

Aug. 1, 1939.

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2,167,786

SUCTION CLEANER

Filed Sept. 4, 1937

2 Sheets-Sheet 1

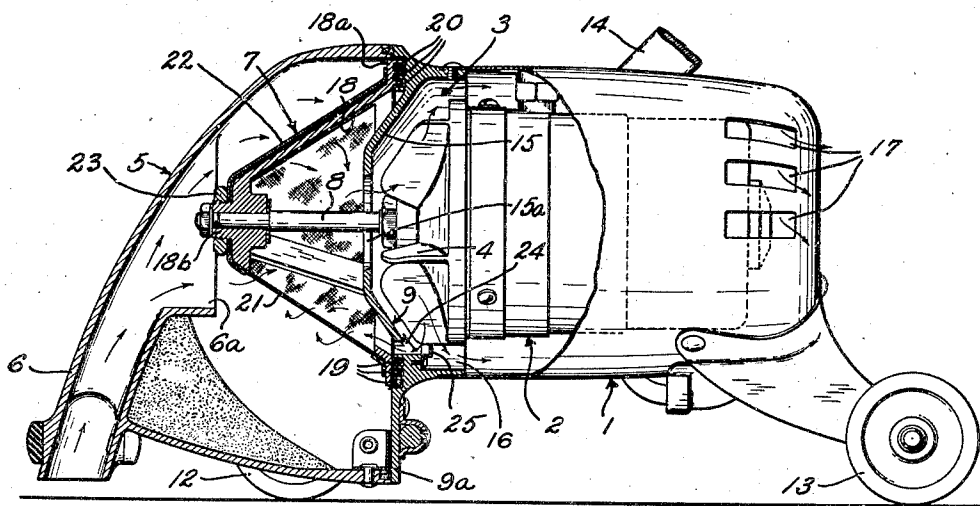


Fig. 1

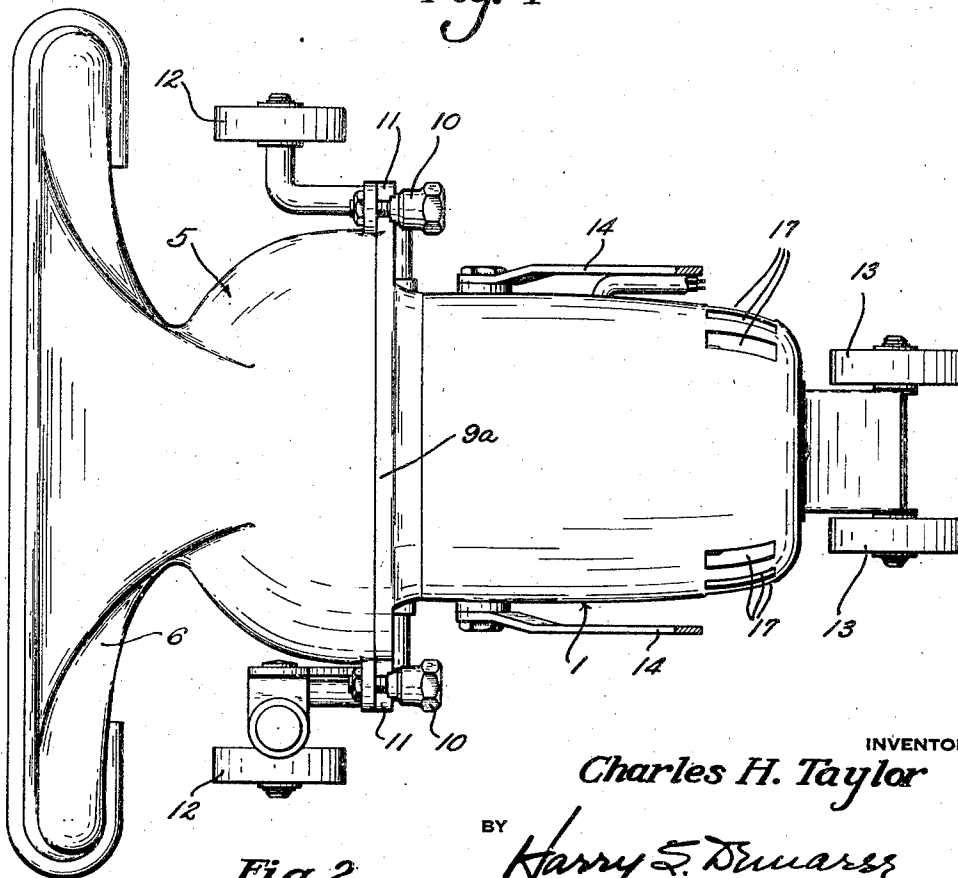


Fig. 2

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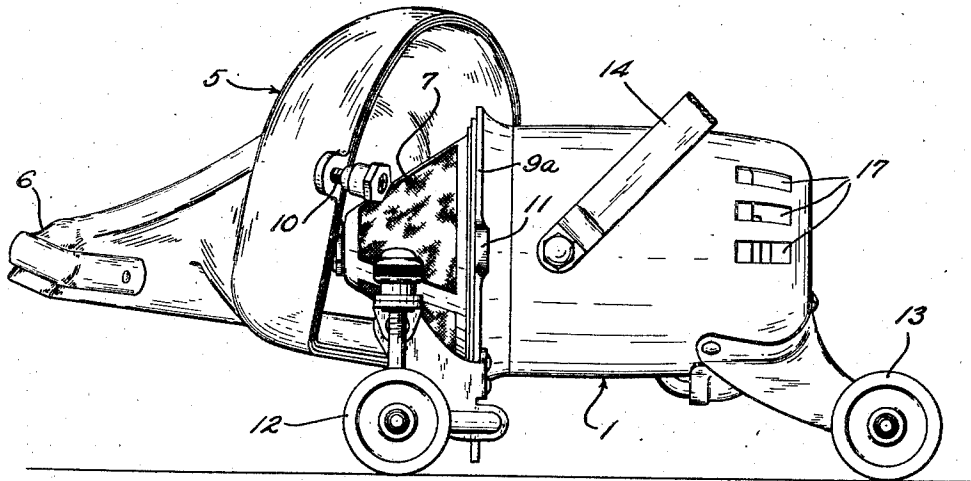


Fig. 3

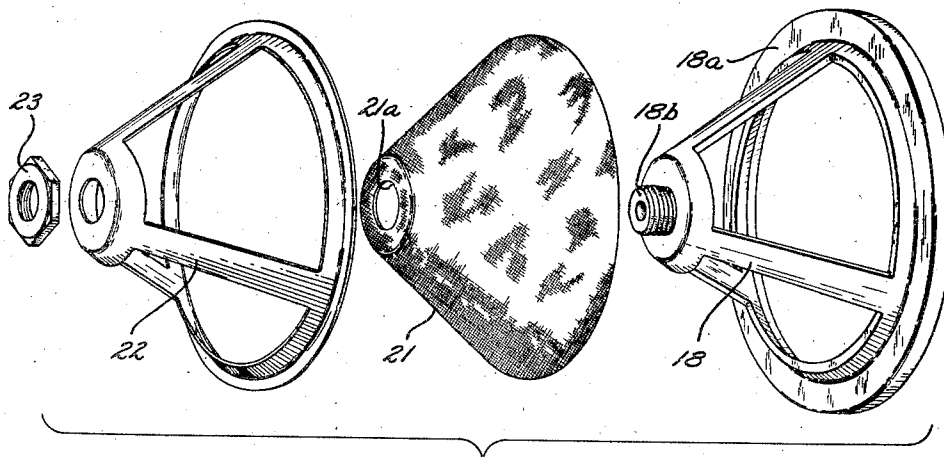


Fig. 4

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2,167,786

SUCTION CLEANER

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Application September 4, 1937, Serial No. 162,423

3 Claims. (Cl. 183-63)

This invention relates to improvement in suction cleaners, more particularly a suction cleaner of the portable type wherein the dirt separation is accomplished by means of a filter screen rotating at a high speed and preferably positioned immediately ahead of the suction creating fan.

The object of the invention is to provide a suction cleaner in which it is possible to effectively remove the dirt particles from the incoming air stream by means of a rotating filter screen of a comparatively limited area and thus dispense with the use of the usual filter bag into which the dirt-laden air is discharged.

And a further object of the invention is to provide an efficient filter unit, capable of performing effectively over long periods of time without becoming clogged or requiring frequent removal for cleaning or renewal.

Other novel and meritorious features of the invention will hereinafter be disclosed and in connection with the accompanying drawings, in which:

Figure 1 is a general view in side elevation of a suction cleaner embodying the novel features of the invention with the nozzle and filter portions of the cleaner shown in vertical section.

Figure 2 is a top plan view of the cleaner showing its general design and arrangement.

Figure 3 is another view in side elevation but showing the nozzle and filter casing detached and partially removed from the main body of the cleaner, and

Figure 4 is a perspective view of the several parts making up the rotary filter, the several parts being separated in the direction of their common axis.

The suction cleaner embodying the present invention is preferably of the horizontal motor type wherein the motor, fan and, in this instance, the filter member extend horizontally and lengthwise of the cleaner.

