W. H. RAKESTRAW.

VACUUM CLEANER.

APPLICATION FILED OCT. 4, 1910. RENEWED FEB. 12, 1916.

1,199,713.

Patented Sept. 26, 1916.

2 SHEETS—SHEET 1.

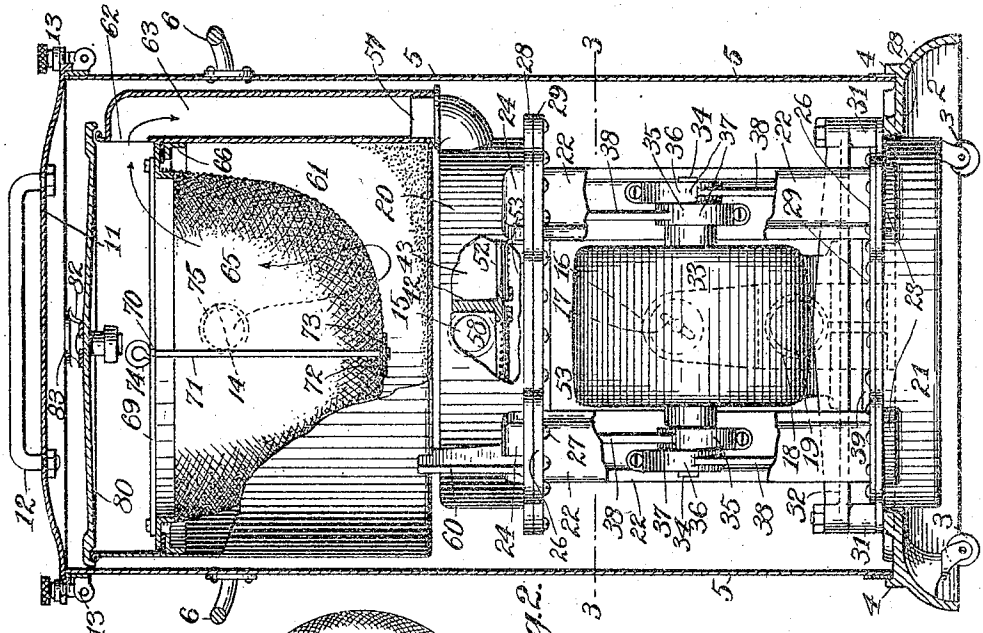


Fig. 2.

