

April 9, 1946.

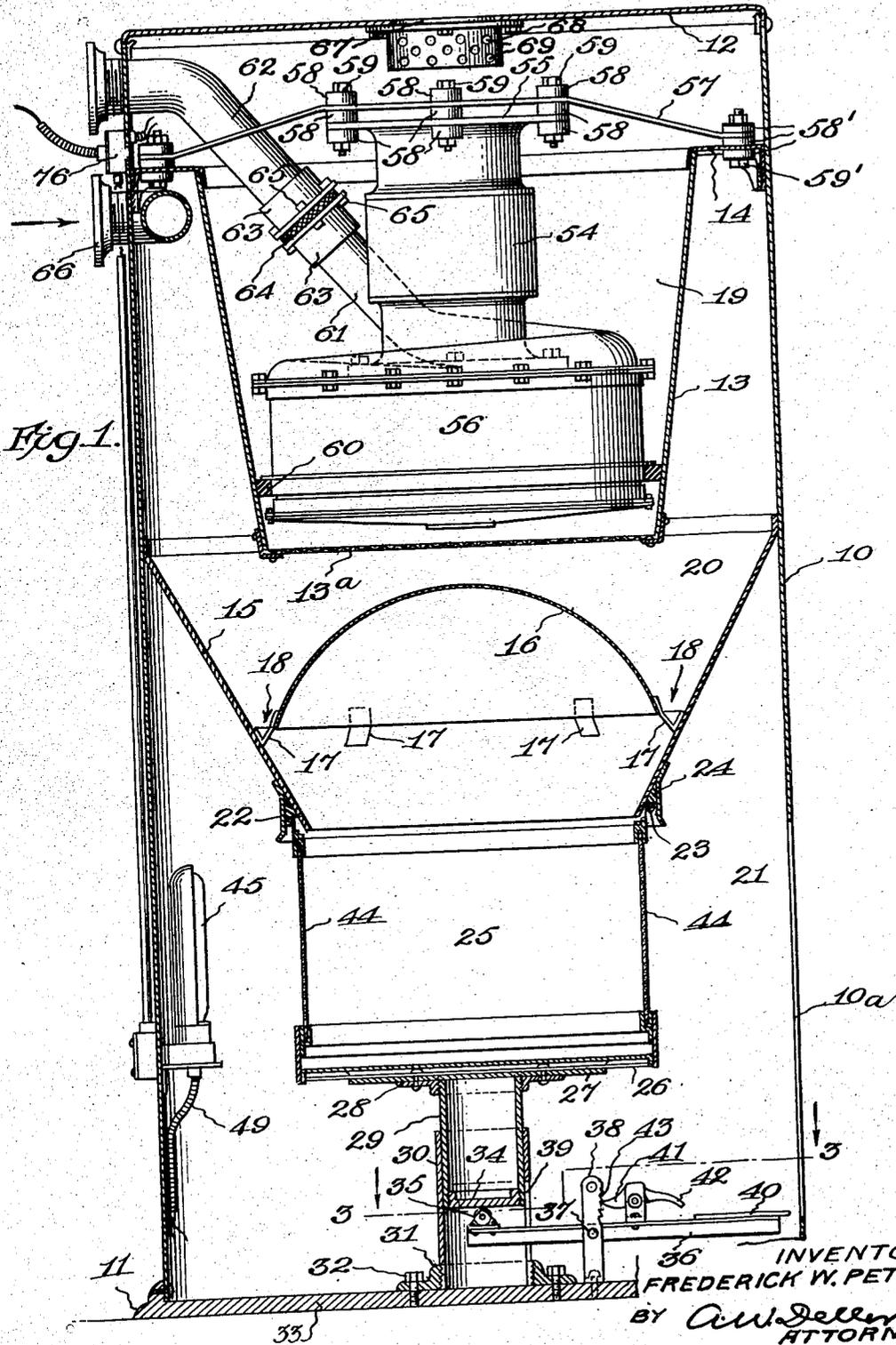
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2,397,980

VACUUM CLEANING APPARATUS

Filed Nov. 25, 1943

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Fig. 2.

