June 23, 1936. F. CARLSTEDT 2,044,830

VACUUM CLEANER

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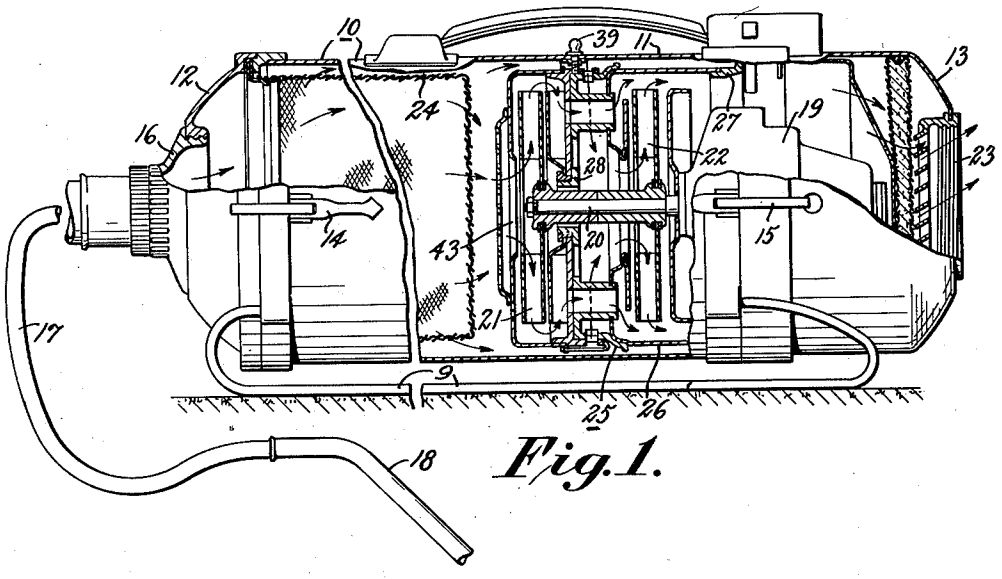


Fig. 1.

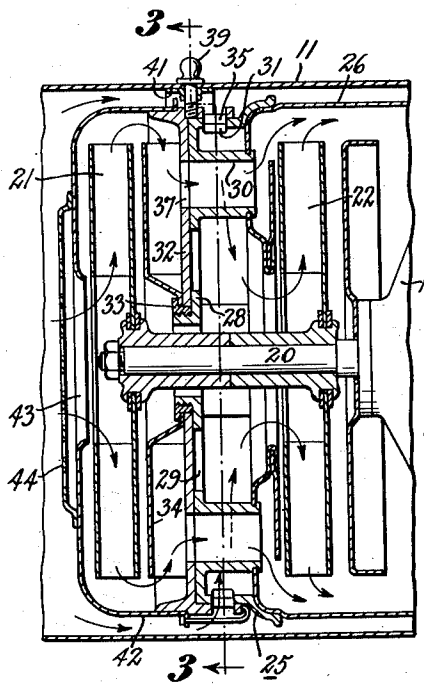


Fig. 2.

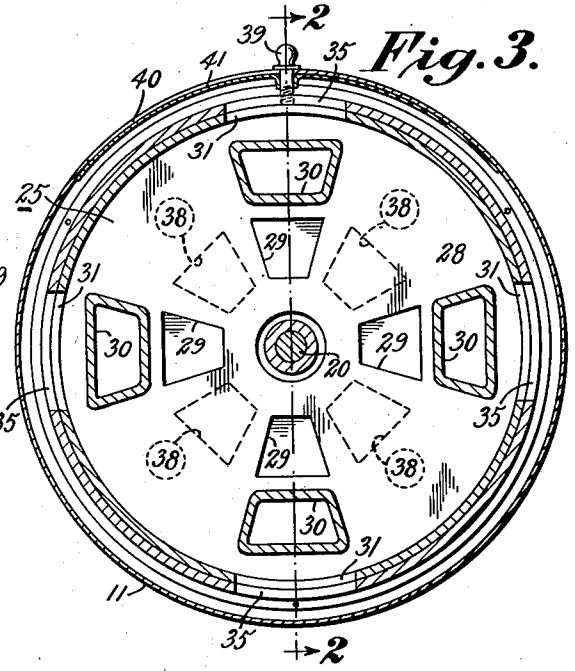


Fig. 3.

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Fig. 4.

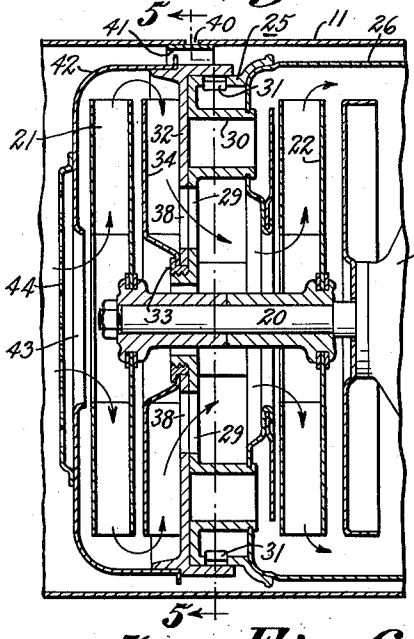


Fig. 5.