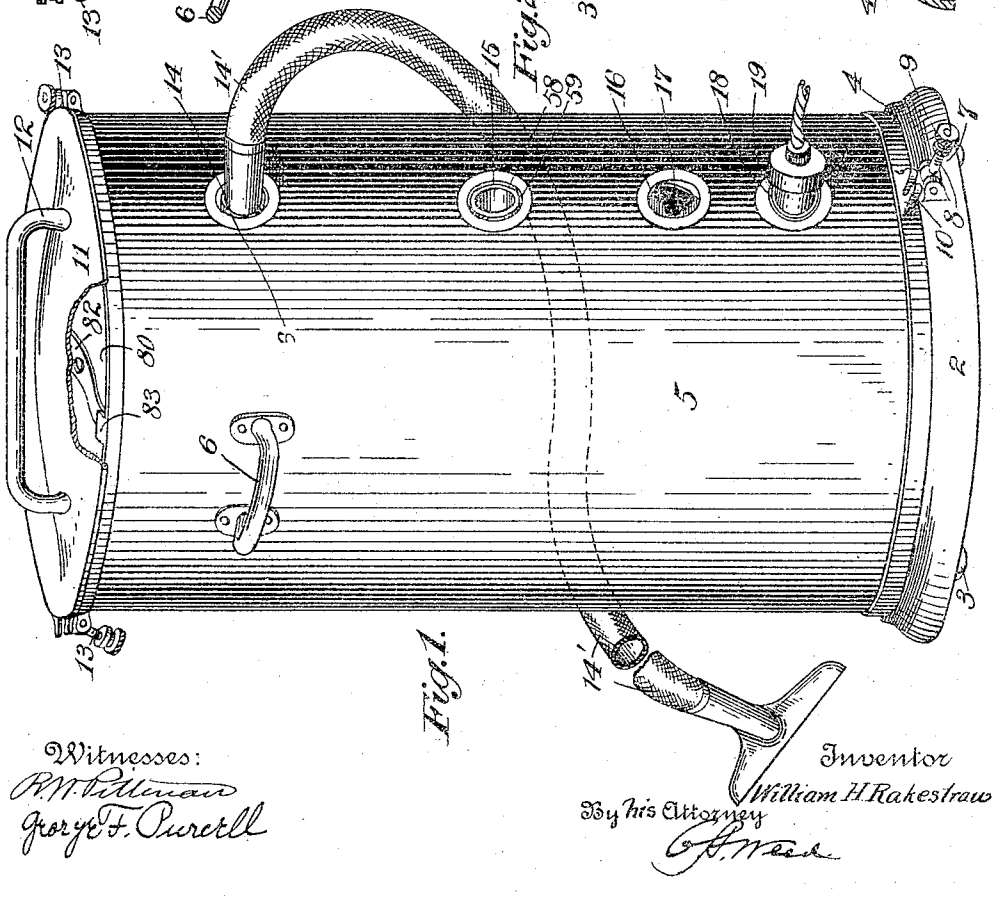


Fig. 1.

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THE ROBB'S PETERS CO. PHOTO-LITHO., WASHINGTON, D. C.

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2 SHEETS—SHEET 2.

Fig. 3.

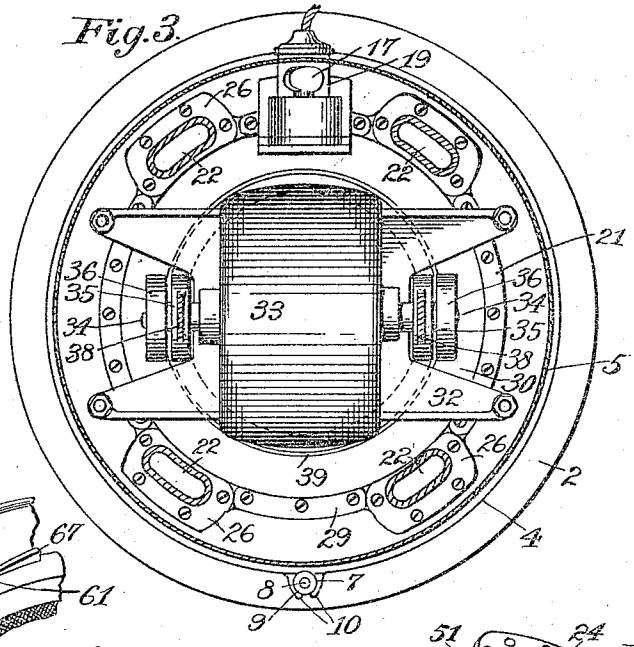


Fig. 8.

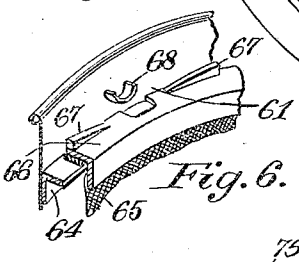


Fig. 6.

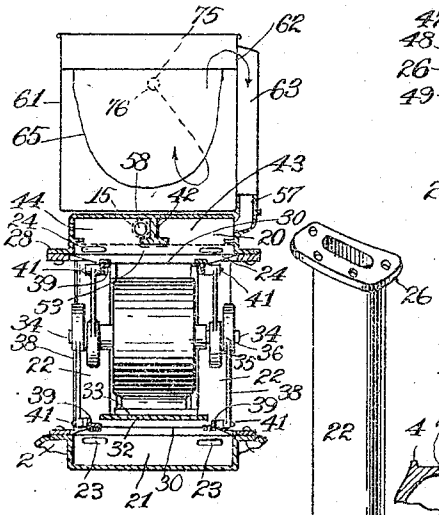


Fig. 7.

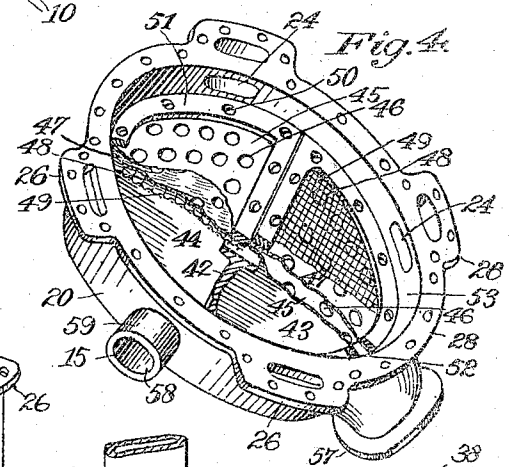


Fig. 4.

