 4

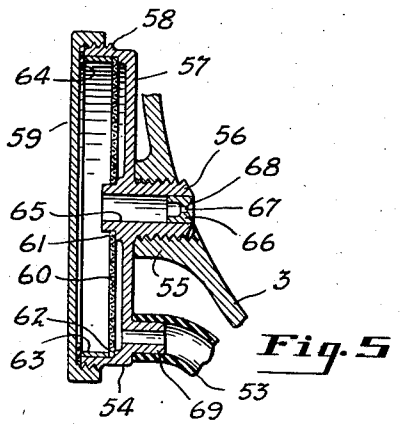

Fig. 5

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AUTOMATIC NOZZLE ADJUSTING DEVICE FOR VACUUM CLEANERS

Filed April 22, 1946 3 Sheets-Sheet 3

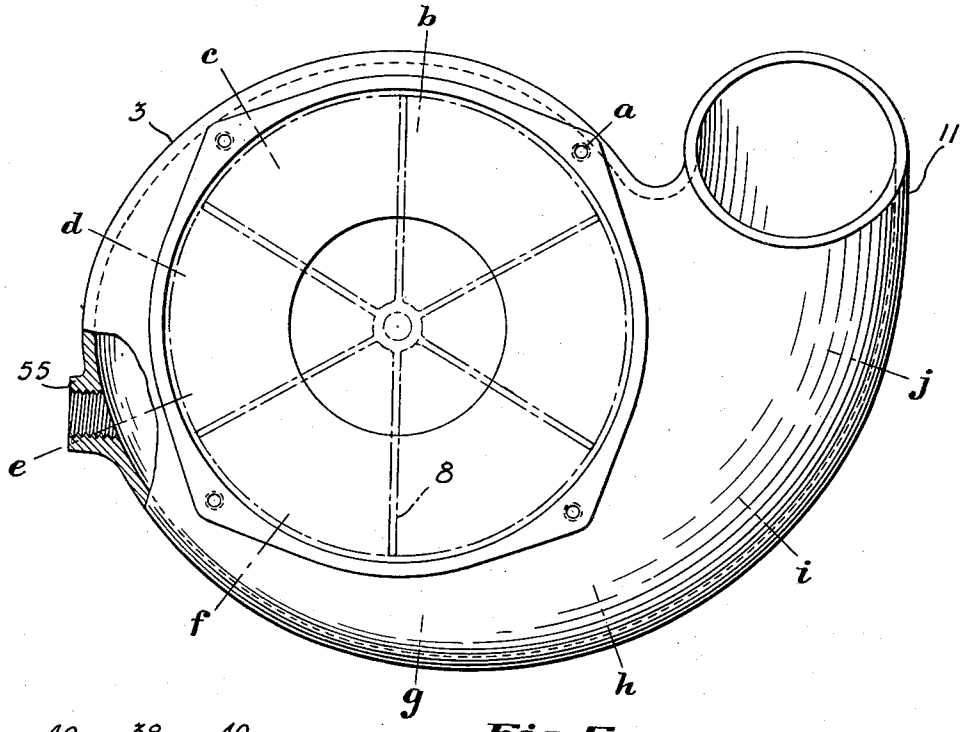

Fig. 6

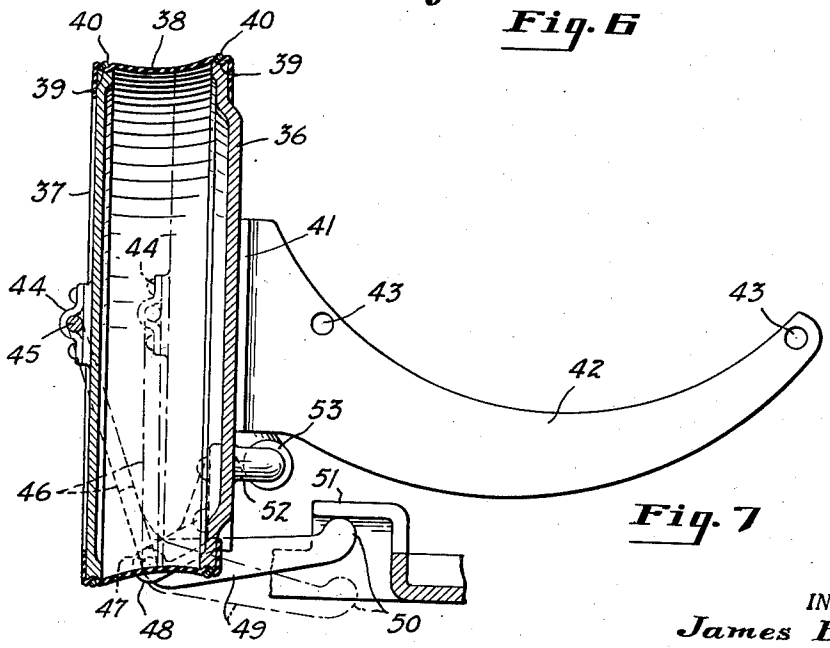

Fig. 7

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Patented Jan. 22, 1952

2,583,054

UNITED STATES PATENT OFFICE

2,583,054

AUTOMATIC NOZZLE ADJUSTING DEVICE FOR VACUUM CLEANERS

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Application April 22, 1946, Serial No. 663,923

3 Claims. (Cl. 15—319)

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This invention relates to vacuum cleaners and more particularly to a device for automatically shifting the nozzle from an elevated inoperative position to a cleaning position when the cleaner is started in operation.

To obtain proper and efficient cleaning it is important that the nozzle be kept at the proper level to lift the carpet slightly while the brush agitates and sweeps it as the air gets under and comes up through the carpet. With the various manual adjustments provided in cleaners heretofore manufactured it is very difficult for the average individual to adjust the nozzle of a cleaner to the proper cleaning position. Many homes have a variety of rugs, each requiring a different adjustment of a vacuum cleaner nozzle for efficient operation.

It is an important object of the present invention to provide instant and automatic adjustment of the nozzle to cleaning position when the cleaner is started into operation and to maintain the nozzle in the proper position for the particular carpet being cleaned during the operation of the cleaner.

In my copending application, Serial No. 545,044, filed July 15, 1944, now Patent No. 2,555,887, granted June 5, 1951, I have disclosed a cleaner in which the nozzle is automatically positioned by means of a yieldable support that normally holds it in an elevated inoperative position and an air pressure actuated device subjected to air under pressure delivered by the suction fan of the cleaner that acts in opposition to the yielding supporting means to overbalance the same and shift the nozzle to cleaning position when the cleaner is started into operation. The present invention is an improvement on the device shown in the aforesaid patent.