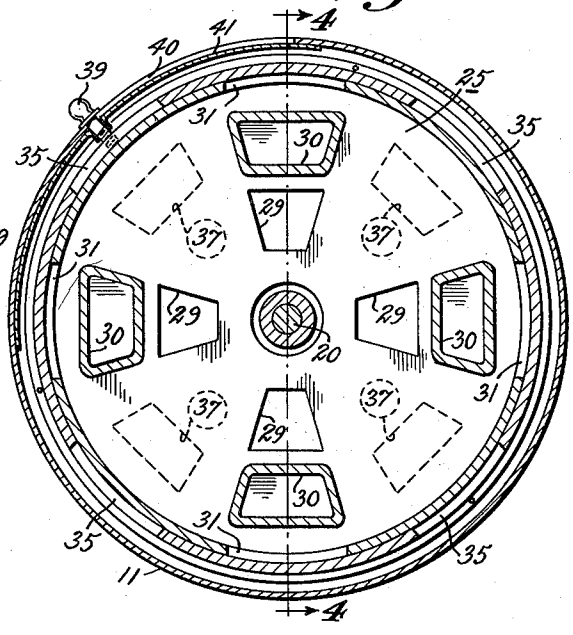


Fig. 6.

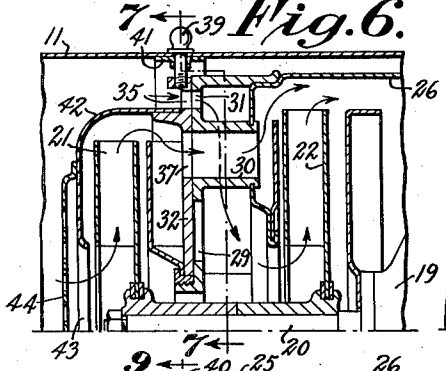
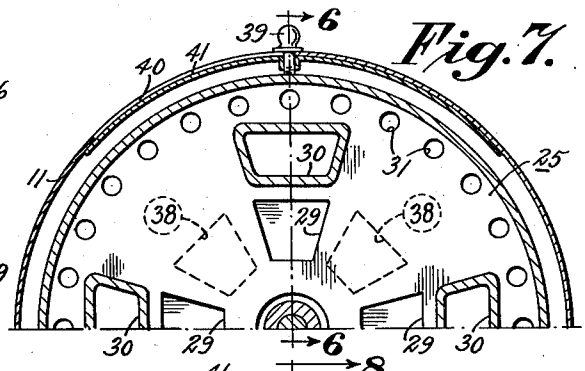


Fig. 7.



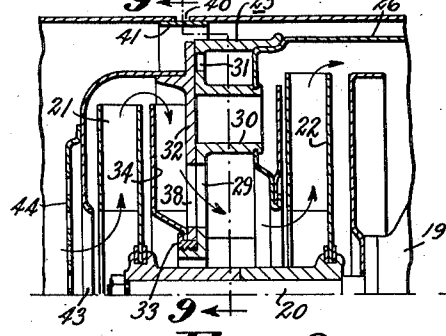
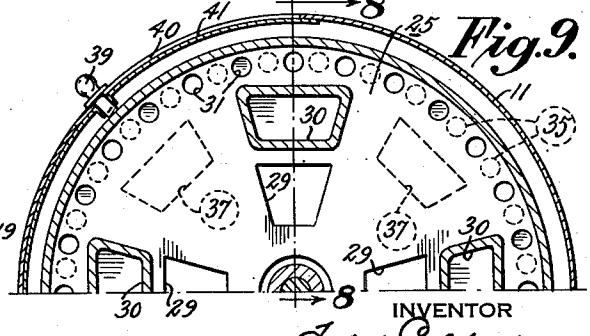


Fig. 8.

Fig. 9.



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Fig. 10.

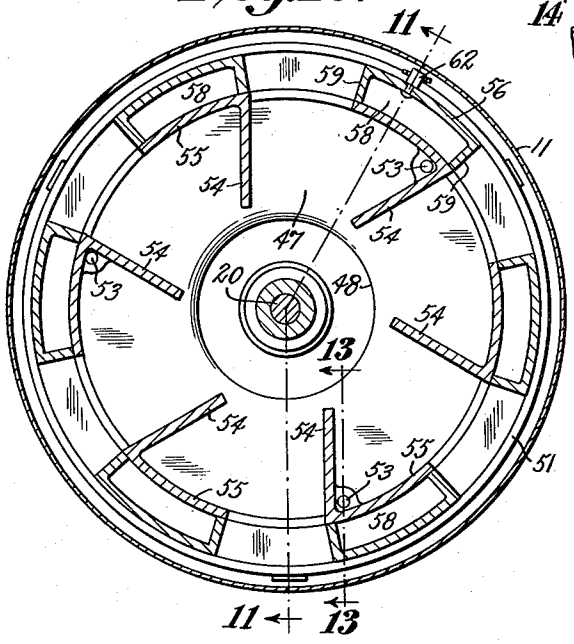


Fig. 11.

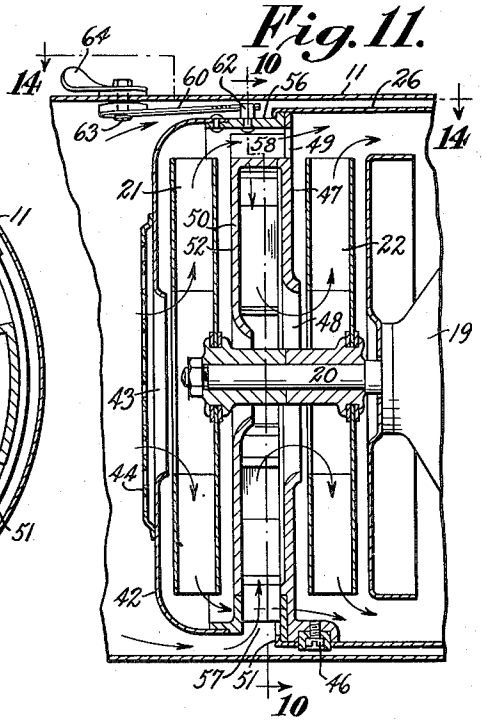


Fig. 12.