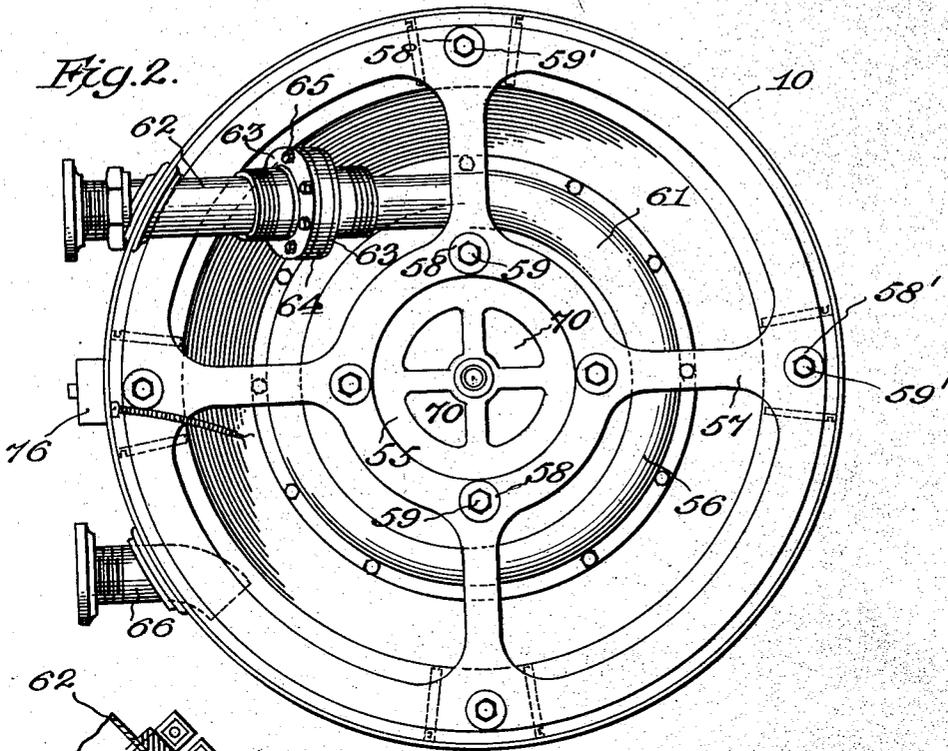


Fig. 4.

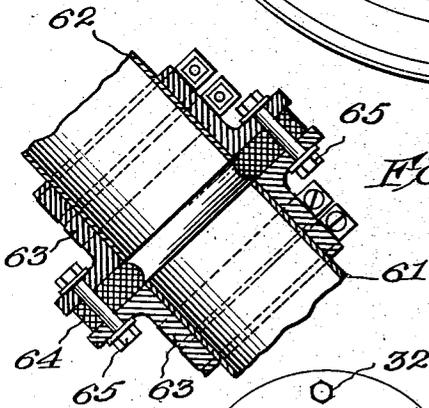
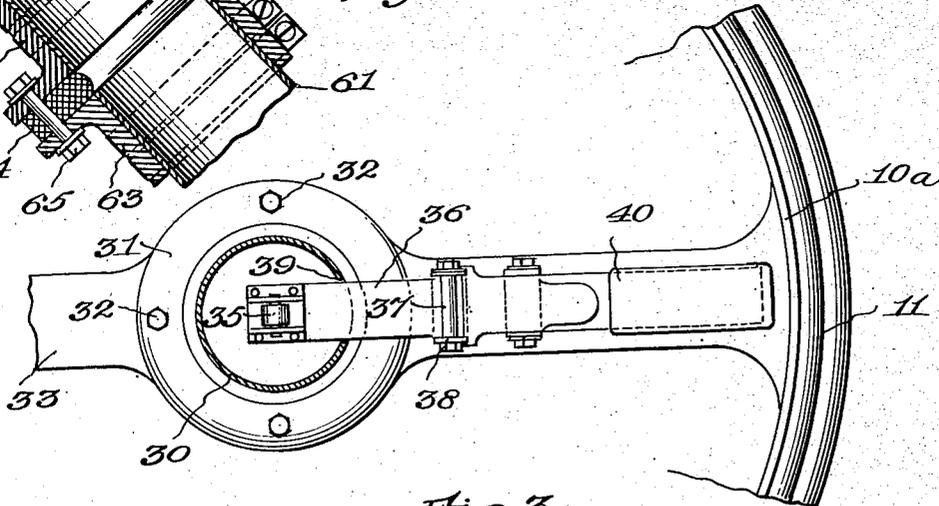


Fig. 3.



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Fig. 5.

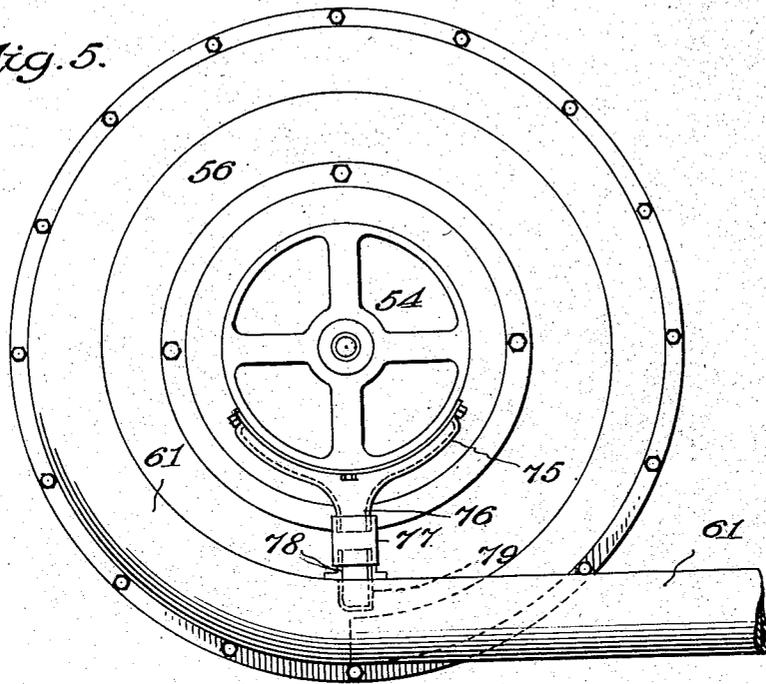


Fig. 6.