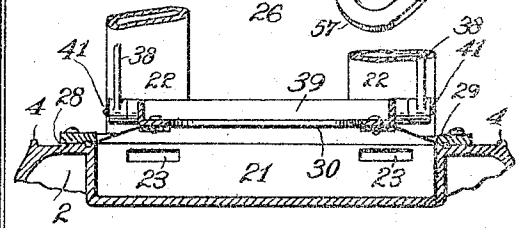


Fig. 5.

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UNITED STATES PATENT OFFICE.

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VACUUM-CLEANER.

1,199,713. Specification of Letters Patent. Patented Sept. 26, 1916.

Application filed October 4, 1910, Serial No. 585,193. Renewed February 12, 1916. Serial No. 78,072.

To all whom it may concern:

Be it known that I, WILLIAM H. RAKESTRAW, a citizen of the United States, residing at Bloomington, in the county of McLean and State of Illinois, have invented certain new and useful Improvements in Vacuum-Cleaners, of which the following is a specification.

This invention relates to vacuum cleaners, more particularly to that class thereof known as portable vacuum cleaners, the object of the invention being to provide a power, such as a motor, driven machine in which the motor will be so supported and connected with the pumping mechanism that vibration thereof will be reduced to a minimum, and reference is hereby made to my contemporaneously pending allowed application, Serial No. 612,814, filed March 7, 1911, and allowed October 20, 1911.

A further object of the invention is the provision of an improved vacuum cleaner having a pair of pumps opposite each other and spaced apart, and operated simultaneously by driving means located between such pumps, whereby the driving means will be properly balanced and vibration of the machine overcome.

A further object of the invention is the provision of an improved vacuum cleaner extremely simple in its construction and organization, and therefore comparatively inexpensive to manufacture, and in which the several parts are so assembled that the necessity of providing a number of packing rings, as heretofore in machines of this general class, is avoided, and in which also the air drawn into the machine will not come into contact with the driving means or motor, so that there is no opportunity for any dust which may remain unseparated from the air injuring the driving parts of the machine.

One of the serious defects in portable motor driven vacuum cleaners is the tremendous amount of vibration caused by the motor, owing to the manner in which it has been supported and connected with the pumping mechanism, and various attempts have been made to overcome this, as by suspending the motor, or by the use of springs, all of which are of questionable practicability so far as the production of a machine having any considerable longevity is concerned.

In the drawings accompanying and forming part of this specification, Figure 1 is a side elevation of this improved vacuum cleaner, with a form of renovator or suction nozzle connected therewith; Fig. 2 is a vertical sectional view thereof, with parts broken away; Fig. 3 is a cross sectional view taken on line 3—3 Fig. 2; Fig. 4 is a perspective partly sectional view of one of the pumping chambers and the valves for controlling the inlet and outlet of the purified air, the said view being shown upside down from its proper position in the machine; Fig. 5 is a cross sectional view of the lower pumping chamber; Fig. 6 is a diagrammatical, partly sectional view illustrating the operation of the cleaner; Fig. 7 is a perspective view of one of the tubes connecting the pumping chambers; and Fig. 8 is a detail view of a portion of the dirt chamber and bag supporting means, illustrating the manner in which these parts are assembled.

Similar characters of reference indicate corresponding parts in the several figures of the drawings.

In the preferred form thereof, herein shown and described, this improved portable vacuum cleaner comprises a suitable base 2 provided with some suitable form of casters 3, whereby it may be readily moved around the room or from one place to another, and also with an upwardly extending annular flange 4 for the reception of a cylindrical casing 5 provided with handles 6. This casing is secured to the base by suitable fastening devices 7, one at each side thereof, and which comprises a threaded and pivotally supported bolt 8 carrying a thumb nut 9, the bolt adapted to be received in slotted ears 10 carried by the cylinder. A cover 11 provided with a suitable handle 12 closes the upper end of this cylinder casing, and is secured thereto by similar locking devices 13. The casing is provided with an opening 14 for the attachment of the inlet suction hose and nozzle 14′, and with an exhaust outlet 15 for the exhaust purified air. The casing is also provided with an opening 16 for the reception of a thumb piece or switch 17, by means of which the motor may be started and stopped. The casing also has another opening 18 for the insertion of a conduit cord coupling 19. Within this cylindrical casing is located an