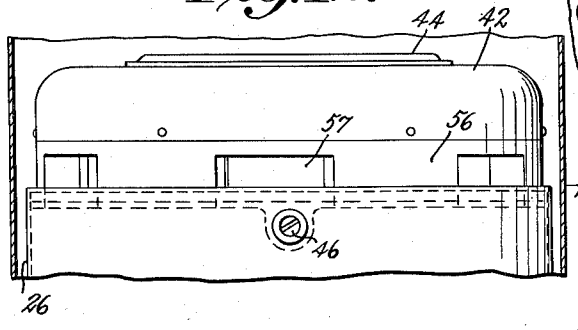


Fig. 14.

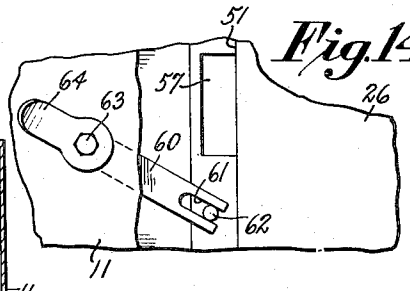


Fig. 15.

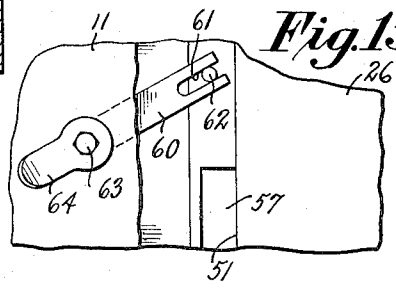
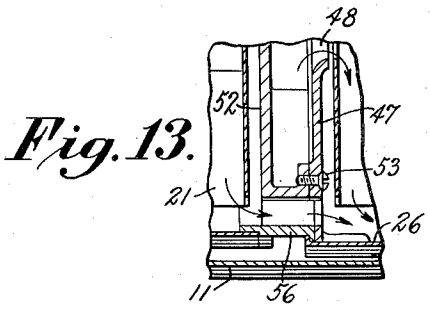


Fig. 13.



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Fig. 16.

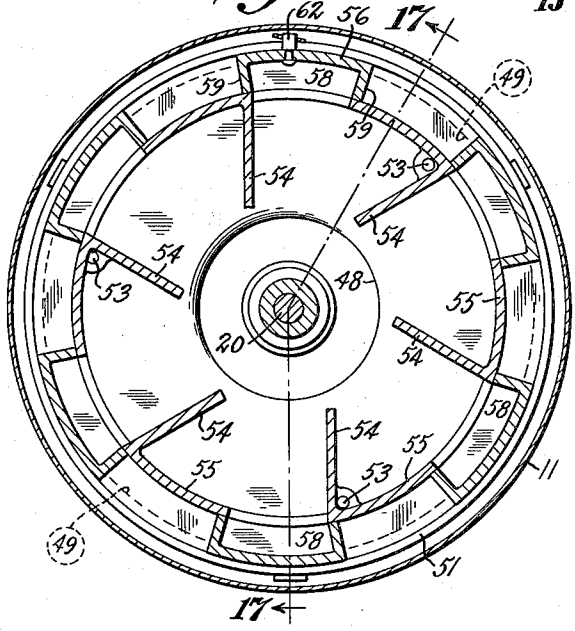


Fig. 17.

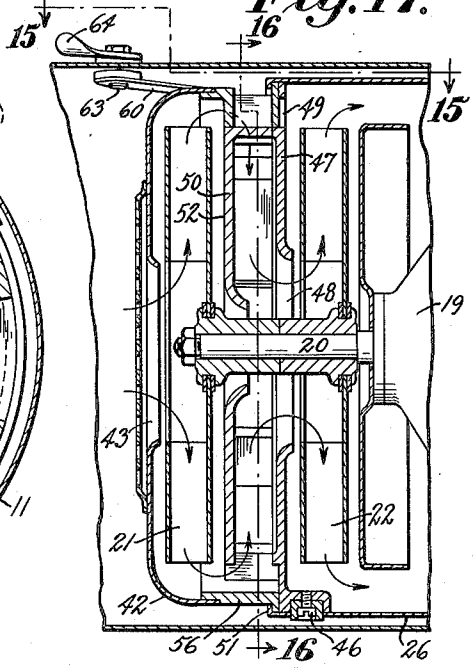
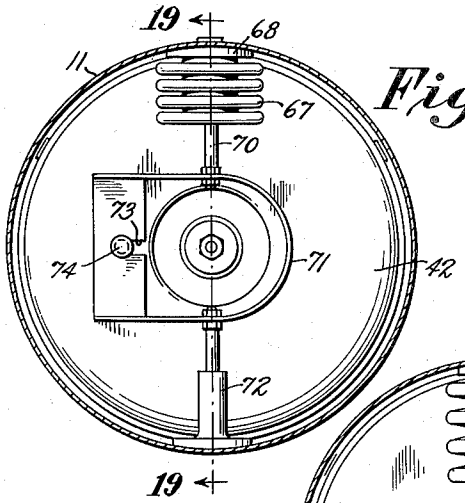


Fig. 18.



