May 20, 1969 P. J. COTE 3,444,584

AIR EJECTOR TYPE DEVICE

Filed July 11, 1966

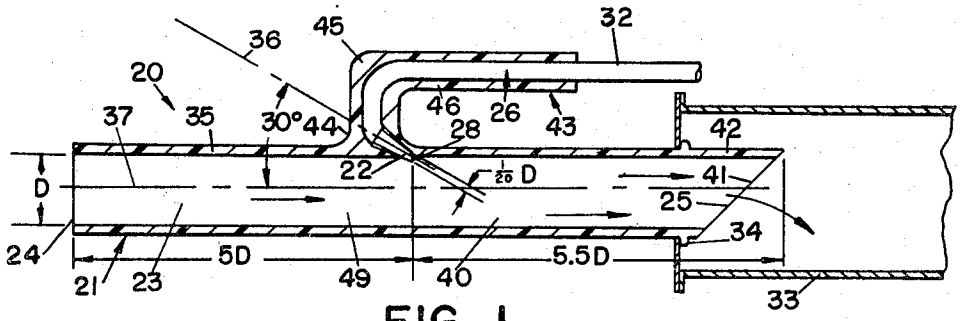



FIG. 1.

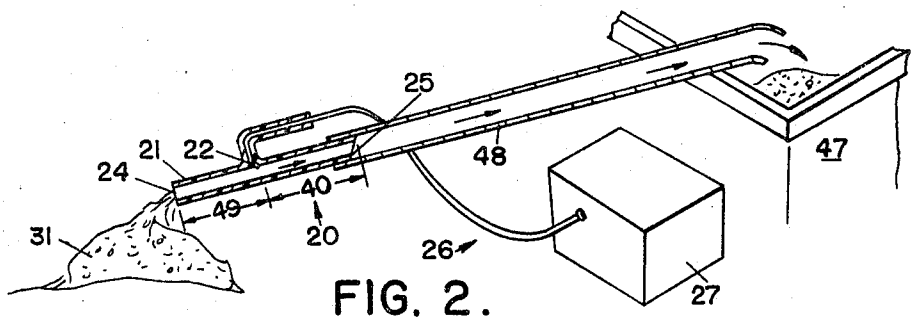



FIG. 2.

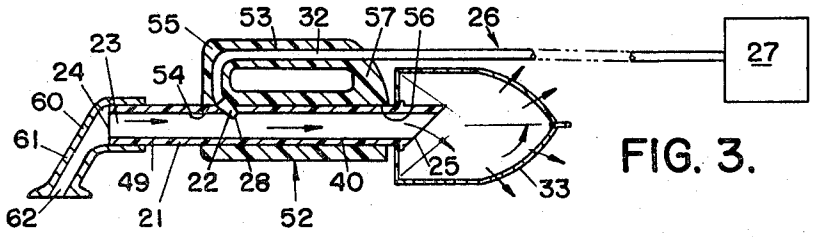



FIG. 3.

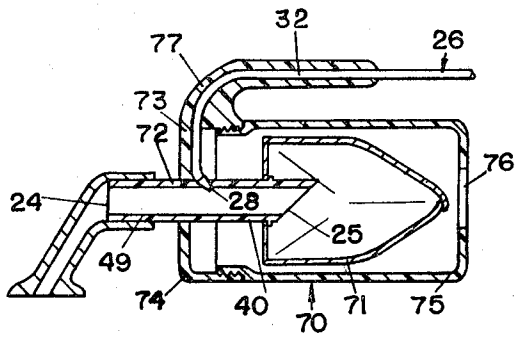
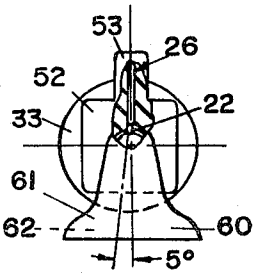



FIG. 4.

FIG. 5.




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# AIR EJECTOR TYPE DEVICE

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## ABSTRACT OF THE DISCLOSURE

An air ejector device of the type using compressed air to create suction in an elongated tube has a single air injector nozzle inclined rearwardly toward the discharge outlet at an angle of about 30° to the axis of the tube. The air ejector nozzle tapers to a small diameter orifice and is inclined at about 5° laterally to create a helical, or cyclonic, flow path toward the outlet.

This invention relates to air pressure actuated, hand operated vacuum cleaners.

It is conventional to provide hand operated vacuum cleaners of the type having a built-in electric motor for creating suction, but such devices are heavy to handle because of the motor and are limited as to suction effect because of the necessary light weight of the motor.