electric motor, when this form of power is used, the pumping mechanism, and the dirt chamber. The pumping mechanism comprises a pair of air chambers 20 and 21, one as 21 being supported by and adjacent to the base of the machine, and in practice it is preferably formed as an integral structure with such base. The air chamber 20 is spaced apart from, and in the present instance is supported above, the air chamber 21 by one or more, shown herein as four in number, tubes 22 of elongated form in cross section. Each of these tubes communicates at its lower end by means of openings or ports 23 with the air chamber 21, and at its upper end by similarly formed openings or ports 24 with the air chamber 20. Each of these ports is formed by a lateral projection carried by and integral with its chamber, and to which the tubes are fastened by means of suitable flanges 26 formed on the ends thereof and screws 27, suitable packing rings being located between the juxtaposed parts to make an air-tight connection. Thus there is provided a pair of air or pump chambers connected by a plurality of tubes. Each of these air chambers is provided with an annular flange 28 to which is secured by means of a sectional ring 29 a diaphragm 30 constructed of any suitable material, such as leather. Supported on posts 31 carried by the base is a motor supporting member or plate 32 adapted to support the driving mechanism, such as an electric motor 33. This plate extends from side to side of the base above the lower diaphragm, the posts referred to raising it sufficiently above the base to give free and proper action to the diaphragm. Any suitable form of motor adapted for the purpose may be used. On each end of the shaft 34 of the motor 33 is located a pair of eccentrics 35 and 36 disposed side by side, the eccentric portion of one of such eccentrics being diametrically opposite or opposed to the eccentric portion of the other eccentric. Located on each of these eccentrics is an eccentric strap 37 having a connecting rod 38. By this organization it will be observed that the connecting rods of the pumps extend in opposite directions, or one down and one up of each pair, in the present arrangement of the machine. The outer end of each connecting rod is pivotally connected to a diaphragm, and for this purpose each diaphragm is provided centrally with a head or ring 39 to which the diaphragm is secured, and this ring is provided with oppositely located alined studs or pivots 41 projecting into bearings of the rods. By this organization it will be observed that both diaphragms of the two air or pump chambers are moved in unison, at one time toward each other, and at another time away from each other, and that the motor is supported between these two diaphragms and connected therewith in such manner by means of the diametrically opposed connecting rods that the mechanism is balanced and vibration of the motor avoided. Between the eccentrics on the motor shaft and the connecting rod straps are located some suitable form of anti-friction bearings. One of the pump or air chambers, shown in the present instance as the upper one, is provided with a partition 42 dividing the chamber into two compartments 43 and 44 provided with valves, one constituting the inlet and the other the outlet. In the present instance the compartment 43 is provided with the inlet valve, while the compartment 44 is provided with the outlet valve.

The two valves are made alike but disposed in a different manner. By dividing the upper air chamber into two compartments each forms a semi-circular compartment, and each valve is so made as to completely fill its compartment and comprises a metal plate 45 having a series of rows of openings 46 therein. On one side of this plate is located a flexible sheet of material 47, such for instance as leather, having likewise a series of rows of openings 48 therein, the openings of the leather sheet being staggered with relation to the openings in the metal plate. For properly supporting this sheet of leather and limiting the movement thereof a suitable sheet of wire 49 is located at the side thereof opposite to that which is in engagement with the metal plate. A valve formed in this manner is secured across each compartment by being fastened by means of screws 50 and a semi-circularly formed ring 51 to a flange 52 and the bottom wall of the partition hereinbefore referred to. The valve forming the inlet is so located that the leather sheet will be at the underside in the present arrangement, while the valve forming the outlet will be at the upper side of the metal plate. Thus, in operation, the air will be drawn through the holes in the metal plate of the inlet valve when the leather is drawn away therefrom and will then pass between the leather sheet and the metal plate and through the openings of the leather sheet to the chamber 53 located just below the valves and which is in communication with the tubes by ducts or openings 24 formed in the side wall of the upper air chamber. In other words, the valves are so located, see Fig. 6 for instance, that the upper air chamber is divided into a pair of chambers one above the other, so that the air from the dirt and dust separator will first come into the compartment 43 above the valve, then pass through the openings of the inlet valve, into the chamber 53 below such valve, the lower wall of which chamber is formed by the pump diaphragm, and from thence pass

through the openings or ports 24 formed in the side walls of the pump or air chamber into the tubes, the lower ends of which tubes communicate with the lower pump or air chamber just below the lower diaphragm which constitutes the upper wall of this lower air chamber. The compartment 43 is provided with an inlet port or opening 57, while the compartment 44 is provided with an outlet or exhaust port 58 formed by a short tube 59 which projects in juxtaposition to the opening hereinbefore described formed in the cylindrical casing.

