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VACUUM CLEANER

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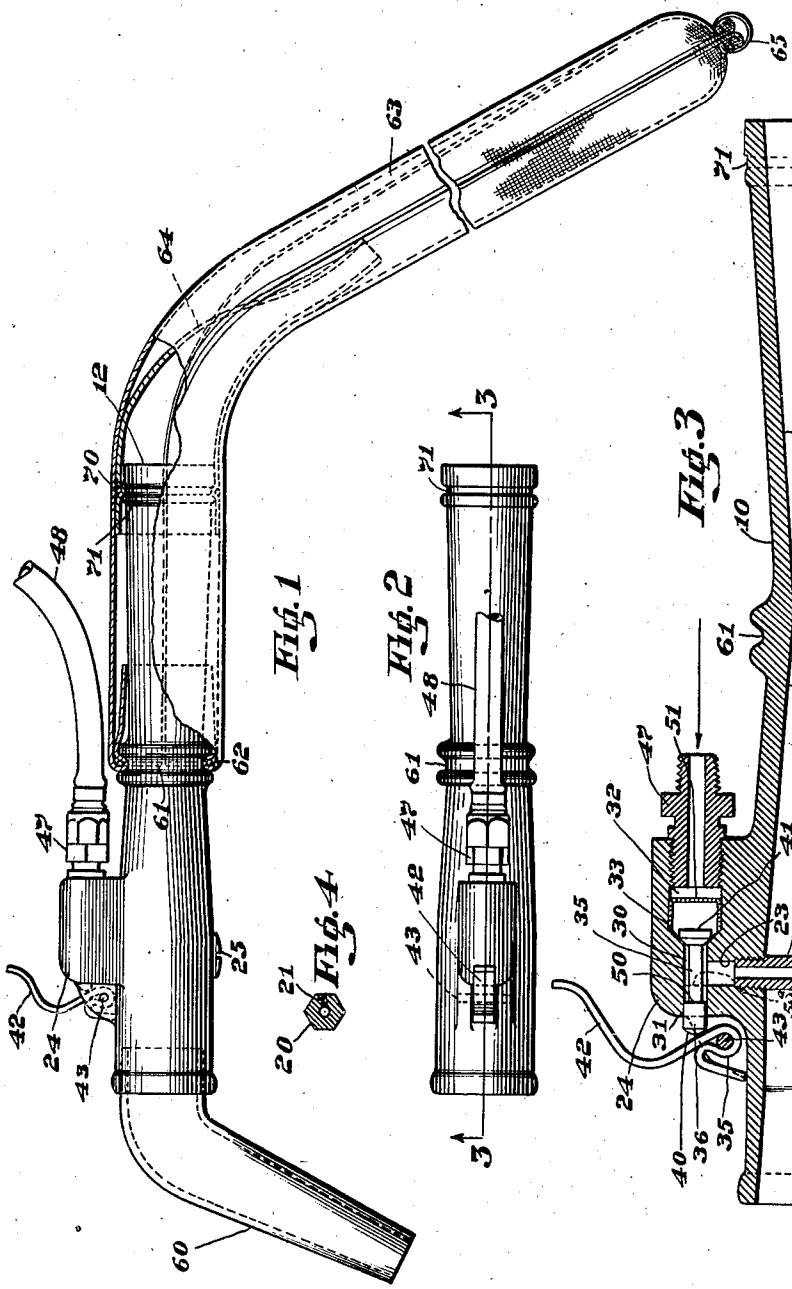


Fig. 1

Fig. 2

Fig. 3

Fig. 4

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VACUUM CLEANER

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2 Claims. (Cl. 230—95)

This invention relates to vacuum cleaners and it has for its object to provide a device of that character which, because of its simplicity and compactness in construction, forms a handy implement for cleaning automobile cushions and the like, and yet in which its simplicity in construction is obtained without sacrifice to the suction necessary for a thorough cleaning. To that end, I dispense with the use of a fan and motor, such as are customarily employed to create the suction in such cleaners, and instead I utilize compressed air, commonly available in garages, as the means for producing the suction.

It has heretofore been proposed to employ a stream of compressed air directed longitudinally of an open tube as means for creating suction in apparatus of various sorts, but, so far as I am aware, no such devices have been successfully employed heretofore as vacuum cleaners because of the inability of such devices to suck in large quantities of cleaning air with the force necessary for a thorough cleaning, the high cost of operation involved in the large quantities of compressed air consumed, and finally because of the cumbersomeness of such prior structures.

