Nov. 19, 1935. A. A. FORSBERG 2,021,298

VACUUM CLEANER

Filed Feb. 25, 1933 2 Sheets-Sheet 1

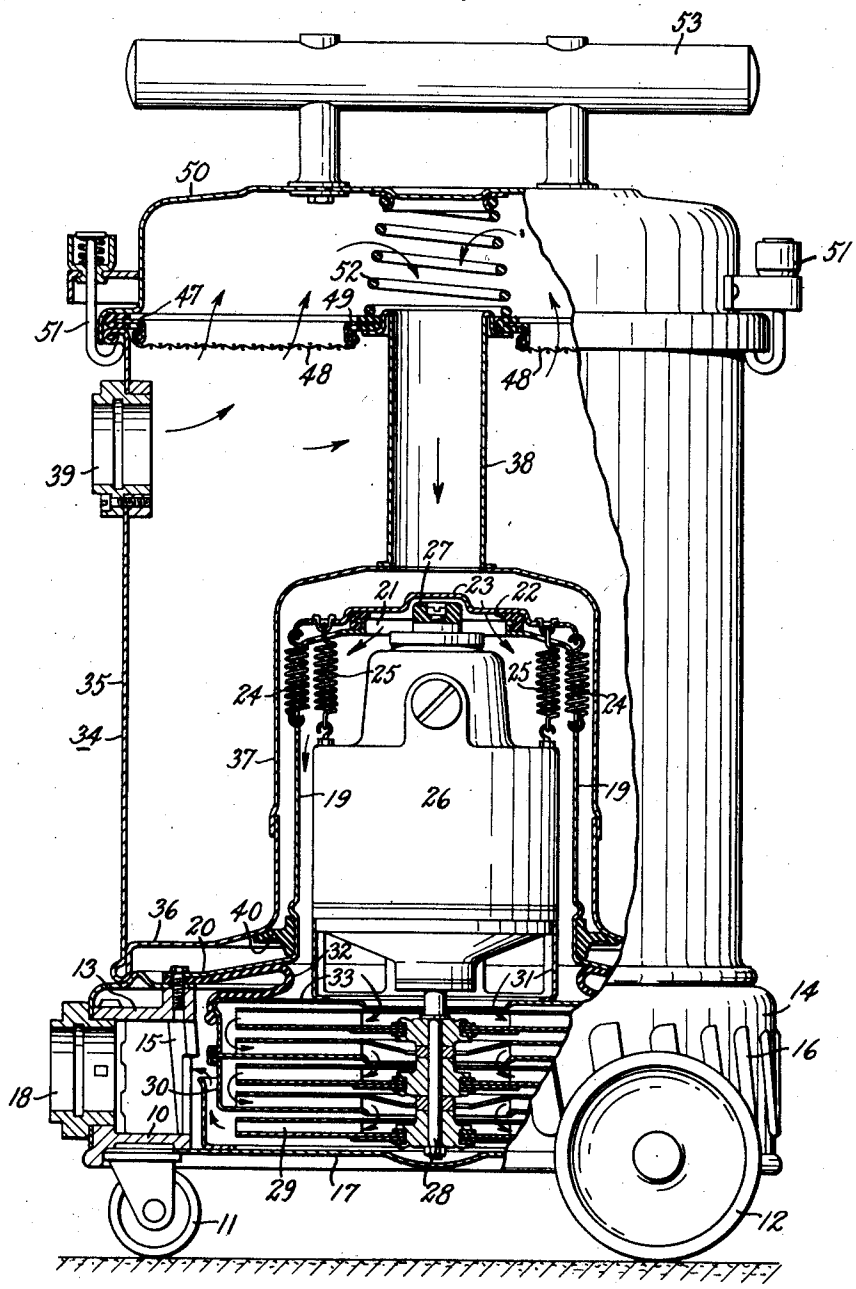


Fig. 1.