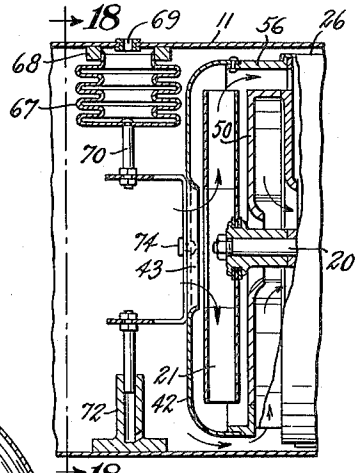


Fig. 19.

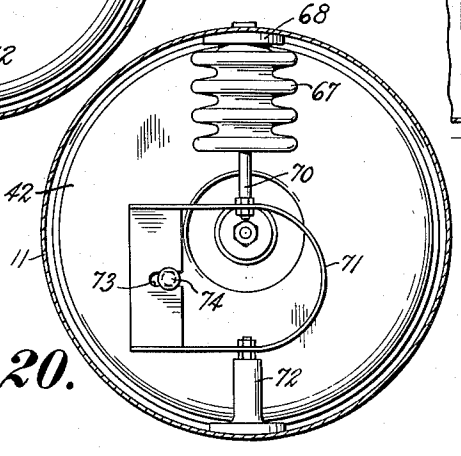


Fig. 20.

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Fig. 21.

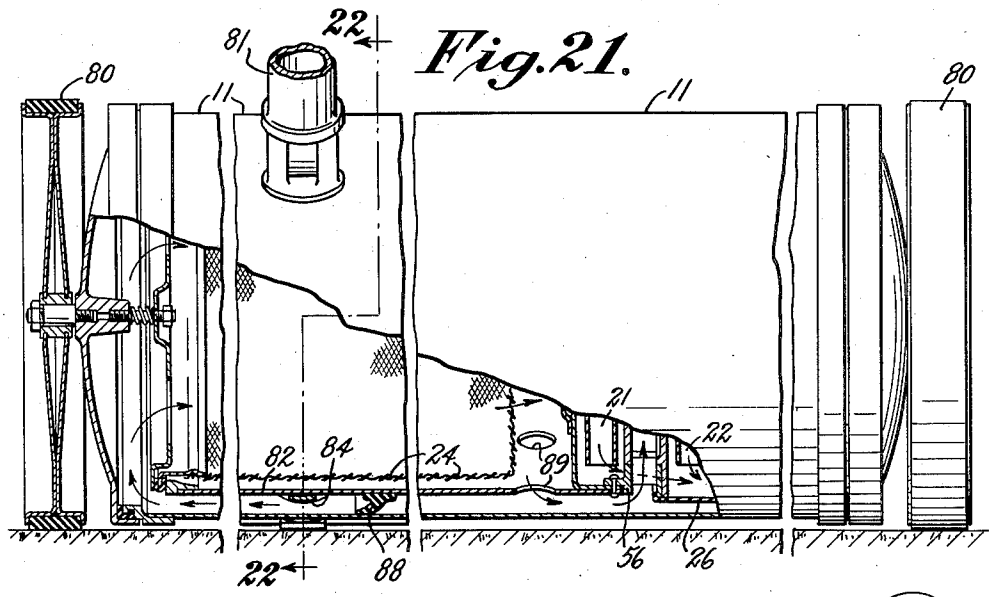


Fig. 23.

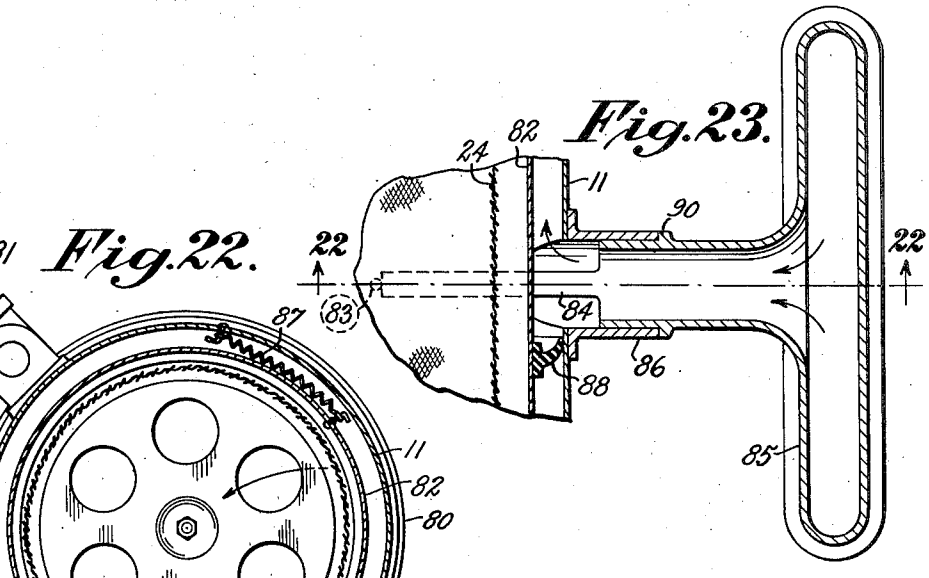


Fig. 22.

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Fig. 24.