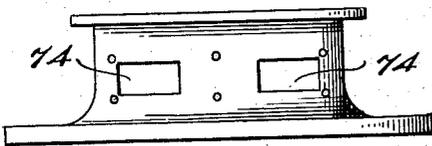


Fig. 7.

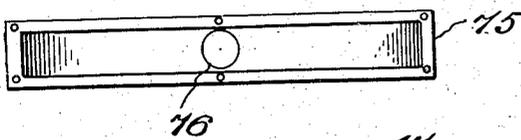


Fig. 8.

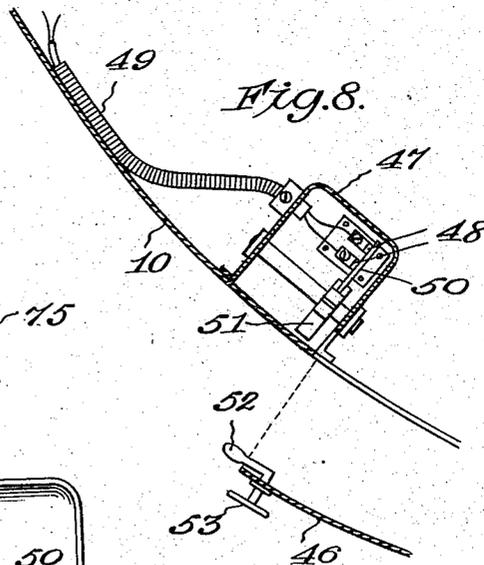
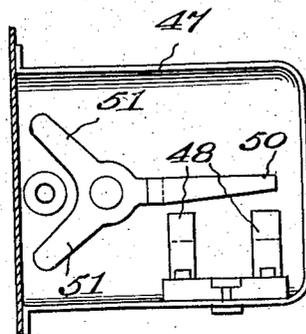


Fig. 9.



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Fig. 10.

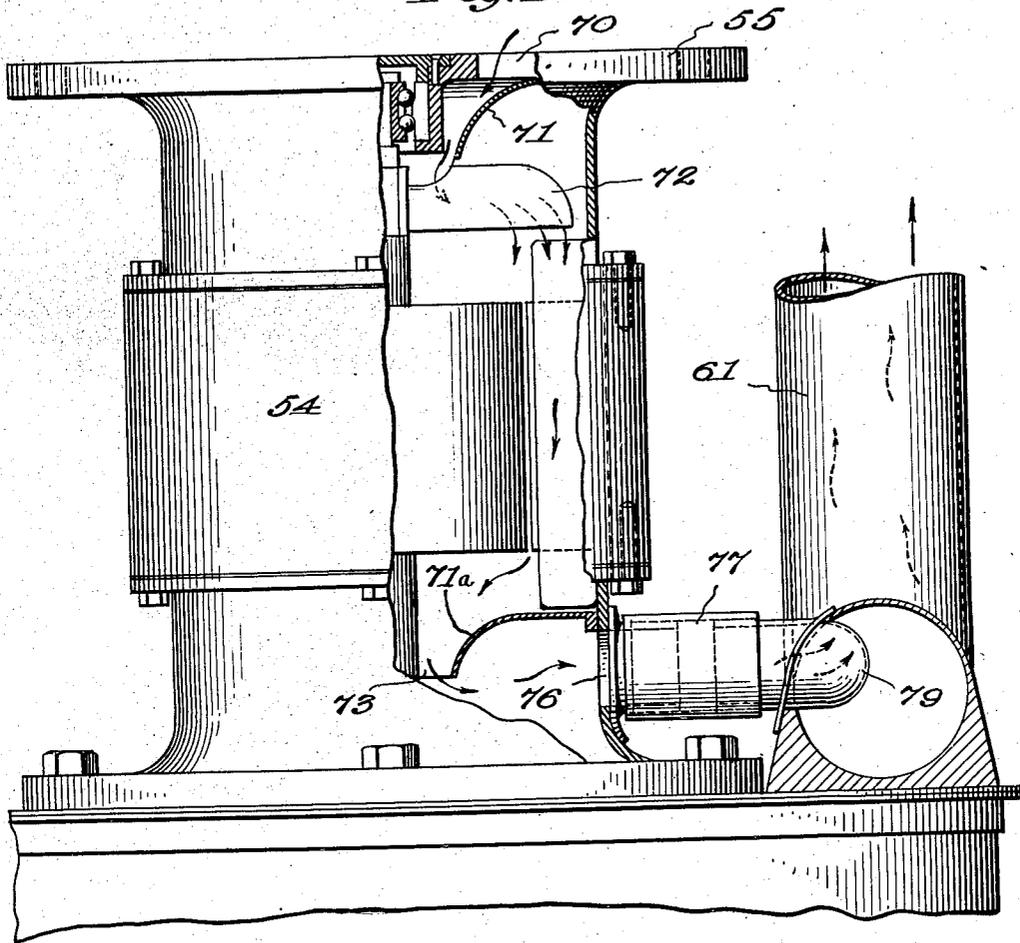
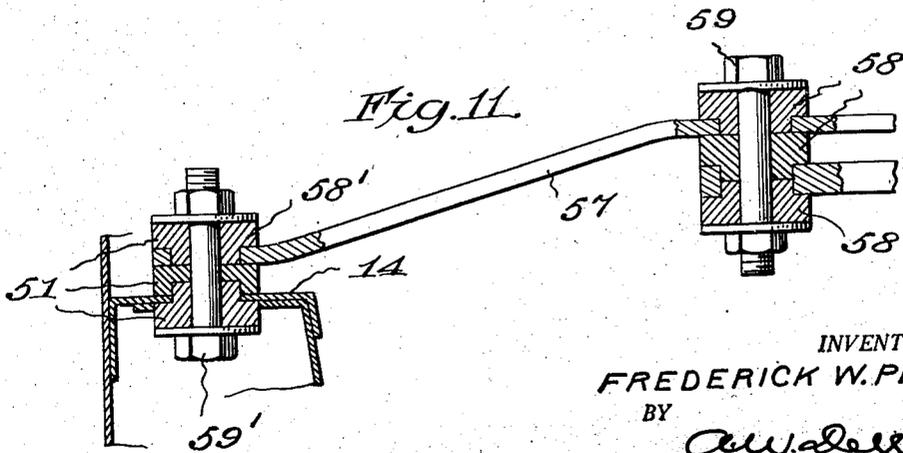