In practice, the casting forming the upper air or pump chamber is provided with a plurality of recessed uprights or brackets 60, which, together with the flanged port 57, constitute supporting means for the dust separator, whereby the same will be properly supported at proper points on top of the pumping apparatus and whereby it can be readily removed for cleaning.

The dirt separator comprises a receptacle 61 shown herein of cylindrical form and in the form of a metal can having adjacent to its top an outlet or port 62 leading to a tubular passageway 63 formed on the outer side of the can and the lower end of which fits over the inlet port 57 of the compartment 43. Located within the receptacle or can is an interiorly extending annular flange 64 adapted to carry a suitable packing of felt or other material for supporting the separating medium. This separating medium in the present instance comprises a bag 65 of any suitable material, the upper end of which is secured to a ring 66 adapted to rest upon the flange of the separator, the ring being secured in contact with the packing by suitable inclined or cam surfaces 67 and projections 68 located on the interior of the receptacle. The ring is provided with recesses or cut away portions to enable it to be readily inserted into the can and pass the projections, whereupon on turning the same the inclined surfaces will come in contact with the cam projections and the ring be locked firmly in engagement with the can.

Extending diametrically across the can supporting ring is a suitable bar 69 having a centrally located opening 70 for the passage of a wire or rod 71, the lower end of which is secured by a pair of disks 72 and a nut 73 to the center of the bag and the upper end of which rod is provided with a ring or handle 74 for raising and lowering the bag.

The dirt and dust inlet 75 to the separator is in the present instance located adjacent to the upper end of the receptacle, but below the bag supporting flange thereof, this inlet being formed by a short tube 76 adapted to project in juxtaposition to the inlet opening of the cylindrical casing hereinbefore described and into position to receive the suction hose attached to the nozzle in the manner shown in Fig. 1.

From the foregoing it will be observed that by reason of the fact that the inlet is located below the bag supporting flange of the receptacle it is of course located below the ring which supports the bag, so that the air and dust is drawn into the receptacle at the outer side of the bag instead of, as heretofore, into the interior of the bag. Consequently the dust settles by gravity into the can below the bag, the purified air passing through the bag from the outer sides thereof in the manner shown by the arrows in Fig. 6 to the outlet opening or port 62, and from thence to the inlet valve chamber or compartment 43. By this organization the larger proportion, nearly one hundred per cent., of the dust is received by the can below the bag, the remaining portion being separated from the air by the bag as the air passes therethrough, so that by this improvement the dust does not accumulate interiorly of the bag on the walls thereof and so prevent the passage of the air therethrough as heretofore, but on the contrary, settles in the bottom of the can, and consequently the structure is very much more sanitary than those constructions in which the bag receives all of the dirt, while the separator can be used for a much longer period of time without the necessity of cleaning it. Furthermore, by means of the rod or wire attached to the bottom of the bag such dust as accumulates on the outside of the bag can be readily shaken off by shaking the bag without the necessity of the user handling it and before the bag is removed from the separator, which is a material advantage, since it enables the bag to be almost practically free from dirt and dust before it is lifted out of the can, thus providing a very sanitary structure while enabling a bag to be used as a separating medium. After the bag is shaken and removed the can can then be removed and the dirt dumped therefrom.

A suitable cover 80 is provided for the upper end of the receptacle, some suitable form of packing ring being located between the cover and the upper edge of the receptacle, and for maintaining the cover tightly on the top of the dirt separator it is provided with a spring cross piece 82 adapted to be shifted under a pair of interiorly extending lugs 83 carried by the cylindrical casing, which in turn is provided with the cover hereinbefore referred to having the handle for lifting the receptacle when this is necessary.