It has heretofore been proposed, as in U.S. Patent No. 2,051,717 to Johnson of Aug. 18, 1936, to provide a hand carried suction cleaner in which suction is created by an air ejector nozzle located in advance of the suction opening, the air being led past the suction opening and along a dust collecting passage. In U.S. Patent No. 1,654,-727 to Green of Jan. 3, 1958 and U.S. Patent No. 2,902,-708 to Riley of Sept. 8 1959 the air ejector nozzle is also located in advance of the suction opening, for the purpose of blowing the particles before they are sucked into the opening. It is believed that the location of an air ejection nozzle in advance of a suction mouth is disadvantageous and results in considerable reduction of efficiency.

On the other hand, it has been proposed in U.S. Patent No. 2,746,078 to Spurlin of May 22, 1956 to locate the air ejection nozzle in rear of the duct collecting receptacle and this also is believed to greatly reduce the suction effect of the cleaner.

In this invention the hand operated vacuum cleaner comprises a rigid walled body or tube of predetermined length having an air ejector nozzle in rear of the suction mouth and in advance of the discharge opening, or dust collecting receptacle, this having been found to produce maximum suction and efficiency. The body, or tube, is of predetermined inside diameter and the air nozzle is at least one, and preferably five diameters in rear of the suction mouth while being at least one and one half and preferably five and one half diameters in advance of the discharge opening. In addition, the air ejector nozzle tapers from about 3/20 diameters to 1/20 diameters at the orifice, the orifice is located in a wall of the tube alongside the flow path and is angled rearwardly at about 30° relative to the longitudinal centre line of the body, or tube. With a disposable collection bag at the discharge end, the device constitutes a rugged, low cost, light vacuum cleaner capable of lifting coins, cigarette butts and the like. Without the bag and when of desired dimensions, the device is highly efficient at extracting sand or snow from a pile and throwing it for considerable distances, depending on the pressure applied.

The principal object of this invention is, therefore, to provide a low cost, hand vacuum cleaner, free of the weight and power limitations of a built-in electric motor, the cleaner having unusually high suction by reason of actuation by air under relatively high pressure directed



rearwardly at an angle of about 30° from a single tapered nozzle, the nozzle being located at one side of an unobstructed flow passage and at a spaced longitudinal distance from the entrance mouth and from the discharge port of the cleaner.

Another object of the invention is to provide a simple, highly efficient vacuum cleaner arranged to be flexibly connected to a single source of air under high pressure, as at a filling station tire pump, and to be capable of picking up particles and objects from the interior of automobiles, not usually liftable by a conventional hand vacuum cleaner.

A further object of the invention is to provide an ejector nozzle type portable vacuum cleaner in which the air ejector nozzle is angled to the suction air flow path to cause a helical, or cyclone, effect and mounted intermediate of, and at one side of, the unobstructed flow passage to achieve the capability of picking up dust, dirt, sand, water, snow, coins, papers or other similar material.

Still another object of the invention is to provide such a cleaner in which a readily detachable collection receptacle may be used, or a collection conduit may be attached leading to a waste vehicle or without such parts, the cleaner may merely discharge a stream of snow, sand or other material from one location to another.

Other objects and advantages of the invention will be apparent from the claims, the description of the drawing and from the drawing in which:

FIGURE 1 is a side elevation, in half section, of a simple, low cost embodiment of the invention.

FIGURE 2 is a side elevation, in half section, on a smaller scale, showing the device of FIGURE 1, extracting snow or sand from a pile and discharging the same into a truck.

FIGURE 3 is a view similar to FIGURE 1 of another embodiment of the cleaner.

FIGURE 4 is a view similar to FIGURE 3 showing a commercial embodiment, having different predetermined dimensions and configurations from the cleaner of FIGURE 3, and

FIGURE 5 is a front elevation, with parts broken away, of the device shown in FIGURE 3.

As shown in the drawing the air pressure actuated, hand vacuum cleaner **20** of the invention, in the lowest cost, embodiment of FIGURES 1 and 2, consists essentially of the elongated hollow tube, or body, **21** of predetermined length and internal diameter, the angled air pressure nozzle **22** mounted alongside the flow passage **23**, intermediate of the suction mouth **24** and the discharge opening **25** plus the flexible tube air supply means **26** for connecting the nozzle to a source of air under pressure **27**.