I have found that small quantities of compressed air only need be employed to draw in substantial volumes of cleaning air, with the desired force, if the compressed air be introduced longitudinally of a tube through a jet orifice which is very small in size and if the flaring, generally cone-shaped stream of air so produced be permitted to travel unconfined for a substantial, but definitely limited, predetermined distance along the tube, to entrain the surrounding air, after which, and while the conical air stream is still travelling at a predetermined high velocity, the walls of the tube are converged internally to shield the stream, whereby to inhibit further entrainment of surrounding air by the stream, while at the same time not materially restricting the longitudinal flow of the stream. The shield commences at a mouth which is spaced from the orifice the distance required for the initial unconfined travel of the stream and the shield continues from the mouth to the outlet end of the tube in a diverging conical flare which may be slightly less than the angle of divergence of the stream entering the mouth.

I have found that this combination of small jet orifice and spaced shield is not only effective for utilizing the available compressed air without wasting it, but is also advantageous in that it enables me to simplify the structure in ways other than by the mere elimination of the motor and fan. Thus the jet orifice and spaced shield, which are preferably in axial alignment with each other, enable me to form the device in the shape of a short piece of tubing with a nozzle of desired shape at one end and a small dust bag at its opposite end. Furthermore, the construction of the valve provided for turning on and off the compressed air which induces the suction, may be simplified by operating it from the back pressure of the compressed air in the tube leading to the small jet orifice.

These and further objects and advantages of my invention will appear from a more detailed description thereof taken in connection with the accompanying drawing, in which,—

Fig. 1 is a side elevation view of the vacuum cleaner complete with suction nozzle and dust bag.

Fig. 2 is a plan view of the tube.

Fig. 3 is a vertical longitudinal section taken through the line 3—3 of Fig. 2 in which the device is shown at substantially its full size, and

Fig. 4 is a section on line 4—4 of Fig. 3.

Referring to the drawing and particularly to Fig. 3, the device consists of a straight piece of tubing 10 which may be of substantially the length and external shape indicated and having an inlet suction mouth 11 and outlet exhaust mouth 12. Disposed near the inlet mouth 11 of the tube is a compressed air jet 20 having an orifice 21 of predetermined area hereinafter described, and which may be bevelled slightly at its outlet end, disposed in substantial alignment with the axis of the tube and directed toward the outlet end to cast a fine stream of compressed air which is generally conical in form, longitudinally of the tube toward its outlet end. The internal periphery of the tube 10 gradually converges from the jet for a predetermined distance, as shown at 13, toward the tube outlet end until it reaches the mouth 15 of a shield commencing at the mouth and defined by the side wall 14 of the tube which flares outwardly toward the outlet end of the tube at a predetermined divergent angle to be described more in detail hereinafter.

The air jet 20 may conveniently be formed in the shape of a tube, as indicated, closed at the bottom 22 and screw threaded at its upper end to be received in the correspondingly screw threaded outlet end of a duct 23 formed in a boss 24 cast on the top of the tube 10. The lower end of jet 20 may be made hexagonal externally for the use of a wrench and access for insertion of the jet may be provided through an aperture in the side

wall of the tube 10 which is closed by the screw threaded plug 25.

The duct 23 communicates with a horizontally disposed duct 30 opening out of the boss 24 at 31 and leading into the enlarged valve chamber 32 having a valve seat 33.

Reciprocating in the duct 30 is a valve stem 35 substantially smaller in diameter than the duct 30 and having an enlarged head 36 closely but slidably fitting in the duct 30 and terminating in a nose 40. At the opposite end of the valve stem 35 from the nose 40 is a valve 41 seating on the valve seat 33.

Lengthwise movement of the valve stem 35 to open the valve 41 is effected by thumb lever 42 pivoted at 43 to the boss 24 and abutting the protruding nose 40 of the valve stem. Screw threaded into the open mouth of the chamber 32 is a tube 47 screw threaded at its protruding end to secure the coupling of a small rubber hose 48 (Fig. 1) leading from the compressed air supply. I preferably provide the valve chamber 32 with a fine mesh screen strainer 51, of the shape indicated, for removing any extraneous matter that may pass to the chamber from the air compressor.

The inlet mouth 11 of the tube 10 may be provided with any suitable form of nozzle 60 (Fig. 1) and the outlet mouth 12 is received within a suitable dust bag 63 secured at one end to the tube as by the snap ring 62 in the groove 61 on the external periphery of the tube and closed at its opposite end with a sliding clamp 65. I preferably also enclose the outlet mouth of the tube in a check valve 64 to prevent dust passing backwardly through the mouth 12 from the bag 63. The check valve may be in the form of an open ended sleeve disposed within the bag 63 and secured about the outlet mouth by a snap ring 70 co-operating with a groove 71 on the surface of the tube.

One feature of my invention is the utilization of the compressed air supply to effect self closing of the valve 41 and to that end the enlarged head 36 on the valve stem 35 terminates in a shoulder 50 which, when the valve has been manually opened by depression of the thumb lever 42, is disposed in the position indicated at 50*a* in dotted lines in substantial alignment with one side of the vertical duct 23. As a result of the relatively small size of the orifice 21, hereinafter to be discussed in more detail, the back pressure in the ducts 23 and 30, when the valve is open, exerts a pressure against the shoulder 50 and against valve 41, thereby urging the valve to closed position.