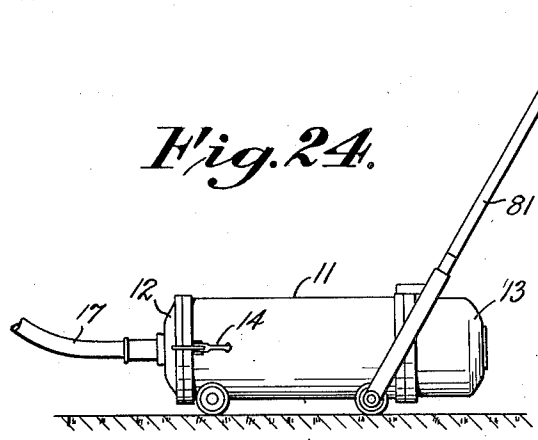


Fig. 25.

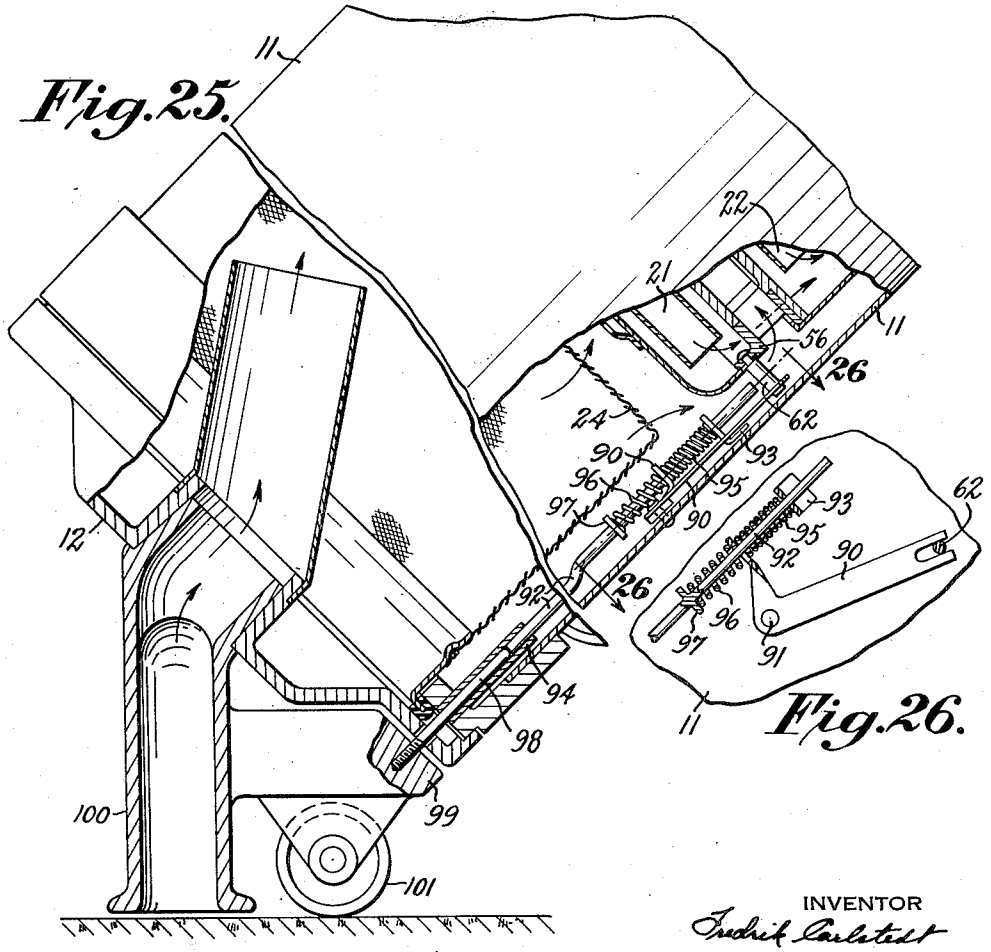


Fig. 26.

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Patented June 23, 1936

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UNITED STATES PATENT OFFICE

2,044,830

VACUUM CLEANER

Fredrik Carlstedt, Stockholm, Sweden, assignor to Electrolux Corporation, Dover, Del., a corporation of Delaware

Application February 9, 1934, Serial No. 710,421
In Germany July 8, 1933

10 Claims. (Cl. 15—16)

In the use of vacuum cleaners, different conditions of cleaning make it desirable to have different conditions of vacuum cleaner action. For example, in cleaning overstuffed furniture, tapestries or the like, a high vacuum is desirable, while in cleaning a smooth floor, a large quantity of air is more desirable. In the first case, a high suction serves to draw air through the cloth or the like and to take up threads and the like attached to the fabric. A high vacuum is not necessary in cleaning a floor, but a large air quantity at lower pressure differential suffices and permits cleaning a given area in a quicker time. When using the cleaner for tapestries and the like the nozzle is preferably connected with the cleaner unit by means of a hose and possibly a hollow steel tube. In cleaning a smooth floor, it is desirable to use large nozzles, which are directly connected to the cleaner without the hose.

The present invention has for its principal object to efficiently accomplish both the foregoing types of cleaning in one and the same apparatus and more particularly to provide mechanism for altering the flow of air through a plurality of air impellers so that the flow may be in parallel or in series; parallel flow corresponding to the larger quantity of air at lower pressure, and series flow corresponding to lower volume of air at higher suction.