INVENTOR
Axel Albert Forsberg
BY
Wm. J. Hedlund
his ATTORNEY

Nov. 19, 1935. A. A. FORSBERG 2,021,298

VACUUM CLEANER

Filed Feb. 25, 1933 2 Sheets-Sheet 2

Fig.2.

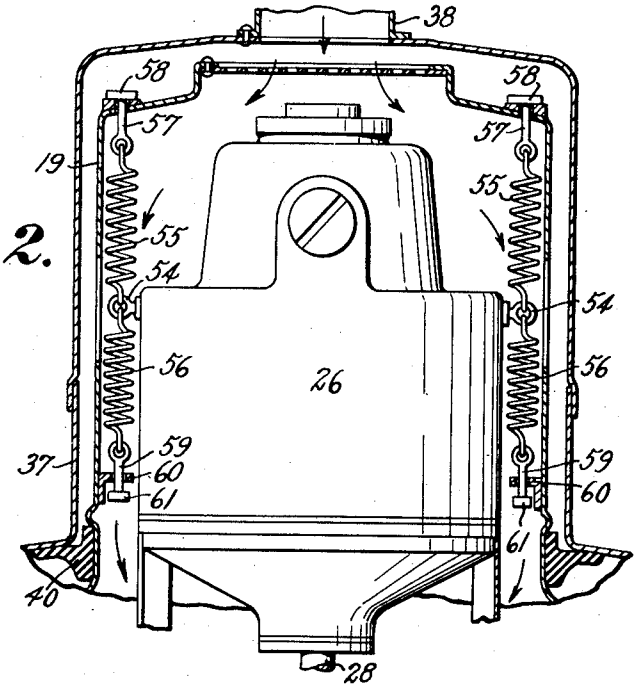
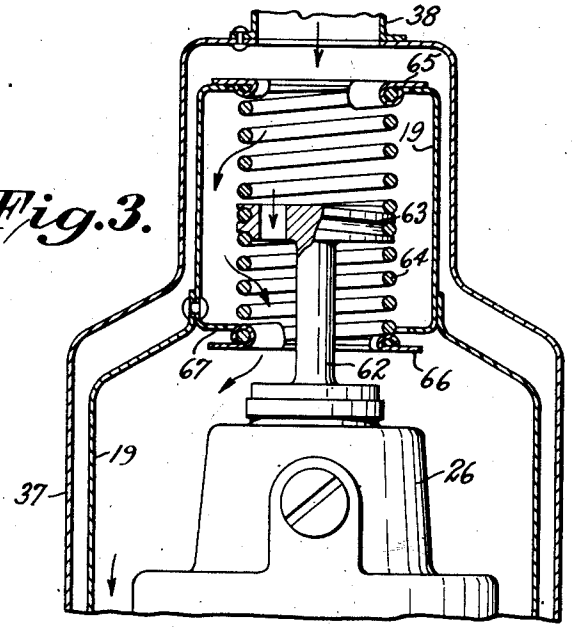


Fig.3.



INVENTOR
Axel Albert Forsberg
BY
Wm T. Hedlund
his ATTORNEY

Patented Nov. 19, 1935 2,021,298

UNITED STATES PATENT OFFICE

2,021,298

VACUUM CLEANER

Axel Albert Forsberg, Stockholm, Sweden, assignor to Electrolux Corporation, Dover, Del., a corporation of Delaware

Application February 25, 1933, Serial No. 658,608
In Germany March 14, 1932

17 Claims. (Cl. 183—37)

My invention relates to vacuum cleaners and particularly to means for reducing the noise and vibration in a vacuum cleaner having a vertically arranged motor-fan unit.