In use, the tube 48 is connected to a compressed air supply which, in garages, is usually at a pressure of between one hundred and two hundred pounds per square inch, or higher. The valve 41 is opened by depression of the lever 42 with the thumb and the compressed air flows through the ducts 30 and 23 to the orifice 21 which is considerably smaller in cross-sectional area than the ducts, thereby causing back pressure against the piston shoulder 50, now in the position at 50*a*, which urges valve 41 to closed position. Although the size of the jet orifice may be varied, I prefer to make it extremely small, such for example as between 1/64th of an inch and 3/32ds or possibly 1/8th of an inch in diameter, and preferably about 1/32d of an inch.

The air, upon issuing from the minute orifice 21, immediately expands somewhat and then assumes a general conical shape, flaring at a small angle of divergence approximating 7½° but varying possibly a degree or two either way, depending upon various factors, the apex of the cone being an imaginary point a short distance behind the orifice. By means of baffle plates or the like in the air stream, an angle of divergence as high as 20° might be obtained but I prefer to let the stream flow unobstructed and at the aforementioned small angle of divergence.

The flow continues in the general conical flaring shape until the mouth 15 of the shield is reached and during the unshielded flow of the air stream, suction is created in the tube and through the inlet mouth 11 thereof as a result of the entrainment or absorption of surrounding air.

The mouth 15 of the shield is of a cross-sectional area approximating, though possibly slightly less than, the cross-sectional area of the flaring air stream at the mouth and the purpose of the shield and its mouth is not to restrict the stream to a smaller than normal cross-sectional area, but merely to enclose it at substantially its normal size and to shield it from surrounding air. The radius of the mouth will approximate the sine of one-half the angle of divergence for the distance of the mouth from the orifice.

The specific size of the shield, and particularly its mouth 15, will of course vary, depending upon the angle of divergence of the stream and the distance of the mouth from the orifice 21. The velocity of the air stream at this point of initial enclosure is of importance as it determines directly, to a large degree, the amount of suction in inches of mercury produced by the stream. An excessive suction which may be produced by placing the mouth closer to the orifice and making it correspondingly smaller in size would, however, result in sacrifice to the quantity of air drawn in and would produce an excessively high suction which would drop materially upon the intake of a substantial amount of cleaning air through the mouth 11. I therefore prefer to place the shield mouth at a substantial distance from the orifice 21, and yet not at such an excessive distance as would reduce the suction force below that required. This distance of shield mouth from jet orifice should be no less than one inch and should not exceed five inches and I have found that a distance of approximately 2¾ inches is preferable. Of course the size of the mouth which approximates that of the stream at the mouth will vary as this distance varies, and may be between about ⅜ of an inch and ⅞ of an inch in diameter and should be about 5/8 of an inch if placed about 2¾ inches from the orifice.

The shield continues from its inlet mouth 15 to the outlet end 12 of the tube in a flaring shape, as indicated at 14, and with an angle of divergence which approximates, but may be slightly less than, the angle of divergence of the air stream entering the mouth.

My invention is not, of course, to be limited to the details of construction or specific numerical values given above, except as indicated in the appended claims and in those claims in which diameters are specified, I do not mean to limit myself to cross-sections which are circular in shape, although that is obviously preferable, but I am thereby merely defining areas relative to the area of a circle of the diameter given.

I claim:

1. In a vacuum cleaner, the combination of a conduit adapted to communicate with a supply

of compressed air, an orifice in the conduit, no larger than one-eighth inch in diameter, adapted to eject an elongated, flaring stream of air, a shield to receive the air stream so ejected, generally frusto-conical in shape and conforming approximately to the size and shape of the air stream at the shield, means positioning the shield with its axis in alinement with the orifice and at a distance from the orifice to dispose the imaginary apex of the shield approximately at the orifice, and a mouth in said shield to receive the air stream, spaced from the orifice by a distance of from one to five inches whereby to permit an unconfined flow of the flaring air stream prior to its entrance to the shield.

2. In a vacuum cleaner, the combination of a conduit adapted to communicate with a supply of compressed air, an orifice in the conduit, no larger than one-eighth inch in diameter, adapted to eject an elongated, flaring stream of air, a shield to receive the air stream so ejected, generally frusto-conical in shape and conforming approximately to the size and shape of the air stream at the shield, means positioning the shield with its axis in alinement with the orifice and at a distance from the orifice to dispose the imaginary apex of the shield at or behind the orifice, and a mouth in said shield to receive the air stream, spaced from the orifice by a distance of from one to five inches whereby to permit an unconfined flow of the flaring air stream prior to its entrance to the shield.

HERMANN LINGENBRINK.