Fig. 11.



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# UNITED STATES PATENT OFFICE

2,397,980

## VACUUM CLEANING APPARATUS

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Application November 25, 1943, Serial No. 511,659

5 Claims. (Cl. 183-37)

The invention relates to vacuum-cleaning apparatus and more particularly to that type of vacuum-cleaning apparatus commonly referred to as stationary or central vacuum cleaners.

The object of the invention is to provide an apparatus of the indicated type whereby the advantages of the aforesaid system of pneumatic cleaning is made available in a simple and efficient manner.

The invention contemplates further the provision of a compact integrated apparatus occupying relatively small floor space, and designed in such form as to make it susceptible to artistic treatment of the type used in modern industrial design, as applied to electrical household equipment.

Another object of the invention is to so arrange the various parts that the rotating elements comprising the electric motor and turbo-exhauster are located within an enclosing casing, but easily accessible for any needed attention.

In addition, the invention has for its object the provision of an apparatus relatively free of vibration and possible acoustical effects resulting therefrom, and their transference to the casing.

Furthermore, the invention contemplates the provision of an apparatus of the indicated class, in which the dust container is easily accessible for the removal of its contents in a clean and hygienic manner, or for any other purpose.

A still further object of the invention is the provision of a vacuum cleaner apparatus in which the level of the contents of the dust container are visible without requiring removal of said container.

And still another object of the invention is the provision of an apparatus of the class indicated which includes a novel means of ventilation for cooling the electric motor.

Other objects of the invention will appear from the description hereinafter and the features of novelty will be pointed out in the claims.

In the accompanying drawings which illustrate an example of the invention without defining its limits,

Fig. 1 is a sectional elevation of the novel vacuum cleaner;

Fig. 2 is a plan view thereof with the cover removed;

Fig. 3 is a horizontal fragmentary section on the line 3-3 of Fig. 1;

Fig. 4 is an enlarged detail section of a coupling or connection included in the novel vacuum cleaner;

Fig. 5 is a plan view of the upper end of the

motor and showing air connection to turbine exhaust from lower end of motor.

Fig. 6 is a detail side elevation of a part of the motor showing ventilating openings;

Fig. 7 is a detail inside end view of a manifold included in the novel vacuum cleaner;

Fig. 8 is a fragmentary section illustrating an electrical switch embodied therein;

Fig. 9 is a detail elevation of a co-operating element of said switch;

Fig. 10 is an elevation, partly in section of the motor and associated elements, and

Fig. 11 is a detail sectional view illustrating the motor mountings.