The present invention has for an object to provide an automatic nozzle adjusting device in which the nozzle actuating mechanism exerts sufficient force to move the nozzle down against the carpet when the nozzle opening is unobstructed and insufficient force to overcome the supporting spring or other yielding support when the nozzle is sealed by the carpet, so that the spring or other means lifts the carpet from the floor during cleaning operation.

Where a nozzle is mounted for free vertical movement and supported by a spring of sufficient strength to lift the nozzle with a carpet held to the nozzle by suction, a substantial force is required to move the nozzle from its elevated inoperative position into engagement with the carpet in opposition to the spring and where air

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pressure created by the fan is employed for such actuation of the nozzle it is desirable that the pressure be sufficient to actuate the nozzle through a bellows diaphragm or the like of relatively small size. It is also desirable that there be a very substantial difference in the pressure exerted on the actuator when the air flow through the nozzle is free and when the air flow is obstructed by engagement of a carpet with the cleaner, so that the actuator will be effective to overcome the spring only when the air flow is unobstructed as it is when the cleaner is started into operation.

It is an object of the present invention to control an air pressure operated actuating device by the pressure in a portion of the cleaner where there is a substantial difference in the pressure when the cleaner is operating with the suction nozzle unobstructed and with the suction nozzle obstructed by engagement with a carpet or other surface being cleaned.

It is also an object of the present invention to so connect an air pressure operated nozzle actuator to the fan casing that the air passing from the fan casing to the actuator contains little if any dust.

With the above and other objects in view, the invention may be said to comprise the vacuum 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;

Fig. 2 is a transverse vertical section taken on the line indicated at 2—2 in Fig. 1;

Fig. 3 is a fragmentary side elevation of the lower portion of the suction head and the supporting carriage;

Fig. 4 is a plan view of the supporting carriage with the head removed to show attachment of the handle to the carriage;

Fig. 5 is a section taken on the line indicated at 5—5 in Fig. 3;

Fig. 6 is a side elevation of the fan casing looking to the side thereof that is attached to the body portion of the head, and

Fig. 7 is a transverse vertical section through the nozzle actuating diaphragm taken on the line indicated at 7—7 in Fig. 3.