In a vacuum cleaner wherein the motor-fan unit is arranged vertically and the air is drawn in at the top of the fan and expelled from the bottom thereof, there are two oppositely directed forces acting on the unit when the latter is in operation. First, there is the weight of the unit which acts vertically downwardly and is constant. Second, there is the force resulting from the air pressure difference created by the fan which, with the direction of flow as described, acts vertically upwardly. This second force varies with variations in the suction produced by the fan, which, although the fan speed is constant, is caused to vary by changes in the resistance to flow of the air. Such a change occurs, for instance, when the nozzle or other cleaning implement is removed from a surface being cleaned. Slighter changes occur almost constantly during the operation of the cleaner as the cleaning implement is moved over such surface. These changes, which affect the forces acting on the motor-fan unit, cause the latter to vibrate and thus to produce noise.

In accordance with my invention I propose to support the motor-fan unit within a casing in such manner that the air pressure difference created by the fan lifts the unit, and I resist such upward movement of the unit by resilient means. Hence, the motor-fan unit floats, so to speak, in the air stream produced by the fan and is able to move vertically upon changes of the suction effect produced by the fan, without such movement being communicated to the casing of the vacuum cleaner. Hence, substantially all of the vibration is confined to the motor-fan unit, which results in a quieter operation of the vacuum cleaner.

Further objects and advantages of my invention will be apparent from the following description considered in connection with the accompanying drawings, which form a part of this specification and on which:

Fig. 1 is an elevational cross-sectional view of a vacuum cleaner including one embodiment of my invention;

Fig. 2 is a cross-sectional view of a portion of the vacuum cleaner similar to that shown in full in Fig. 1, but including another embodiment of my invention; and

Fig. 3 is a cross-sectional view of a portion of a vacuum cleaner similar to that shown in full in Fig. 1, but including a third embodiment of my invention.

Referring more particularly to Fig. 1, reference character 10 designates an annular base member provided with a caster 11 and a pair of small wheels 12 for supporting it on a surface. A second annular member 13 is spaced above member 10 by means of an outer cylindrical member 14 and an inner cylindrical member 15. Member 14 is provided with louver openings 16 for the discharge therethrough of air. A circular plate 17 is supported by member 10 and serves to close the circular opening in annular member 10. A hose coupling member 18 is secured in cylindrical member 14 and is provided for the connection thereto of a hose or the like when it is desired to use the apparatus for blowing.

A motor casing 19 is provided with a lower annular flange 20 which is supported by and secured to member 13. The upper part of casing 19 is provided with an opening 21 which serves as an inlet for air. A ring-shaped cushion of rubber, leather or other similar material 22 is secured around the periphery of opening 21. A rigid yoke member 23 is adapted to rest on cushion 22. A plurality of springs 24 are secured at their upper ends to the extremities of yoke 23 and at their lower ends to casing 19. In the embodiment shown, the casing is provided with vertical slots in which the springs 24 are located and with apertures below the lower ends of the slots to receive the lower ends of the springs. The various parts are so dimensioned that, when the yoke 23 is resting on cushion 22, the springs 24 are stressed very slightly, if at all.

A plurality of springs 25 are secured to yoke 23 and extend through openings formed in the top of casing 19. The lower ends of springs 25 are suitably secured to the frame of an electric motor 26, the axis of which is arranged to extend in a vertical direction. The upper end of the motor is provided with a cushion member 27 of rubber, leather or the like. Springs 25 are so designed that, when placed under tension due to the weight of the motor unit, there is a space between cushion 27 and that portion of yoke 23 which is directly above it, and that, when the motor is moved up, as will be described later, so that cushion 27 contacts yoke 23, springs 25 are under little or no tension.

The motor 26 is provided with an armature shaft 28 to which is secured for rotation therewith a centrifugal fan 29 comprising, in the embodiment shown, three rotors. A fan housing 30 is secured to the motor housing by means of brackets 31 and serves to enclose all except the lowermost rotor of the fan. Motor 26, fan 29 and housing 30 comprise what may be termed a motor-fan unit. A flexible sealing member 32 of generally annular configuration is secured to the upper part of fan housing 30 and to casing 19. This sealing member prevents the back flow of air from the discharge of the fan to the intake thereof and makes possible the existence of different pressures on either side of the sealing

member. It will be noted that the upper surface 33 of the fan housing, bounded by sealing member 32, is greater than the cross-sectional area of the air inlet 21. If the upper part of the fan housing were not horizontal but, for instance, cone shaped, it would be the projection of this surface on a horizontal plane which should be greater than the inlet opening 21. It is this horizontal area of the fan housing against which the air pressure difference created by the fan acts to raise the motor-fan unit. In order that the force so produced shall be sufficient to overcome the weight of the motor-fan unit, the respective areas are preferably proportioned as above described.