As clearly shown in Figures 1 and 2 the body of the cleaner consists of a cylindric housing or casing 1 within which the motor 2 is symmetrically mounted, the forward portion of the casing 1 constituting the fan chamber 3 in which is the motor-driven suction fan 4. Immediately ahead of the cylindric casing 1 is a somewhat larger casing 5 of a rounded or bulbous formation supporting at its forward end a laterally diverging nozzle portion 6. The main portion of the casing 5 surrounds a conical shape filter unit 7 which is supported at the forward end of a shaft 8 which also serves as the motor and fan shaft or, to put it in another way, the fan

4 and the filter unit 7 are directly connected with and supported upon an extension of the armature shaft of the motor 2.

As clearly shown in Figure 1 the forward end or apex of the conical filter unit 7 is positioned centrally of the internal discharge outlet 9a from the nozzle 6, this discharge outlet opening rearwardly into the large chamber surrounding the filter unit with the space therebelow forming a relatively large receptacle for the dirt removed from the incoming air stream by the filter unit.

Figure 3 reveals the casing 5 as a unit detachable bodily from the main body of the cleaner and parted in a vertical plane coinciding substantially with the base of the conical filter member. More definitely, there is provided at the forward end of the main casing 1 of the cleaner, a vertically arranged wall 9 having a radially projecting flange 9a against which the rear edge of the casing 5 has tight sealing contact. The casing 5 is further held securely in place by a pair of clamping bolts 10, 10 one carried on each side of the casing 5 and adapted to engage a corresponding pair of notched ears 11, 11 integral with the radial flange 9a.

The cleaner body is supported upon a pair of front wheels 12, 12 and rear wheels 13, 13 and furthermore, is maneuvered over the carpet surface by means of a handle, only the lower end of a U-shaped handle ball 14 being illustrated. Moreover, the mounting of the supporting wheels including means for vertically adjusting one pair to raise and lower the nozzle with respect to the floor surface, is so common in suction cleaner design that these details will be omitted.

Referring now in greater detail to the filter unit 7 it is to be noted that the suction chamber 3 is separated from the space enclosed by the forward casing 5 by an annular segment 15 of the forward wall 9 of the main casing 1, this segment having a slight forward bulge which carries its central portion a short distance into the space surrounded by the basal portion of the filter unit 7. At the center of this partition wall 15 is an annular opening 15a concentric with the axis of the shaft 8 and rotating parts carried thereby. This annular opening or "fan eye" is the passage through which the filtered air enters the fan chamber 3, to be thence dispersed radially outward and finally discharged in a rearward direction through ports 16 extending around the periphery of the fan chamber and into an annular space between the motor and the surrounding wall of the casing 1 and form-

ing an exhaust passage for the air delivered from the fan chamber and which ultimately is discharged into the atmosphere through groups of slots 17, 17 located at the rear and on the sides of the motor casing 1.

As clearly shown in Figures 1 and 4 the filter unit per se consists primarily of a two-part skeleton frame, having the form of a conical shaped spider supporting a layer of filtering material. The inner frame member 18 has an annular ring 18a at its base supporting a tripod with a threaded stem 18b at its apex. On the bottom face of the ring 18a is a group of three concentric annular flanges 19 adapted to fit in a complementary group of annular grooves 20 formed in the face of the front wall 9 of the main casing 1. The purpose of these interfitting flanges and grooves is to create or form an air seal between the base of the filter member and the adjacent wall of the casing to prevent the short circuiting of dust-laden air around the filter and into the fan chamber. Such a seal is ordinarily termed a "labyrinth" seal and is commonly used for this purpose.

Continuing now with the description of the filter unit per se, a screen of fine filtering material 21 of suitable grade and quality is preferably pre-shaped into conical form to fit over the inner frame member 18, with an aperture 21a at its apex to receive the threaded stem 18b of said frame member 18. And finally, an outer frame member 22, conforming generally to the shape and contour of the inner frame member 18 is fitted over the conical screen 21 and the entire assembly joined together as a unit by applying a nut 23 onto the threaded stem 18b, with a suitable lock if necessary.

With the filter unit thus assembled and mounted upon the shaft 8 as clearly shown in Figure 1, it is comparatively easy to visualize the cleaning action when the cleaner is in operation. Manifestly, the suction created by the fan 4 rotating at a high speed draws the air into the nozzle 6 and toward the surface of the filtering unit but at an acute angle thereto. Since the filter unit is rotating at a substantially high speed, that is, at the same speed as the fan, there is created around the filter a movement of air travelling at high speed and in a circular path so that the dirt particles approaching the filter unit are caught in this whirling strata of air and the direction of movement of at least a substantial portion of these particles is altered with the result that a certain proportion thereof will be thrown outwardly by centrifugal force and eventually will fall into the dirt collecting receptacle at the bottom of the casing 5. However, a certain amount of the dirt will be carried into contact with the surface of the filter screen 21 only to be deflected outwardly without adhering to or becoming lodged in the filter material. Thus it will be seen that the effect of the high speed of rotation of the filter unit is to create a condition wherein the same is substantially self-cleaning. That is, to say, the speed of rotation is such that the centrifugal force acting on the dirt particles prevents them from clogging the filtering material. Thus, it is assumed that the dirt entering through the nozzle is entirely removed from the air stream by the filter with the result that only clean air is discharged into the fan chamber and thence into the atmosphere from the rear end of the main casing 1.