As shown in the illustrated example, the vacuum cleaner unit comprises a vertical preferably cylindrical casing 10 attached to and projecting upwardly from a ring base 11 and having its open upper end normally closed by means of a tightly fitted cover 12 capable of being removed at will.

Interiorly the casing 10 is provided with a hollow inverted frusto-conical member 13 secured in place near the upper end of the casing 10 in any suitable manner as by being suspended by means of an annular supporting flange 14 fastened in place in the casing 10 in any convenient manner. In the preferred arrangement the lower open end of the member 13 is provided with a screen 13-a suitably fixed in place.

Beneath the member 13 a member 15 in the form of a hopper is secured to the inner surface of the casing 10, and is provided interiorly with a dome-shaped member 16 supported in place by spaced brackets 17 with its lower peripheral edge in spaced relation to the hopper-member 15 to form an annular space 18 for the purpose to be more fully described hereinafter.

With this arrangement the interior of the casing 10 is divided substantially into three sections constituting respectively a housing 19 for the motor-vacuum unit, a dust separator section 20, and a dust bucket section 21.

As shown in Fig. 1, the member or hopper 15 is provided near its lower open end with an annular member 22 suitably secured to the outer surface of the hopper 15 in a manner to form an annular recess 23 in which a gasket 24 is located. In the operative condition of the apparatus the upper edge of the bucket 25 or equivalent receptacle projects into the recess 23 into sealing engagement with the gasket 24 therein.

Any suitable means may be provided for supporting the bucket 25 in receiving relation to the lower end of the member or hopper 15: for in-

stance, as shown in Figs. 1 and 3 the bucket-supporting means may be constructed and arranged to raise and lower the bucket 25 to and from its operative position and to maintain it therein.

As illustrated the bucket-supporting means comprises a radially-ribbed circular plate 26 dimensioned to fit into the bottom of the bucket 25 which is recessed for this purpose. The circular plate 26 may be made of metal or any other suitable material of adequate mechanical strength, and is combined, for instance, by riveting with a supporting member 27 and an interiorly threaded flange 28. The latter is threaded upon the upper end of an inner tube 29 which telescopically fits an outer tube 30 so as to be vertically slidable therein. The outer tube 30 has its lower end threaded into an internally-threaded annular flange 31 which is secured by screws 32 or the like to the enlarged central portion of a diametrical bar 33 with which the ring base 11 is provided as shown in Fig. 3.

As shown in Fig. 1, the lower end of the inner tube 29 is closed, for instance, by means of a plug 34 for engagement by a roller 35 comprising part of the bucket-manipulating means. The latter comprises a lever or treadle 36 which carries the roller 35 and is pivotally mounted at 37 between the upright legs of a U-shaped fulcrum member 38 secured in any convenient way upon the diametrical bar 33 of the ring base 11. The lever 36 projects into the interior of the outer tube 30, through a slot 39 with which the latter is provided, and at its outer end preferably carries a foot-piece or pedal 40. The latter is accessible through an opening 10-a of the casing 10, as illustrated in Fig. 1. Any suitable means may be provided for releasably locking the bucket-manipulating means and bucket 25 in the operative position. For instance, the lever 36 may carry a pivoted pawl 41 having a toe-piece 42 and cooperating with ratchet teeth 43 provided on the fulcrum member 38.

To enable the dust level in the bucket 25 to be visually ascertained at will without requiring the removal of the bucket, the latter is provided with two relatively narrow vertical windows 44 of glass or other suitable transparent material. The windows 44 are located diametrically opposite each other for co-operation with an electric light, preferably a candle-shaped electric bulb 45 suitably supported at the proper point within the casing 10 and controlled by the action of an electric door switch which is in the "on" position to close the circuit for the bulb 45 only when the door 46 of the dust bucket section 21 is open. The door 46 may constitute a closure for the opening 10-a of the casing 10. With this arrangement the bulb 45 will be electrically energized when the door 46 is open and thereby will illuminate the interior of the bucket 25 through the windows 44. If the latter are not in registry with the light 45 the bucket 25 may be readily adjusted to bring this about. If the bucket 25 appears to be fairly well-filled, the pawl 41 may be released from the ratchet teeth 43 to permit the lever 36 to operate pivotally in a direction to lower the bucket 25 and permit its removal from the casing 10.

The door switch mentioned above may be of any convenient type suitable for the purpose, and as shown in Figs. 8 and 9, may comprise a switch box 47 provided interiorly with two terminals 48 located in the electric circuit 49 which includes the bulb 45. A suitably insulated switch member 50 is pivotally mounted in the box 47 for contact with the two terminals 48 to close the circuit,

and is provided with a forked end 51 arranged to be engaged by an operating member 52 to maintain the switch member 50 out of contact with the terminals 48 when the door 46 is closed. The member 52 forms part of the door-handle 53 carried by the door 46 and accessible on the exterior thereof. With the arrangement described the handle 53 is manipulated when the door 46 is closed, to cause the member 52 to engage the forked end 51 of the switch member 50 and pivotally shift it out of contact with the terminals 48 to thereby break the circuit in which the light 45 is located. When the handle 53 is operated to open the door 46 the forked end 51 is forced upward by the member 52 causing the insulated switch member 50 to be forcibly placed in engagement with the terminals 48 whereby the aforesaid circuit is closed and bulb 45 is electrically energized to develop illumination. The reverse of this action follows when the door handle 53 is turned to its closed position.