In operation, the dirt and dust drawn through the nozzle or renovator and the suction hose enters the dirt or dust separator at the outer side of the bag, where, as herein-

before stated, the larger proportion of the dust settles in the can, the purified air passing through the walls of the bag and through the outlet 62, and from thence to the inlet of the compartment 43, thence through the valve into the tubes, to the lower pump chamber. On the next stroke of the pumps the air in these several chambers and tubes is forced out through the outlet valve in the manner hereinbefore described, and through the exhaust outlet 58 to the open air. Thus it will be observed that on the inward movement of both diaphragms toward the motor air is drawn in through the inlet valve to the two pump chambers, while on both outward strokes of the diaphragm this same air is expelled or forced out through the outlet valve.

From the foregoing it will be observed that both pumps operate in unison from the same shaft, so that by placing the pumps opposite each other, one at each side of the power, the pumping mechanism is perfectly balanced on the driving shaft and all vibration is overcome. Not only this, but less power is required to displace the same amount of air, as the eccentrics are only offset from the center about half what would be necessary in a machine with one pump located at one side thereof. At the same time a very sanitary structure is furnished, in which nearly all of the dirt and dust will settle by gravity into the can itself, outside of the bag, the whole being arranged in a very compact structure. Furthermore, by the arrangement of the pumps connected by means of one or more tubes the necessity of using the motor chamber as an exhaust chamber is obviated, so that the possibility of the motor being injured by fine particles of dust which might be carried from the dust separator into such chamber is avoided, and this construction also avoids the necessity of making the motor chamber air-tight, and so obviates the use of large rubber gaskets at the lower end of the cylindrical casing, which joint it would be difficult to keep tight.

In practice the inlet and outlet valves may be so constructed that they act as release valves, so that if the tools should get stopped up and close off the air entering the cleaner the motor could still run and not stop, and this is obtained by placing the perforations farther apart or closer together, by means of which the amount of vacuum that the cleaner will pull can be regulated. In practice also, the dirt separator can have a deflecting means on the inside to deflect the dirt toward the bottom if this is preferred.

From the foregoing it will be observed, as hereinbefore stated, that the air and dirt going into the receptacle below the dirt separating medium or bag and passing therefrom above the said separating medium allows but a small portion of the dirt to adhere to the bag, thus causing that much less resistance to the power over the usual way of bringing all the dirt into the bag or sack and necessitating the air passing downward through this accumulation of dirt at all times, and consequently the necessity of making the upper end of the cylindrical casing air-tight is likewise avoided, while the separator can be readily emptied without the necessity of being obliged to directly take hold of a dirty sack.

In operation the tendency of the air passing from the separator somewhat draws the walls of the bag inward and upward, forming pockets or corrugations, which action not only effects a movement or shifting of the bag to increase the separation of any dust which accumulates thereon, but it also increases the separation of the finer dust from the air, since it increases in a way the separating surface.

It will be observed, as hereinbefore stated, that the diaphragm pistons of the two pumps move in unison; that is to say, the two diaphragms move toward each other simultaneously and away from each other simultaneously, and not in alternation as is the usual practice, so that both diaphragms act simultaneously and in unison to draw in air at one time and to expel it at another time.

I claim as my invention:

1. In a vacuum cleaning apparatus, the combination with a vacuum chamber, of vacuum creating means connected therewith and comprising a pair of air pumps spaced apart and operative simultaneously and in unison both to draw in or to expel air, and driving means located between and connected with each of the pumps to operate them in unison and simultaneously so that vibration of the apparatus is reduced to a minimum, said pumps having one or more connecting air passages through which the air passes from one pump to the other and back again.

2. In a vacuum cleaning apparatus, the combination with a vacuum chamber, of vacuum creating means connected therewith and comprising a pair of pump chambers spaced apart, a diaphragm in each of said chambers and operative simultaneously and in unison both to draw in or to expel air, a motor located between and connected with each of the diaphragms to operate them in unison and simultaneously so that vibration of the apparatus is reduced to a minimum, said pump chambers having one or more connecting air passages through which the air passes from one pump chamber to the other and back again.

3. In a vacuum cleaning apparatus, the combination with a vacuum chamber, of vacuum creating means connected therewith

and comprising a pair of air pumps spaced apart and operative simultaneously and in unison both to draw in or to expel air, driving means located between and connected with each of the pumps to operate them in unison and simultaneously so that vibration of the apparatus is reduced to a minimum, said pumps having one or more connecting air passages through which the air passes from one pump to the other and back again, and an inlet and an outlet valve located in one of said pumps.