The invention will be more clearly understood by reference to the accompanying drawings illustrating the invention and forming a part of this specification and of which:

Fig. 1 is an elevational view principally in cross section of a vacuum cleaner embodying the invention;

Fig. 2 is a similar view on an enlarged scale of part of the apparatus shown in Fig. 1;

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

Fig. 4 is a view similar to Fig. 2 but showing the parts in a different position;

Fig. 5 is a sectional view taken on the line 5—5 of Fig. 4;

Fig. 6 is a view of part of a modified embodiment of the invention shown in vertical sectional elevation;

Fig. 7 is a sectional view taken on the line 7—7 of Fig. 6;

Fig. 8 is a view similar to Fig. 6 showing parts in different relative positions;

Fig. 9 is a transverse sectional view taken on the line 9—9 of Fig. 8;

Fig. 10 is a transverse sectional view taken on the line 10—10 of Fig. 11 and showing still another form of the invention;

Fig. 11 is a sectional view taken on the line 11—11 of Fig. 10;

Fig. 12 is a top view of the mechanism shown in Figs. 10 and 11;

Fig. 13 is a sectional view of a part of this embodiment;

Figs. 14 and 15 show different positions of an actuating mechanism, Fig. 14 being taken on the line 14—14 of Fig. 11;

Fig. 16 is a view similar to Fig. 10 but showing the parts in different relative positions;

Fig. 17 is taken on the line 17—17 of Fig. 16;

Fig. 18 is a transverse sectional view taken on the line 18—18 of Fig. 19 and showing an automatic mechanism for changing the relation of parts in the apparatus;

Fig. 19 is a view taken on the line 19—19 of Fig. 18;

Fig. 20 is similar to Fig. 18 and shows a different relative position of parts;

Fig. 21 shows still another embodiment of the invention, the view being partly cut away to show an elevational cross-section;

Fig. 22 is a transverse sectional view taken on the line 22—22 of Fig. 21;

Fig. 23 is a horizontal sectional view taken on the line 23—23 of Fig. 22;

Fig. 24 is an elevational view of another embodiment of the invention;

Fig. 25 is a view partly in section of the apparatus shown in Fig. 24; and

Fig. 26 is a cross-sectional view taken on the line 26—26 of Fig. 25.

Referring to the embodiment shown in Figs. 1 to 5, the vacuum cleaner includes a main cleaner unit 10 comprising a cylindrical barrel 11, to which are attached end members 12 and 13 secured to the barrel portion of the cleaner unit by any suitable means such as spring clips 14 and 15. The unit may be horizontally mounted by means of runners 9. A coupling member 16 screws into the end cap 12 and serves for a connection with a hose 17 adapted to be connected to a cleaning tool or nozzle. A steel tube or wand 18 may be interposed between the nozzle and the hose. In the casing of the cleaner unit formed by the barrel 11 and the end caps 12 and 13 is a motor 19, preferably resiliently mounted. The motor has a shaft 20 on which are mounted a forward fan impeller 21 and a rear fan impeller 22. The fan impellers preferably are of the turbine type having blades disposed between parallel discs.

Operation of the motor serves to rotate the fan impellers and thereby draw air through the hose 17 and through the casing in the direction of the arrows and out through the outlet 23. Disposed in the casing and held in place by end cap 12 is a dust-bag 24 of air-pervious but dust-impervious material.

Disposed between the forward and rear fan impellers 21 and 22 is a partition member designated generally by reference numeral 25. Partition member 25 is secured to a housing 26 which surrounds the motor and rear fan impeller 22 and which may be attached to an insulation ring 27 on which the motor is resiliently mounted. It will be understood that the casing or housing member 26 is preferably fixed with respect to the barrel 11. Partition member 25 has a front wall 28. Wall 28 is centrally apertured for the passage of shaft 20. Radially outward therefrom is a series of openings 29. Radially outward from the openings 29 is a plurality of rearwardly extending passageways 30 formed in box-like extensions which are secured to the member 26. The peripheral part of the member 25 is provided with apertures 31. The openings 29, the passageways 30 and the apertures 31 correspond in number.

Rotatably mounted on member 25 is a disc member or valve member 32. A flanged nut or the like 33 holds the disc member 32 and an attached plate member 34 rotatably against the member 25. The valve disc 32 overlaps the member 25 peripherally and is provided with peripheral opening 35 which are adapted to register with the apertures 31. Valve disc 32 is provided with apertures 37 adapted to register with passageways 30 and apertures 38 adapted to register with openings 29. The apertures 37 and 38 are radially out of alignment so that when the apertures 37 register with the passages 30 the openings 29 and 38 are shut; and when openings 29 and 30 register the openings 37 and passages 30 are closed. A manipulating knob 39 extends through the casing 11 so as to be operable from the exterior of the cleaner, and is screwed into the rotatable disc member 32 and is adapted to move in a slot 40. In order to prevent leakage of air a shield 41 is provided which moves with the manipulating knob and closes the slot 40. A cover plate 42 is attached to disc member 32 and has a central aperture 43 for admission of air to the fan assembly covered by a shield 44 in the form of a perforated plate.

When it is desired to have a high vacuum, as when the hose 17 is connected and the cleaner is being used to clean overstuffed furniture, the manipulating knob is moved to the position shown in Fig. 5. In this position of the parts, the air flows in through the central aperture 43, is forced outwardly in the fan impeller 21 and thence passes inwardly between parts 34 and 32, through the aligned openings 38 and 29, across the inner chamber of the member 25, into the center of fan impeller 22 and is thrown outwardly in fan impeller 22 and past the motor to the outlet 23. Thus the air passes through the impellers in series and the suction effect of the fan impellers is additive.