The apparatus further includes a unit constituting a suction-producing means and comprises a vertical shaft electric motor 54 having at its upper end a suitable flange type of end shield 55 for bearing support and mounting. A similar type of end shield is provided at the opposite or lower end of the motor 54 to which the casing of the turbine 56 is directly bolted or otherwise fastened, provision being made for a labyrinth seal at the point where the extended motor shaft enters the casing of the turbine 56. The motor shaft is of extended or overhung construction and extends beyond the lower bearing sufficiently to accommodate the impellers of the turbine 56 which are keyed in position or otherwise fixed on said motor shaft.

The rotating elements comprising the unit consisting of the motor 54 and the turbine 56 are resiliently suspended within the frusto-conical member 13 from a spider 57 which itself is resiliently mounted on the horizontal flange 14 which supports said frusto-conical member 13. The aforesaid resilient suspension and mounting may be effected in any convenient manner by any suitable means.

For instance, as shown in Figs. 1 and 11, the means for resiliently suspending the rotating elements from the spider 57 may comprise rubber or other resilient collars 58 located in co-operating groups of three respectively above the spider 57, between the latter and the upper end shield 55, and beneath the latter. The collars 58 are combined in groups of three and fixed in place by screw bolts 59 which pass through the shield 55, spider 57 and collars 58 as illustrated. The spider 57 likewise may be resiliently mounted by means of resilient collars 58' of rubber or its equivalent correspondingly arranged in groups of three, the collars of each group being located respectively above the spider 57, between the latter and the flange 14 and beneath the latter, and fastened in place by screw bolts 59' as shown in Fig. 1.

Additional resilient support for the rotating elements may be provided in the form of an annular cushion 60 of rubber or other material, preferably substantially wedge-shaped in cross-section. The annular cushion 60 externally surrounds the casing of the turbine 56 near its lower end where said cushion 60 will be forced into compressive contact with the inner surface of said frusto-conical member 13 as illustrated in Fig. 1.

With the arrangement set forth the rotating

elements are resiliently mounted in an efficient manner in which any metal to metal contact between the spider 57, end shield 55 and horizontal flange 14, is avoided, so that no vibration from the moving elements is transmitted to the casing 10 or pipe system associated with the apparatus. The amount of pressure on the resilient collars 58 and the annular cushion 60 may be controlled by the degree of bolt pressure used to secure the spider 57 in position, as a means for preventing the development of annoying acoustical effects produced by the rotating elements within a cylindrical body.

A resilient tube connection is provided between the turbine exhaust 61 and the discharge pipe 62 which passes through the casing 10 near its upper end for attachment to a continuing discharge pipe leading outdoors or through an unused chimney flue. In its illustrated form the tube connection comprises flanged collars 63 preferably of resilient material clamped upon the opposed ends of the turbine exhaust 61 and discharge pipe 62 respectively as shown in Fig. 4. A resilient gasket 64 is located between the collars 63 and is clamped in place by screw bolts 65 which serve also to connect the collars 63 and complete the resilient connection. In the preferred arrangement the flanged collars 63 are made of resilient material of a much firmer consistency than the resilient gasket 64. This arrangement adequately prevents the transmission of any vibration developed by the rotating elements.

A flanged intake pipe 66 is provided near the upper end of the casing 10 for connection with the vacuum line running through the house, preferably in the room partitions thereof. The pipe 66 extends into the casing 10 and terminates therein in a tangential direction as shown in Fig. 2.

It is known that certain pitch notes emanate from an electric motor and the blades of a turbine when operating at high peripheral speeds. When placed within an enclosure incapable of absorbing such effects, these pitch notes become more pronounced. They may, in a measure, be reduced by the complete sealing of the rotating parts within the cylinder, and lining the latter with a suitable sound-absorbing material. In the present design the principal resonant means is found in the flat drum-shaped top or cover 12 and the avoidance or reduction of resonance is provided by spray-coating with metallic lead, the interior surface of the top or cover 12 and that part of the frusto-conical member 13 within which the rotating elements are located, after the surface of the steel or other material of which the top or cover 12 and the member 13 are made has had adequate preparation to assure satisfactory bond between the two metals.