In the accompanying drawings the invention is

shown applied to a Kirby cleaner of the type shown in my Patent No. 1,983,175, granted December 4, 1934, in which the cleaner head has a body 1 within which the operating motor is housed and which has an annular flange 2 at its forward end to which a fan casing 3 is secured by suitable means such as attaching bolts 4. A suction nozzle 5 rigidly attached to the fan casing has a central upstanding portion 6 that is connected to the central inlet of the fan casing. A motor shaft 7 projects through the fan casing and has a fan 8 attached thereto within the casing. The nozzle 5 has a transversely elongated open lower end in which a rotary brush 9 is mounted, the brush 9 being driven by a belt 10 which is operated by the shaft 7.

The fan casing 3 has a peripheral outlet 11 that opens into a dust compartment 12 in the rear portion of the body 1 of the head, the dust compartment having an air outlet 13 at the top thereof to which a flexible filter bag 14 is attached. The bottom of the compartment 12 has a detachable dust receptacle 15 in which the dirt collects and which can be emptied from time to time.

The cleaner head is mounted upon a suitable carriage which is provided with side members 16 that are connected intermediate their ends by an integral bed plate 17 and which have lateral extensions 18 at their forward ends which are connected at their ends with an elongated front cross bar 19. At the ends of the cross bar 19, short standards 20 are formed integrally with the members 18 and 19, and outwardly of the standards 20 supporting wheels 21 are rotatably mounted upon a suitable stub shaft or trunnions attached to the standards 20. The rear ends of the side frame members 16 of the carriage are connected by a rear axle 22 which projects on opposite sides of the carriage frame to support rear wheels 23.

The cleaner body 1 has a rearwardly extending integral arm 24 provided with a bearing portion 25 at its rear end that is pivoted on the rear axle 22 between the side members 16. The wide front end portion of the carriage is disposed immediately behind the nozzle 5 and is of a length such that the supporting wheels 21 are adjacent the ends of the nozzle.

The cleaner head, composed of the body 1, fan casing 3 and nozzle 5 is pivotally supported at its rear end on the rear axle 22 and is yieldably supported forwardly of its pivot by means of a coil spring 26 that is interposed between the bottom of the body 1 and the bed plate 17 of the carriage. The supporting spring 26 has sufficient strength to normally support the cleaner head with the suction nozzle 5 in an elevated inoperative position. Tension of the spring, however, is not sufficient to prevent the nozzle from being held by suction against a carpet being cleaned. The spring 26 is preferably strong enough, however, to lift the portion of the carpet engaged by the nozzle and held by suction against the nozzle slightly off the floor so that air can be drawn through the body of the carpet into the suction nozzle.

The side frame members 16 of the carriage have integral upwardly extending standards 27 which provide a support for a cross shaft 28 and the carriage frame is braced by a cross web 29 connecting the standards 27. The cleaner is pushed over the floor by means of a suitable handle 30 that is pivotally mounted on the shaft 28 and connected to the carriage only. The

operating handle 30 is provided with curved forked arms 31 which straddle the body 1 of the cleaner head with sufficient clearance to permit the head to move freely independently of the operating handle and means is preferably provided for counterbalancing the handle 30 to normally hold it in vertical position.

As best shown in Figs. 2 and 4, a sleeve 32 is mounted on the shaft 28 between the arms 31. A collar 33 is mounted on one end of the sleeve and held in various adjusted positions with respect to the shaft 28 by means of a screw 34 that is secured in one of a number of openings in the collar and which engages with the web 29 to limit the turning movement of the collar 33. A coil spring 35 is mounted on the sleeve 32 and has one end anchored to one of the arms 31 of the handle and its opposite end anchored to the collar 33. By turning the collar 33 with the screw 34 detached the desired tension may be applied to the spring 35, whereupon the collar may be secured in adjusted position by attaching the set screw 34 to the collar.