When it is desired to have a greater flow of air but high vacuum is not essential, as when cleaning floors, the long hose is preferably omitted and a large nozzle may be used and the manipulating knob is moved to the position shown in Figs. 2 and 3. In this position, only part of the air flows in through central aperture 43 and into fan impeller 21, while the remainder flows outside hood 42 and in through the aligned apertures 31 and 35 and directly to the center inlet of the rear fan impeller 22. The air discharged from fan impeller 21 passes through openings 37 and passages 30 to the outlet of fan impeller 22. Thus, the air, which passes through fan member 21 does not pass through fan member 22; and the air passing through fan member 22 does not pass through fan member 21. In this position, the apertures 29 and 38 are out of alignment so that the series connection is blocked off. In the position shown in Figs. 4 and 5, the passages 30 are blocked off and the apertures 31 and 35 are not in alignment. In the position of Figs. 2 and 3, the air flows in parallel through the fan members and the quantity is large but the pressure differential is only that of one fan impeller.

In the apparatus shown in Figs. 6 to 9, corresponding parts to those of the previously described embodiment are similarly designated. The member 32 in this case is a flat disc and the apertures 35 are in the same plane as the apertures 37 and 38. The apertures 31 are on the plane part of the partition member 25. This apparatus operates in the same manner and the arrows show how the air passes in series through the fan members in Fig. 8 and in parallel in Fig. 6.

Figs. 10–17 show another embodiment of the invention. Rigidly attached to the fan housing 26, as by bolts 46, is a plate member 47 having a central aperture 48 for admitting air to the inlet of the rear fan impeller 22 and outwardly disposed apertures 49 for admitting air to the discharge side of fan impeller 22. Rigidly secured to plate 47 as by screws 53 is a member 50 having a forward circular wall 52 and rearwardly projecting angle pieces comprising radial parts 54 and peripheral parts 55. The radial parts 54 serve as guide vanes for conducting air to the inlet of fan impeller 22. Circumferentially disposed about member 50 is a rotatable member 56 guided by flange 51 on housing 26. Member 56 has a continuous peripheral wall apertured at 57 and inward projections 59, whereby passages 58 may be formed in the position of the parts shown in Figs. 10 and 11 communicating with apertures 49. The apertures 57 communicate with the spaces outside the fan assembly on the air inlet side. Attached to member 56 is a hood 42 having a central opening 43 for admission of air to the center of fan member 21. Member 56 is rotated by a lever 60 having a slot 61 in which a pin 62 slides, which pin is secured to member 56. The lever 60 is pivoted at 63 and moved by a handle 64 on the outside of the casing.

In the position of parts shown in Figs. 10, 11 and 14 the fan impellers are connected for parallel flow of air. Some of the air flows into the fan assembly through opening 43, passing outwardly through the forward fan impeller 21 and through the passages 58 and openings 49 to the outlet of fan member 22. The remainder of the air passes around the outside of hood 42 and inwardly through the openings 57, between the guide vanes 54 into the center of fan impeller 22, and outwardly therethrough to meet the air leaving the forward fan impeller.

If it is desired to couple the fan impellers in series, the handle 64 is turned to rotate member 56 to the position shown in Figs. 16 and 17. As shown in Fig. 16 the outer wall parts 56 together with the peripheral parts 55 completely close off the flow of air inwardly from around hood 42.

All the air must pass through the central inlet 43, and is carried outwardly in fan member 21 and thence passes within the partially formed passageways 58 which are now inwardly open due to the movement of the peripheral parts 55, thence inwardly between the vanes 54 and to the inlet of the fan member 22. In this position, the passageways 49 are blocked off by the back walls of the spaces 58.

In Figures 18, 19 and 20 is shown an automatic arrangement for rotating the member 56 shown in Figs. 10 to 17. Within the barrel 11 is a flexible bellows 67. The bellows is attached to a ring 68 secured to the inside of the casing, and the interior of the bellows is in communication with the outside atmosphere through an aperture 69. Attached to the closed bottom of the bellows is a spindle 70, to which is attached a member 71 guided in a device 72. Member 71 is formed with a slot 73 in which moves a pin 74 attached to the hood 42. So long as the pressure differential between the outside atmosphere and the intake to the fan is small, the bellows 67 is contracted. The bellows may have internal resiliency tending to contract it, or a spring may be used to contract the bellows. In this condition, the parts are in the position shown in Fig. 18 and the member 56 is so positioned as to provide for parallel flow through the fan impellers. Should the pressure differential increase, which is the condition when, for instance, a hose is attached to the cleaner or a small nozzle is tightly pressed against a surface to be cleaned, the free end of the bellows moves inwardly, thus moving the stem 70 downwardly and causing rotation of the pin 74 and member 56 so as to change the connection from parallel to series flow, thereby providing greater suction effect of the fan assembly.

If a graph were drawn showing operation of parallel and series connected fan members, showing pressure plotted against air quantity, the curves will cross each other. It is desirable that the automatic changeover take place substantially at the point where such curves cross.

Another embodiment of the invention is shown in Figs. 21–23. The barrel or casing member 11 is mounted on wheels 80. A handle 81 is provided for moving the cleaner over a floor or carpet. An inner casing 82 is provided within which is contained the dust bag 24. The fan assembly may be provided with the same valvular arrangement as is shown in Figs. 10–17. To move member 56, it is connected to the inner cage 82 and this cage is provided with a projection 83 engageable with an extension 84 on a nozzle 85 insertable in a nozzle connection 86. A spring 87 is attached to the outer casing and the movable cage 82 and tends to move the inner cage 82 in counter-clockwise direction as shown in 22. A packing 88 is provided between the nozzle opening and the fan assembly to prevent flow of air from the nozzle directly to member 56. Thus all the air entering through the nozzle must pass through the dust bag as shown by the arrows. Thereafter some of the air may pass out through openings 89 so as to pass inwardly through member 56 as shown in Fig. 11.