A dust receiving receptacle 34 comprises an outer cylindrical part 35, a lower annular portion 36 and an inner cylindrical portion 37 connected to a conduit 38. Cylindrical portion 37 surrounds motor casing 19. An inlet opening 39 is provided near the upper part of dust receptacle 34 and is adapted to receive a hose or the like leading from a suitable cleaning implement. Receptacle 34 is supported on an inturned portion of cylindrical member 14 and on a packing 40 secured to casing 19. Packing 40 comprises a ring of rubber or the like and effects an air-tight seal.

The upper end of conduit 38 is in the plane of the upper end of the outer cylindrical portion 35 of receptacle 34. The upper edge of cylindrical portion 35 is formed with an out-turned flange upon which rests a ring 47 provided with a packing ring of rubber or the like so as to provide an air-tight seal. Ring 47 carries a circular dust separating member 48 made of cloth which is pervious with respect to air but prevents the passage therethrough of dust particles. The center of member 48 is provided with an opening surrounded by a ring 49 adapted to rest on the flanged upper end of conduit 38. Ring 49 is provided with a packing ring of rubber or the like in order to effect an air-tight seal. A cover member 50 rests upon ring 47 and clamps it against flange 46. Cover member 50 is held in place by means of catch members 51. A spiral spring 52 is secured to the center of cover member 50 and serves to hold ring 49 against the flanged top of conduit 38. A suitable handle 53 is secured to the top cover member 50.

The dust separating member 48 per se constitutes no part of the present invention and may be replaced by any other suitable dust separating member, such, for instance, as that shown in application Serial No. 594,181 of Tom C. Bieth, filed February 20, 1932, which has since matured into Patent No. 1,946,665 dated Feb. 13, 1934.

The operation of the above described device is as follows:

When the motor and fan are not rotating the weight of the motor-fan unit is carried by springs 25 which, when under tension caused by such weight, supports the cushion 27 on the top of motor 26 a short distance below yoke 23. When the fan is rotated it creates a partial vacuum in the chambers communicating with the inlet of the fan. This causes air to flow inwardly through the cleaning implement and hose attached to inlet opening 39 and, if the cleaning implement is moved over a dusty surface, this air is laden with dust. The dust thus introduced into receptacle 34 is deposited within the receptacle while the air itself passes upwardly through dust separating member 48 and into cover member 50. From here the air passes downwardly through conduit 38, through opening 21 to within the motor casing and thence to the inlet of the fan housing. The fan discharges the air into the space between cylindrical members 14 and 15 and the air escapes through louver openings 16.

There is thus produced in the motor casing a partial vacuum, while the air outside of the fan housing is under somewhat greater than atmospheric pressure. This air pressure difference tends to raise the entire motor-fan unit until cushion 27 strikes yoke 23. Under these conditions springs 25 are under little or no tension. Further upward movement of the motor-fan unit, caused by this air pressure difference, lifts yoke 23 upwardly from ring 22 against the resistance offered by springs 24. The motor-fan unit comes to rest at such a point that this upward force is balanced by the tension of springs 24. The motor-fan unit is thus floating, so to speak, in the air stream produced by the fan.

The greater the resistance to flow of air into the vacuum cleaner, the greater will be the suction effect produced by the fan, and hence the greater will be the air pressure difference. As the cleaning implement is moved over the surface to be cleaned, this resistance to flow varies. This causes the upward force acting on the motor-fan unit to vary, which in turn causes the unit to move up and down, but this movement will not be communicated to the casing or other stationary parts of the vacuum cleaner. Any vibration produced in the motor-fan unit will be absorbed in the springs and not communicated to the rest of the cleaner.