For shifting the suction nozzle into cleaning position, an air pressure operated actuator is provided which is automatically controlled by the air flowing through the cleaner. As best shown in Figs. 2 and 7, the actuator has relatively movable heads 36 and 37 that are connected by an annular flexible fabric wall 38 which is preferably formed of rubber impregnated fabric which is collapsible to permit movement of the head 37 toward and away from the head 36. The flexible bellows wall 38 has a fluid tight connection to the heads 36 and 37, each of which has a peripheral groove 39 into which the fabric wall is pressed by means of a suitable clamping ring 40. The fabric wall 38 is formed to normally occupy its collapsed position and preferably has sufficient elasticity to normally hold the movable head 37 in collapsed position. The head 36 is attached to the body 1 of the cleaner head by means of a bracket 41 rigidly attached thereto and having a curved arm 42 which fits against the rear side of the flange 2 and which is provided with holes 43 to receive the attaching bolts 4. On the outer side thereof the movable head 37 is provided with bearing brackets 44 which are positioned on opposite sides of the center of the head, providing a pivotal support for the central portion of a U-shaped member 45 which forms an arm of an actuating lever and which has downwardly extending parallel arms 46 at the ends thereof that are provided with inturned ends 47 engaging in pivot brackets 48 attached to the inner head 36.

A lever arm 49 is rigidly attached to one of the arms 46 of the actuating member and extends inwardly beneath the bottom of the head 36. The lever arm 49 has a rounded end 50 that is adapted to bear against the under side of an outwardly projecting flange on the adjacent side members 16 of the carriage frame so that upon actuation of the head 37 the lever arm 49 will be swung upwardly exerting an upward thrust on the flange 51 of the carriage and a downward thrust on the cleaner head to move the same downwardly in opposition to the spring 26 to position the nozzle 5 in cleaning position, where engagement with the carpet is maintained by suction.

Air under pressure is delivered to the interior of the bellows through an air inlet 52 in the inner wall 36 which is connected by a flexible tube 53 with a fitting 54 through which air is delivered

to the bellows from a peripheral portion of the fan casing. The fitting **54** is attached to the periphery of the fan casing at a point where the pressure above atmospheric is maintained during operation of the cleaner and where there is a substantial difference between the pressure existing when the flow of air to the suction nozzle is unobstructed and when the suction nozzle is obstructed by engagement with a carpet being cleaned.

Referring to Fig. 6 of the drawings, which shows a rear elevation of the fan casing of a standard Kirby cleaner, it will be observed that a series of points in the periphery of the casing are indicated by the circumferentially spaced lines designated from *a* to *j* inclusive. Tests were made with a standard cleaner in which the pressure was measured by means of a manometer at points corresponding substantially to the points indicated in Fig. 6, with the cleaner operating with its nozzle engaging the carpet and with the nozzle in an elevated inoperative position. The following chart shows the pressures in inches of water at each of the points indicated, the first column showing the pressures in inches with the nozzle unobstructed, the second column showing the pressures with the nozzle engaging a carpet, and the third column showing the differences in the pressures.

	In.	In.	In.
a	4.7	1.3	3.4
b	4.5	1.5	3.0
c	4.3	1.4	2.9
d	4.7	1.8	2.9
e	5.8	1.8	4.0
f	4.8	1.4	3.4
g	3.9	.5	3.4
h	4.9	2.0	2.9
i	5.4	2.8	2.6
j	5.6	3.1	2.5

As shown by the above chart, the greatest change in pressure due to obstruction of the cleaner nozzle is at the point designated "*e*" which is substantially diametrically opposite the fan casing outlet. The fitting **54** is therefore attached to a boss **55** formed on the fan casing adjacent the point *e*. The boss **55** is bored and tapped to receive a threaded hub **56** formed integrally with the fitting **54**. As best shown in Fig. 5, the fitting **54** has a flat rear wall **57** of circular form to which the hub **56** is centrally attached. The fitting also has an externally threaded cylindrical flange **58** upon which a threaded cap **59** is screwed. A filter **60** in the form of a flat disc is clamped against shoulders **61** and **62** formed on the inner end portion of the hub **56** and upon the interior of the flange **58** by means of the clamping ring **63** which is pressed against the edge of the filter by the cap **59**. A suitable sealing washer **64** is interposed between the outer edge of the ring **63** and the cap **59** to prevent leakage of air through the threaded connection between the cap and the body of the fitting.