A hose insertable in connection 86 does not have a projection such as 84 and consequently the spring 87 holds the parts in position for series flow through the fan impellers. When, however, the nozzle 85 is inserted as when a floor is to be cleaned, the member 56 is rotated to the position wherein air passes through the fan impellers in parallel. A stop 90 is provided on the nozzle 85 to limit the movement for properly aligning the parts.

In the structure shown in Figs. 24 to 26, the invention is embodied in a cleaner of the general form shown in Fig. 1. The fan arrangement is substantially that shown in Figs. 10 to 17. The pin 62 is moved by a lever 90 pivoted to the casing 11 at 91 and operated in a manner analogous to the arrangement of Fig. 22. A rod 92 is mounted in a bracket 93 secured to casing 11 and in a plunger tube 94 so as to have longitudinal movement. Rod 92 passes through a hole in lever 90. A spring 95 surrounds rod 92 and is positioned between bracket 93 and lever 90. A spring 96 surrounds rod 92 and is positioned between lever 90 and a stop 97 on rod 92. The springs urge rod 92 toward the air inlet end of the cleaner and act as a resilient connection between it and lever 90. The plunger tube 94 is adapted to receive a plunger 98 attached to a leg 99 attached to nozzle 100. Leg 99 carries several wheels 101 for supporting the cleaner when tilted to the position shown in Fig. 25. Members 92 and 98 fit snugly in tube 94 to prevent leakage. The nozzle 100 is intended to work where large volume is preferable to high vacuum.

When the hose 17 is fitted into cap 12, there is no plunger 98. Consequently rod 92 is in forward position and pin 62 is moved from the position shown in Fig. 25 and the fan impellers are connected in series. When the large nozzle 100 is directly connected to the cleaner unit, the plunger 98 pushes the rod 92 rearwardly to the position shown in Fig. 25 and the fan impellers are connected for parallel flow of air.

While several embodiments of the invention have been disclosed, it will be obvious that other embodiments of the invention may be made. For example, more than two fan impellers may be provided and connected in series or in parallel. The greater the number of impellers the greater the difference in effect between series and parallel connection. What has been said with respect to a small nozzle plus hose as against a large nozzle without hose obviously applies to small nozzle with a long or narrow hose against large nozzle with short or wide hose.

I claim:

1. A vacuum cleaner comprising a casing, a motor in said casing, a plurality of fan impellers mounted to be driven by said motor, a partition between said impellers having a passage therethrough connecting the outlet of one fan impeller with the inlet of another fan impeller, a passage therethrough establishing communication between the outlets of the impellers and a passage therethrough establishing communication between the inlets of said impellers, and a valve disc for closing the first mentioned passage and opening the second and third mentioned passages and alternatively for opening the first mentioned passage and closing the second and third mentioned passages.

2. A vacuum cleaner comprising a casing having an air inlet, a nozzle connectible to said air inlet, a plurality of fan impellers in said casing, means alterable for connecting said impellers for series or parallel flow, and means operable by the connecting of said nozzle with said inlet to alter the first mentioned means to change the connections between said impellers.

3. A vacuum cleaner comprising a plurality of fan impellers, movable means having two posi-

tions for alternatively connecting said impellers for air flow in series or in parallel, means acting to retain said movable means in one of said positions, and means actuable exteriorly of the cleaner for moving said movable means to the other of said positions.

4. A vacuum cleaner comprising a plurality of fan impellers, rotatable means for alternatively connecting the impellers for air flow in series or in parallel, means acting to position the rotatable means for series flow, and means actuable exteriorly of the cleaner for moving the rotatable means to position of parallel flow.

5. A vacuum cleaner comprising a unit enclosing a plurality of fan impellers, rotatable means for alternately connecting the impellers for air flow in series or in parallel, resilient means acting to position the rotatable means for series flow, and means movable on application of a nozzle to the cleaner unit to move the rotatable means to position of parallel flow.

6. A vacuum cleaner having means for alternatively producing large air flow with low suction and small air flow with large suction, and automatic means responsive to the suction pressure produced by the first mentioned means for changing from the one condition to the other.

7. A vacuum cleaner including a plurality of fan impellers, means to connect said impellers for flow of air in parallel or in series, and automatic means responsive to the suction pressure produced by the first mentioned means for actuating the first-mentioned means.

8. A vacuum cleaner including a plurality of fan impellers, conducting means for directing flow of air through said impellers in series, said conducting means being alterable to direct flow of air through the impellers in parallel, and means responsive to suction variations in the cleaner to alter the conducting means.

9. A vacuum cleaner including a plurality of fan impellers, conducting means for directing flow of air through said impellers in series, said conducting means being alterable to direct flow of air through the impellers in parallel, and a flexible member responsive to atmospheric pressure and pressure within the cleaner for altering the conducting means.

10. A vacuum cleaner including a casing having a suction opening and an exhaust opening, a dust separating member in said casing between said openings dividing said casing into a dust receiving chamber and a fan chamber, a plurality of impeller fans in said casing including fan housings having inlets and outlets, the inlet of one of said housings being permanently in communication with the interior space of said casing immediately adjacent to the side of said dust separating member remote from said suction opening and the outlet of the other of said housings being permanently in communication with the atmosphere, and movable valve means between said impellers for establishing communication between the outlet of said one of said housings and the inlet of said other housing and alternatively for establishing communication between the inlet of said other housing and the said interior space of said casing and between the outlet of said one of said housings and the atmosphere.

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