Inasmuch as the springs 25 are ineffective during the operation of the cleaner, these springs could be replaced with nonelastic members for rigidly securing the motor to the yoke 23. However, during starting and before sufficient air pressure difference has been built up to lift the motor unit, vibration would be communicated to the stationary parts of the vacuum cleaner, wherefore it is preferred to employ resilient means to support the motor from yoke 23.

In the modification shown in Fig. 2, the frame of motor 26 is provided with eyes 54, or other suitable means to which may be secured the ends of springs 55 and 56. The lower ends of springs 55 are secured to eyes 54 while the upper ends of these springs are secured to pins 57 which extend through openings in casing 19 and are provided at their upper ends with enlarged portions 58. The upper ends of springs 56 are secured to eyes 54 while the lower ends are secured to pins 59 which extend through openings in an annular ring 60 carried by casing 19. The lower ends of pins 59 are provided with enlarged portions 61.

In this modification, when the motor and fan are not operating, the motor-fan unit is suspended from casing 19 by means of springs 55. Under these conditions springs 56 are unstressed and pins 59 hang loosely in the openings in ring 60. When the fan is operated and the resultant air pressure difference moves the motor-fan unit upwardly, springs 55 become unstressed and pins 59 move upwardly through the openings in ring 60 until the enlarged portion 61 abuts against the underside of the ring, whereafter further upward movement of the unit is resisted by springs 56, which are thus stressed. Under these conditions, the motor-fan unit is floating in the air stream produced by the fan and is connected to the stationary parts of the cleaner only through the stressed springs 56.

In the embodiment shown in Figs. 1 and 2 there

have been shown one pair of springs for supporting the motor-fan unit when not in operation and one pair of springs for resisting upward movement of the unit when in operation. Obviously, instead of employing pairs of springs, there can be used springs in sets of three or any desired number distributed equidistant around the periphery of the motor.

In the modification shown in Fig. 3 a single spring is employed for both supporting the weight of the motor when not operating and for resisting the upward movement of the motor-fan unit when operating. In this embodiment the motor **26** is provided at its upper end with an extension **62**. The upper end of extension **62** is provided with an enlarged flanged member **63** which is adapted to engage a spring **64** intermediate of the ends of the spring. The upper end of spring **64** is secured to a flanged member **65** which is adapted to rest on the upper end of casing **19**. The lower end of spring **64** is secured to a flanged member **66** which is adapted to abut against a flange **67** carried by casing **19**.

When the motor-fan unit is not operating it is supported by the upper part of spring **64** acting through flange **65** which rests upon the top of casing **19**. Under these conditions, the lower part of spring **64** is not under stress and flange **66** is some distance below flange **67**. When the air pressure difference created by the fan overcomes the weight of the motor-fan unit and moves the latter vertically upwardly, the upper part of spring **65** becomes unstressed at substantially the same time that flange **66** strikes flange **67**. Further upward movement of the unit is resisted by the lower portion of spring **64** which is now placed under tension. Under these conditions the motor-fan unit is floating in the air stream produced by the fan and the only connection between the unit and the rest of the cleaner is through the lower part of spring **64**.

In all of the modifications it will be noted that the springs are either not stressed or are under tension. None of the springs are ever under compression. Due to this fact, no means are necessary to prevent the springs from buckling, as they would do if they were subjected to force of compression.

While I have described three preferred embodiments of my invention, these have been selected for purposes of illustration only and my invention is not to be limited thereto, but its scope is to be determined by the appended claims viewed in the light of the prior art.

What I claim is:

1. In a vacuum cleaner, a motor-fan unit comprising an electric motor having a vertically extending armature shaft and a fan mounted on said shaft, means for supporting said unit so as to permit upward movement of said unit due to the air pressure difference created by said fan, and resilient means for resisting said upward movement.