The filter **60** is spaced from the inner wall **57** of the fitting and serves to prevent passage of dust to the nozzle actuating bellows. The hub **56** is provided with a bore **65** through which air is delivered to the interior of the fitting outwardly of the filter. The inner end of the hub has a plug **66** fitting in the bore **65** which is provided with a small aperture **67** for passage of air and which has a countersunk inner end **68**, the plug **66** serving to restrict the air passage from the interior of the fan casing and prevent entry

of dust particles into the fitting. The tube **53** is connected to the inner wall **57** of the fitting, which is provided with an outlet **69** to which the tube is connected.

During operation of the cleaner the air passes freely from the peripheral portion of the fan casing through the fitting **54** to the nozzle actuating bellows and when the nozzle **5** is unobstructed a substantial pressure is exerted upon the movable head **37** of the bellows to shift the nozzle **5** to carpet engaging position. As shown by the chart, the pressure upon the movable head and bellows amounts to about 5.8 water inches and when the nozzle is obstructed by engagement with a carpet this pressure drops to about 1.8 inches, which is insufficient to overcome the action of the elastic wall **38** of the bellows so that the bellows will collapse and move the lever arm **49** out of engagement with the flange **51** when the carpet is drawn by suction against the nozzle opening. The nozzle actuator is thus normally held into retracted position and is effective to apply a downward thrust to the nozzle only when the nozzle is in an elevated inoperative position, releasing the nozzle after it has been moved to cleaning position so that after the nozzle is adjusted to cleaning position it is held in engagement with the carpet solely by suction.

As the cleaner goes into operation the nozzle has a clear opening above the carpet and substantially clear air is forced by the fan through the port **67** and into the bellows to lower the nozzle to cleaning position. As the nozzle contacts the carpet and dust is forced through the fan chamber little or no air passes through the port **67** as maximum pressure in the bellows by this time equals that of the fan case. Therefore, little or no dust gets through the port **67**. Any dust passing through the port **67** is trapped by the filter box and may be removed by unscrewing the cap **59**.

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 having a carriage, a vertically movable nozzle on the carriage, means yieldably supporting said nozzle in an elevated inoperative position, a fluid pressure operated actuator subjected at all times to the air pressure existing in a portion of the cleaner where pressure above atmospheric is maintained during operation and where the pressure is decreased by obstruction of air flow through the nozzle, a lever pivoted to said nozzle, said lever having an arm connected to said actuator and an arm that is free from attachment to the carriage and engageable with the carriage when the nozzle is in its elevated position to transmit a downward thrust to said nozzle to shift it to cleaning position.

2. A vacuum cleaner having a carriage, a nozzle mounted on said carriage for vertical movement from an elevated position where air flow is through the nozzle is substantially unobstructed to its cleaning position where said air flow is obstructed, yielding means exerting an upward thrust on said nozzle sufficient to support the nozzle in its elevated position, nozzle lowering means comprising a thrust transmitting member interposed between the nozzle and carriage connected to one and releasably engaging the other, said member being advanceable to move the nozzle

to cleaning position and retractible to a position where it permits the nozzle to have free movement to its elevated position, and means controlled by the pressure in a portion of the cleaner where pressure is reduced upon obstruction of the nozzle for advancing and retracting said member.

3. A vacuum cleaner having a carriage, a nozzle mounted on said carriage for vertical movement from an elevated position where the air flow through the nozzle is substantially unobstructed to its cleaning position where the air flow is obstructed, a spring exerting an upward thrust on said nozzle sufficient to support the nozzle in its elevated position, nozzle lowering means comprising a thrust transmitting member interposed between the nozzle and carriage connected to one and releasably engaging the other, said member being advanceable to move the nozzle to its cleaning position and retractible to a position where it permits the nozzle to have free movement to its elevated position, and a fluid pressure operated actuator for advancing and retracting said member, said actuator being connected to a portion of the cleaner where the pressure is above atmospheric and where the pressure is reduced by obstruction of air flow through the nozzle, yieldable means for holding said actuator in retracted position and for returning the same to retracted position, said holding means being yieldable to permit advancement of the actuator under a pressure greater than that existing in said portion of the cleaner when the nozzle is in cleaning position but less than that existing in said portion when the nozzle is unobstructed.

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