The motor 54 and turbine 56 being enclosed to effect a reduction in objectionable acoustical effects, it becomes desirable and even necessary to provide means for preventing temperature rise beyond the rated point of the motor 54, which, in the illustrated example, is accomplished by including a novel and efficient ventilating system in the apparatus. The latter comprises an opening 67 of predetermined dimensions provided, for instance, in the top or cover 12 of the casing 10 preferably above the end shield 55 which supports the rotating parts. The opening 67 is of a size suitable for the admission of a requisite amount of air for cooling, and preferably is provided with a suitable screen and box 68 having perforations

69 and packed interiorly with mineral wool or similar porous material. It is well known that a current of air will affect sound wave transmission: in the instant apparatus, the air in passing through the mineral wool or other porous material in the box 68 will prevent the emergence of said sound waves through the opening 67. The cooling air may be taken in, at an opening otherwise located than in the cover 12 or through said opening 67 and said otherwise located opening, but not necessarily through both openings concurrently. In any event, the incoming air serves the double purpose of reducing sound and as a means for cooling the motor 54. From Figs. 2 and 10 it will be noted that the cooling air enters the motor 54 around the bearing support through openings 70 in the shield 55. Here the incoming air strikes a baffle 71 located within the motor 54 as shown in Fig. 10, and is forced thereby into the "eye" of the fan 72 from which it is discharged in an axial direction into the field windings and rotor. Having passed through those parts the air is forced against a lower baffle 72 at which point said air is directed to a central opening 73 in said baffle 72 and out through ventilating slots 74 in the lower end shield of the motor as shown in Fig. 6. The lower baffle 72 serves to equalize the distribution of air around the windings and to prevent an unduly large proportion of air being drawn directly to the ventilating slots 74 by reason of the suction existing thereat. A manifold 75 having a single outlet pipe 76 is attached to the lower motor end shield over said slots 74 as illustrated in Fig. 5, with the outlet pipe 76 connected by means of a rubber or other flexible tube 77 to an inlet connection 78 of the turbine exhaust 61 as shown in Fig. 5. The inlet connection 78 has an opening 79 facing in the direction of the air flow in said turbine exhaust 61. The entrance of this inlet connection into the turbine exhaust 61 constricts the air passage somewhat at this point, but not sufficiently to create an appreciable or important back pressure factor, if the motor 54 is of sufficient size to properly handle the rated discharge of the turbine 56. The air in the turbine exhaust 61 in passing around the opening 79 of the air inlet 76, 77, 78 develops a Venturi tube action, thereby drawing air from the manifold 75 and assisting in the creation of a circulation of air through the motor 54. The fan attached to the motor shaft will not of itself develop sufficient pressure to force the volume of air displaced through the outlet pipe 76, and to facilitate the discharge of the air through the turbine exhaust pipe 61 through an opening of restricted area, use is made of the Venturi tube principle, as aforesaid, to accomplish the desired result. The arrangement illustrated and described, however, provides a cooling system which is adequate for efficiently cooling the motor 54 under all operative conditions.

The apparatus further is provided with a suitable easily-accessible switch 76 of conventional type for starting and stopping the operation thereof at will.

When the apparatus is in use, the dust-laden air enters the casing 10 at a tangent through the intake pipe 66 and is thereby set up in a circular swirling downward direction. This causes the dust particles, which are heavier than the air, to be impelled by centrifugal force against casing 10, and to be gradually precipitated to the dust bucket 44. Any dust which may not be thus precipitated is very light and in an impalpable form,

and continues to float in the spirally-descending air current to the lower extremity of the frusto-conical member 13, and then into the turbine 56 from which it is discharged through the discharge pipe 62.

As will be noted from Fig. 1, the downward movement of the dust-laden air is reversed and caused to travel upwardly by the dome-shaped member 16, which has the effect of directing or guiding the flow of air towards the "eye" of the turbine 56, and, in doing so, establishes and maintains vortical action in an area (in conventional practice) of reduced air velocity. The maintenance of high air velocity, together with its sudden reversal of direction has a continuing effect on the centrifugal separation of air and dust, and thereby facilitates precipitation of the dust particles through the annular space 18 between the circular edge of the dome-shaped member 16 and the wall of the hopper-shaped member 15 and into the bucket 44. The presence of the dome-shaped member 16 also prevents the churning up or agitation of the dust in the bucket 44, which would result in its absence.

The lower extremity of the frusto-conical member 13 may be extended to a point closer to the dome-shaped member 16, but the actual intervening space will be dependent upon the air displacement characteristic inherent in a particular design.

The ascending current of air, now deprived of about 90% of its dust content, passes through the preferably coarse mesh wire screen 13—a which catches any feathers or lint which may not have been precipitated. The air then passes into the "eye" of the turbine 56 and through to the discharge pipe 62 and out of doors.

Some of the advantages provided by the novel apparatus are as follows:

The arrangement of components within a single vertical enclosure combines in one compact integrated unit occupying small floor space the necessary elements for the production of vacuum and the dust separation and disposal means.

The cylindrical type of enclosure lends itself to the type of artistic treatment now used in modern industrial design practice, and with the utmost economy.

The entire mechanism is enclosed, and there can be no contact with moving parts.