2. In a vacuum cleaner, a motor-fan unit comprising an electric motor having a vertically extending armature shaft and a fan mounted on said shaft, resilient means for supporting said unit so as to permit upward movement of said unit due to the air pressure difference created by said fan, and resilient means for resisting said upward movement.

3. In a vacuum cleaner, a stationary casing, a motor-fan unit comprising an electric motor within said casing and having a vertically extending armature shaft and a fan mounted on said shaft, means for supporting said unit from said casing so as to permit upward movement of said unit with respect to said casing due to the air pressure difference created by said fan, and resilient means reacting between said casing and said unit for resisting said upward movement.

4. In a vacuum cleaner, a stationary casing, a motor-fan unit comprising an electric motor within said casing and having a vertically extending armature shaft and a fan mounted on said shaft, means for resiliently supporting said unit from said casing so as to permit upward movement of said unit with respect to said casing due to the air pressure difference created by said fan, and resilient means reacting between said casing and said unit for resisting said upward movement.

5. In a vacuum cleaner, a stationary casing, a motor-fan unit comprising an electric motor within said casing and having a vertically extending armature shaft and a fan mounted on said shaft, a rigid member supported by said casing so as to be movable in a vertical direction, means for supporting said unit from said member, and resilient means between said casing and said member for resisting upward movement of said member.

6. In a vacuum cleaner, a motor-fan unit comprising an electric motor within said casing and having a vertically extending armature shaft and a fan mounted on said shaft, a rigid member supported by said casing so as to be movable in a vertical direction, resilient means for suspending said unit from, and in spaced relationship below, said member whereby upward movement of said unit due to the air pressure difference created by said fan causes said unit to abut against said member, and resilient means between said casing and said member for resisting upward movement of said member.

7. In a vacuum cleaner, a stationary casing having an air inlet opening in the upper part thereof, a motor-fan unit comprising an electric motor within said casing having a vertically extending armature shaft, a fan mounted on said shaft and a housing around said fan and supported by said motor, flexible sealing means between said housing and said casing, the projected area on a horizontal plane of said housing being greater than the cross-sectional area of said inlet opening, means for supporting said unit from said casing so as to permit upward movement of said unit with respect to said casing due to the air pressure difference created by said fan, and resilient means reacting between said casing and said unit for resisting said upward movement.

8. In a vacuum cleaner, a stationary casing, a motor-fan unit comprising an electric motor within said casing and having a vertically extending armature shaft and a fan mounted on said shaft, resilient means secured at the upper end to said casing and at the lower end to said unit for supporting said unit, and resilient means secured at the upper end to said unit and at the lower end to said casing for resisting upward movement of said unit caused by the air pressure difference created by said fan.

9. In a vacuum cleaner, a stationary casing, a motor-fan unit comprising an electric motor within said casing and having a vertically extending armature shaft and a fan mounted on said shaft, a plurality of springs secured at their upper ends to said casing and at their lower ends to said unit for supporting said unit,

and a plurality of springs secured at their upper ends to said unit and at their lower ends to said casing for resisting upward movement of said unit caused by the air pressure difference created by said fan.

10. In a vacuum cleaner, a stationary casing, a motor-fan unit comprising an electric motor within said casing and having a vertically extending armature shaft and a fan mounted on said shaft, a plurality of springs secured at their lower ends to said unit and at their upper ends to said casing for supporting said unit, the upper ends of said springs having limited movement with respect to said casing, a plurality of springs secured at their upper ends to said unit and at their lower ends to said casing for resisting upward movement of said unit caused by the air pressure difference created by said fan, the lower ends of said last mentioned springs having limited movement with respect to said casing.

11. In a vacuum cleaner, a stationary casing, a motor-fan unit comprising an electric motor within said casing and having a vertically extending armature shaft and a fan mounted on said shaft, a spring secured intermediate of its ends to said unit, means secured to the upper end of said spring and adapted to rest on said casing for supporting said unit, and means secured to the lower end of said spring and adapted to abut against said casing for resisting upward movement of said unit caused by the air pressure difference created by said fan.