It is important to observe that efficient performance of a dirt removing filter of the char-

acter herein disclosed is largely dependent upon the utilization of high motor speeds, that is, speeds sufficiently great to remove a portion of the dirt particles from the incoming air stream by centrifugal force imparted to such particles upon entering the zone immediately surrounding the filter member and consisting of a strata or layer of air moving at a high rate of speed and impelled by the filter. Moreover, the speed of the filter member should be sufficiently great to insure the self-cleaning action, whereby the dirt particles actually coming into contact with the filter surface and which otherwise would tend to cling thereto and eventually clog the filtering material, would be thrown outwardly by centrifugal force and thus maintain the filter in a comparatively clean condition for operation during long periods of time without attention or renewal.

And in this connection it may be advantageous under certain circumstances to facilitate the removal of dirt particles from the outer surface of the dirt filtering material by creating a counter-current of air passing through the filter material in a reverse direction, thus tending to dislodge the dirt particles which otherwise might become imbedded in the material or to adhere to the surface thereof with such tenacity as to be incapable of responding to centrifugal force. Such a counter-current of air would necessarily be directed against the interior of the filtering material at a point or throughout an area least exposed to contact with the incoming dirt-laden air stream.

Thus, referring to Figure 1 there will be observed at the lower edge of the front wall 15 of the fan chamber, an arcuate slot 24 forming an opening directly from the lower portion of the fan chamber into the lower portion of the space enclosed by the conical shaped filter member 7. Moreover, just rearwardly of the slot is a segment 25 formed by a thin metal flange attached to the inner surface of the fan chamber and so arranged as to divert a substantial amount of the air expelled from the fan chamber 3 from its normal direction of discharge in a rearward direction, forwardly through the slot 24 thence outwardly through that portion of the filter surface immediately in front of the slot, as indicated by the arrows. This counterflow of air through the slot 24 is maintained constantly to assist in keeping the filter material free of dirt particles and thus contribute directly to the increased life and efficient performance of the filtering unit.

To summarize briefly the principal features of the method of dirt separation hereinbefore described, it will be observed that the separating action is a combination of centrifugal force and filtration, that is to say, the filter unit driven at high speed, sets up a zone of centrifugal separation around the filter unit wherein a substantial portion of the dirt is removed from the air stream without any accompanying physical contact with the filter itself, whereupon such dirt particles as are not separated by centrifugal action are filtered out, so to speak, as the air passes through the filtering material. Consequently, it is only necessary to provide a filter unit having a single screen sufficiently fine to prevent the passage of the finer dust particles therethrough and therefore making it unnecessary to provide a different grade or texture of screen for different sizes of dirt particles.

Having set forth the novel features of the invention, and the more important advantages to be derived therefrom, I claim:

1. In a dirt-separating system, the combination of a fan chamber, a dirt collecting chamber connected with said fan chamber through an inlet opening, a motor-driven fan mounted in said fan chamber, and a dirt-separating member driven by said motor and comprising a rigid screen mounted to rotate within said collecting chamber and to enclose a space surrounding said inlet opening, and means for directing a counterflow of air from said fan chamber into the space enclosed by said screen and against a portion of its internal surface.

2. In a dirt-separating system, the combination of a fan chamber, a dirt collecting chamber connected with said fan chamber through an inlet opening, a motor-driven shaft extending axially of said fan chamber and through said inlet opening into said collecting chamber, a fan mounted on said shaft within said fan chamber, a dirt-separating member mounted in said collecting chamber and comprising a rigid frame mounted on said shaft with its marginal portion in sealing engagement around said inlet opening, and a screen removably supported on said frame, and

means for creating a counterflow of air through an auxiliary opening offset from said inlet opening and communicating with the pressure area within said fan chamber.

3. In a dirt-separating system, the combination of a fan chamber, a dirt-collecting chamber connected with said fan chamber through an inlet opening, a motor-driven fan in said fan chamber and having a shaft extending axially through said inlet opening into said collecting chamber, a fan mounted on said shaft within said fan chamber, a dirt-separating member mounted in said collecting chamber and operatively connected with said motor, said member comprising a rigid substantially conical-shaped screen enclosing a space around said inlet opening, and means for maintaining said screen free of dirt accumulations on the outer surface thereof, including an auxiliary opening from said fan chamber to the lower portion of the space included within said screen, and a baffle member acting to divert a portion of the air delivered by said fan through said auxiliary opening.

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