The dust removal means provide an easy hygienic method without scattering dust.

The dust bucket contents are visible on opening the door of the dust bucket compartment.

The advantages and desirability of providing a construction which affords easy accessibility for removal of the accumulated dust, as well as a convenient means for making visual examination of amount of dust present, are many and of material importance.

In previous practice in apparatus of this type for household use, the dust was accumulated in either an open container or drawer within a sealed space and the dust as precipitated frequently fell partly into the container and partly around it, making it necessary in many instances to remove the dust with a small shovel or other implement. This was a dusty and unhygienic job.

Furthermore, in apparatus of this type in previous practice, it has frequently happened that the dust container has not been removed often enough, and finally the continued accumulation of dust provided unpleasant complications. In the instant apparatus the easy accessibility, and ready determination of the amount of dust ac-

cumulated will obviate the disadvantages inherent in prior designs.

The removability of the rotating elements as a unit from the cylinder facilitates handling, shipping and setting up at installation.

The method of cooling is believed novel and necessary.

The provisions for silent operation as described are novel and necessary for consumer acceptance.

All of the foregoing are factors contributing to the efficiency of the novel apparatus and the market acceptance thereof.

Although the present invention has been described in conjunction with a preferred embodiment thereof, it is to be understood that modifications and variations may be resorted to without departing from the spirit and scope of the invention, as those skilled in the art will readily understand. For instance, the acoustical control illustrated and described herein may be replaced by other satisfactory and suitable means. Such variations and modifications are considered to be within the purview and scope of the claims.

I claim:

1. A vacuum apparatus comprising an upright circular casing having an interior annular space, an inlet for delivering dust-laden air tangentially into the upper portion of said casing within said annular space wherein the dust is centrifuged toward the casing walls and moves down the same, a subjacent dust receptacle for receiving said dust, a central outlet tube, a motor-driven fan suspended in said tube for expelling the clean air through said tube, and a dome-shaped baffle positioned beneath the entrance to the outlet tube to form the lower limit of the whirl chamber, provide a peripheral slot for the passage of the dust to the dust receptacle and prevent the vortex from disturbing the dust therein.

2. A vacuum apparatus comprising an upright circular casing having an interior annular space, an inlet for delivering dust-laden air tangentially into the upper portion of said casing within said annular space wherein the dust is centrifuged toward the casing walls and moves down the same, a subjacent dust receptacle for receiving said dust, a central outlet tube, a motor-driven fan suspended in said tube for expelling the clean air through said tube, and baffle means positioned beneath the entrance to the outlet tube to form the lower limit of the whirl chamber, provide a slot for the passage of the dust to the dust receptacle and prevent the vortex from disturbing the dust therein.

3. A vacuum apparatus comprising an upright circular casing, a hollow inverted frusto-conical, open-ended member mounted in said casing to constitute an outlet tube and forming an interior annular space in said casing, an inlet for delivering dust-laden air tangentially into said annular space wherein the dust is centrifuged toward the casing walls and moves down the same, a subjacent dust receptacle for receiving said dust, a discharge pipe extending exteriorly of said casing, a motor-driven fan suspended in said frusto-conical member for expelling the clean air through said discharge pipe, and baffle means positioned beneath the entrance to the outlet tube to form the lower limit of the whirl chamber, provide a slot for the passage of the dust to the receptacle and prevent the vortex from disturbing the dust therein.

4. A vacuum apparatus comprising an upright

circular casing, a hollow inverted frusto-conical, open-ended member mounted in said casing to constitute an outlet tube and forming an interior annular space in said casing, a hopper mounted in said casing beneath said inverted frusto-conical member in communication therewith and with said annular space, an inlet for delivering dust-laden air tangentially into said annular space wherein the dust is centrifuged toward the walls of the casing and of the hopper and moves down the same, a dust receptacle at the exit end of the hopper for receiving said dust, a discharge pipe extending exteriorly of said casing, a motor-driven fan suspended in said frusto-conical member for expelling the clean air through said discharge pipe, and baffle means positioned beneath the entrance to the outlet tube to form the lower limit of the whirl chamber, provide a slot for the passage of the dust to the receptacle and prevent the vortex from disturbing the dust therein.

5. A vacuum apparatus comprising an upright circular casing, an inwardly extending horizontal flange near the upper end of said casing, a hollow inverted frusto-conical, open-ended member depending from said flange in said casing to constitute an outlet tube and forming an annular space in said casing into which dust laden air is delivered tangentially and in which the latter is centrifuged toward the casing walls to cause the dust to move downwardly along the same, a dust receptacle for receiving said dust, means positioned beneath the outlet tube to form the lower limit of the whirl chamber and prevent the vortex from disturbing the dust in said receptacle, a spider resiliently supported on said flange above said outlet tube, and a motor-driven fan resiliently suspended from said spider within said frusto-conical member for expelling clean air through said outlet tube.

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