12. In a vacuum cleaner, a base portion, a dust receiving receptacle supported on said base portion, said receptacle formed with an annular lower part, a casing supported on said base portion and extending into the space surrounded by said annular lower part, a conduit extending upwardly from said space, means for causing air to flow into said conduit, said receptacle formed with an air inlet opening, a motor-fan unit comprising an electric motor within said casing having a vertically extending armature shaft and a fan mounted on said shaft, means for supporting said unit from casing so as to permit upward movement of said unit due to the air pressure difference created by said fan, and resilient means reacting between said casing and said unit for resisting said upward movement.

13. In a vacuum cleaner, a base portion, a dust receiving receptacle supported on said base portion, said receptacle formed with an annular lower part, a casing supported on said base portion and extending into the space surrounded by said annular lower part, a conduit extending upwardly from said space, means for causing air to flow into said conduit, said receptacle formed with an air inlet opening, a motor-fan unit comprising an electric motor within said casing having a vertically extending armature shaft and a fan mounted on said shaft, resilient means for supporting said unit from said casing so as to permit upward movement of said unit due to the air pressure difference created by said fan, and resilient means reacting between said casing and said unit for resisting said upward movement.

14. In a vacuum cleaner, a base portion, a dust receiving receptacle supported on said base portion, said receptacle formed with an annular lower part, a casing supported on said base portion and extending into the space surrounded by said annular lower part, a conduit extending upwardly from said space, means for causing air to flow into said conduit, said receptacle formed with an air inlet opening, a motor-fan unit comprising an electric motor within said casing having a vertically extending armature shaft, a fan mounted on said shaft and a housing around said fan and supported by said motor, flexible sealing means between said housing and said casing, means for supporting said unit from said casing so as to permit upward movement of said unit due to the air pressure difference on either side of said sealing member created by said fan, and resilient means reacting between said casing and said unit for resisting said upward movement.

15. A vacuum cleaner comprising a dust collecting receptacle having impermeable walls and having a passageway extending through the same, a casing within a part of said passageway, a motor-fan unit comprising an electric motor in said casing having a vertically extending armature shaft and a fan mounted on said shaft to draw air through said passageway, means to admit air to said receptacle, a cover removably secured to said receptacle and serving to direct air from within said receptacle to said passageway, means for supporting said unit from said casing so as to permit upward movement of said unit due to the air pressure difference created by said fan, and resilient means reacting between said casing and said unit for resisting said upward movement.

16. A vacuum cleaner comprising a dust collecting receptacle having impermeable walls and having a passageway extending through the same, a casing within a part of said passageway, a motor-fan unit comprising an electric motor in said casing having a vertically extending armature shaft, a fan mounted on said shaft to draw air through said passageway and a housing around said fan supported by said motor, means to admit air to said receptacle, a cover removably secured to said receptacle and serving to direct air from within said receptacle to said passageway, flexible sealing means between said housing and said casing, means for supporting said unit from said casing so as to permit upward movement of said unit due to the air pressure difference on either side of said sealing means created by said fan, and resilient means reacting between said casing and said unit for resisting said upward movement.

17. A vacuum cleaner comprising a dust collecting receptacle having impermeable walls and having a passageway extending through the same, a casing within a part of said passageway, a motor-fan unit comprising an electric motor in said casing having a vertically extending armature shaft, a fan mounted on said shaft to draw air through said passageway and a housing around said fan supported by said motor, means to admit air to said receptacle, a cover removably secured to said receptacle and serving to direct air from within said receptacle to said passageway, flexible sealing means between said housing and said casing, resilient means for supporting said unit from said casing so as to permit upward movement of said unit due to the air pressure difference on either side of said sealing means created by said fan, and resilient means reacting between said casing and said unit for resisting said upward movement.

AXEL ALBERT FORSBERG.