4. In a vacuum cleaning apparatus, the combination with a vacuum chamber, of vacuum creating means connected therewith and comprising a pair of pump chambers spaced apart one above the other and operative simultaneously and in unison both to draw in or to expel air, a diaphragm in each of said chambers, a motor located between said chambers and connected with the diaphragms for operating them in unison to move them toward each other at one time and away from each other at another time, one or more connecting air passages between said pump chambers, and an inlet valve and an outlet valve located in the upper pump chamber.

5. In a vacuum cleaning apparatus, the combination with a vacuum chamber, of vacuum creating means connected therewith and comprising a pair of pump chambers spaced apart one above the other and operative simultaneously and in unison both to draw in or to expel air, a diaphragm in each of said chambers, a motor located between said chambers and connected with the diaphragms for operating them in unison to move them toward each other at one time and away from each other at another time, a plurality of hollow pillars supporting one chamber above the other and forming connecting air passages between said chambers, and an inlet valve and an outlet valve located in the upper pump chamber.

6. In a vacuum cleaning apparatus, the combination of a vacuum chamber, pumping mechanism comprising a pair of pump chambers spaced apart, a diaphragm in each of said pump chambers, a plurality of tubes connecting said chambers each permitting the passage of air from one chamber to the other at one time and back again at another time, a motor located between said pump chambers and connected with the diaphragms for actuating them in unison to draw in air at one time and to expel air at another time, and valves for said pump chambers, one an inlet and the other an outlet valve.

7. In a vacuum cleaning apparatus, the combination of a vaccuum chamber, pumping mechanism comprising a pair of pump chambers spaced apart, a diaphragm in each of said pump chambers, a plurality of tubes connecting said chambers each permitting the passage of air from one chamber to the other at one time and back again at another time, and a motor located between said pump chambers and connected with the diaphragms for actuating them in unison to draw in air at one time and to expel air at another time, said motor having a shaft provided with a pair of oppositely disposed eccentrics, and connecting rods between the diaphragms and said eccentrics.

8. In a vacuum cleaning apparatus, the combination of a vacuum chamber, pumping mechanism comprising a pair of pump chambers spaced apart, a diaphragm in each of said pump chambers, a plurality of tubes connecting said chambers each permitting the passage of air from one chamber to the other at one time and back again at another time, a motor located between said pump chambers and connected with the diaphragms for actuating them in unison to draw in air at one time and to expel air at another time, said motor having a shaft provided with two pairs of eccentrics, the eccentrics of each pair being oppositely disposed, connecting rods connecting the diaphragms with said eccentrics, and a pair of valves carried by one of said chambers one comprising an inlet valve and the other an outlet valve.

9. In a vacuum cleaning apparatus, the combination of a vacuum chamber, pumping mechanism comprising a pair of pump chambers spaced apart, a diaphragm in each of said pump chambers, a plurality of tubes connecting said chambers each permitting the passage of air from one chamber to the other at one time and back again at another time, a motor located between said pump chambers and connected with the diaphragms for actuating them in unison to draw in air at one time and to expel air at another time, said motor having a shaft provided with two pairs of eccentrics, the eccentrics of each pair being oppositely disposed, connecting rods connecting the diaphragms with said eccentrics, and a pair of valves carried by one of said chambers one comprising an inlet valve and the other an outlet valve and each made up of a pair of members one comprising a flexible member, said members having staggered openings.

10. In a vacuum cleaning apparatus, the combination of a supporting base, pumping mechanism supported thereby and comprising a pair of pump chambers spaced apart one above the other, a plurality of air tubes connecting said chambers and forming pillars between the same and through each of which the air passes from one chamber to the other at one time and back again at another time, a diaphragm in each of said chambers, a motor supported on said base

between said chambers and having a driving shaft provided with a pair of oppositely disposed eccentrics, connecting rods between said eccentrics and diaphragms, an inlet and an outlet valve in the upper chamber, and a casing supported by said base and inclosing the pumping mechanism and having a vacuum chamber located above the pumping mechanism and communicating with the inlet valve.

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Witnesses:
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Copies of this patent may be obtained for five cents each, by addressing the "Commissioner of Patents, Washington, D. C."