The elongated tube, or body, **21** is preferably of rigid material such as plastic, or metal, and in the form of a hollow cylinder of uniform internal diameter of about one and one half inches for household or automobile. The internal diameter is deisgnated D in the drawing and other preferred dimensions are specified in relation to D. It will be obvious that a vacuum cleaner, used for snow **31**, or sand, as in FIGURE 2, would preferably have a flow passage of more than one and one half inches in internal diameter and the other dimensions increased proportionately.

I have discovered that the distance between the suction mouth and the nozzle and the distance between the nozzle and the discharge opening is critical. If the nozzle is less than about one inch or 1D, in rear of the suction mouth, and the distance between the nozzle and the discharge opening is less than about one and one half inches, or about 1½D, vacuum is only fair and the device may have difficulty picking up coins or other relatively heavy objects. Thus it has been found that a tube of D internal diameter should be at least about 2½D in length, with the

nozzle 1D in rear of mouth 24 and 1½D in advance of opening 25 in order to pick up coins, cigarette butts, dirt, dust and the like. As shown in FIGURE 1, best results have been attained with the nozzle located substantially centrally, or intermediately, or the body 20, and flow passage 23 about 5D in rear of the mouth 24 and about 5½D in advance of the discharge opening 25.

The nozzle 22 in the illustrated embodiment has an orifice 28 of about 1/16 of an inch in diameter, converging from an internal diameter of 3/16 of an inch in the flexible tube 32, which forms part of the flexible tube, air pressure supply means 26. With relation to D, the orifice 28 therefore is about 1/20D in internal diameter and the tube 32 is about 3/20D in internal diameter. The air pressure supply source 27 may be a conventional compressor and motor of the type used in paint spraying, or may be mill supply if the device is used in a factory. However, for automobile use the source 27 can conveniently be the conventional air pressure tube used in filling stations for pumping tires, the available pressure in most such installations ranging from 0 to 150 p.s.i. Too great a pressure may fracture an air pervious, dust, collection receptacle such as shown at 33, or may blow it off the tube, so that pressures in the area of 30 p.s.i. are recommended for cleaning the floor mats and upholstery of automobiles. However, when used without a receptacle, for moving snow or sand, pressures as high as are available are satisfactory, the greater the pressure, the greater the suction if the dimensions taught herein are used.

The dust collection receptacle 33, may be of any well known disposable type such as are commercially available from Electrolux Corporation of New York, N.Y. or such as are sold as vacuum cleaner bags for hand vacuums by any of the various chain stores such as the Grant Maid type sold by W. T. Grant Co. An integral shoulder, 34, or a pair of integral bosses, may be provided on the tube 21 to retain the bag.

The tapered air ejector nozzle 22 is mounted in the wall 35 of the tube 21, alongside the flow passage 23 so as to be out of the path of the air flow through the passage. The longitudinal central axis of the nozzle, designated 36 is angularly disposed to the longitudinal central axis of the tube, designated 37, at an angle of about 30°, the nozzle directing pressurized air along the flow passage toward the discharge opening 25, and bag 33, to draw air in the suction mouth 24. Preferably the axis of the nozzle 22 is also angled slightly laterally, for example 5°, to create a helical air flow path in the effluent section 40 of the tube to give a cyclone effect or helical air movement found to be beneficial.

The suction mouth 24 is unobstructed, as are the flow passage 23 and the discharge opening 25. However, the effluent end 41 of the wall 35 of tube 21 is preferably obliqued as shown so that there is an overhanging baffle portion, or hood, 42 which tends to direct dust and dirt laterally away from the hood and downwardly to the bottom of the bag 33.

Preferably the cleaner 20 includes the integral handle means 43, which is hollow to receive and protect the tube 32 and to secure the air ejector nozzle 22 at the correct angle. The base 44 of the handle is, therefore, at the location of the nozzle and upstands from the tube. It then turns rearwardly at 45, parallel to the axis 37 of the tube to form a hand grip portion 46.

As shown in FIGURE 2, the cleaner 20 may be used, without a dirt bag, to extract material such as snow or sand 31, from a pile, and discharge the material to a desired location such as into a truck 47, or wheelbarrow. A collector tube 48 may be sleeved on the effluent section 40 to guide the material if desired. Such extensions on the influent section 49, or on the effluent section 40, give excellent results. For example a thirty-eight inch tube extension sleeved on the influent section 49, over the suction mouth 24, was found to pick up coins with ease.



In FIGURE 3 another embodiment of the invention is shown, in which a hollow plastic housing 52, having a handle 53, similar to a flashlight casing, is provided. The tube 21 extends longitudinally through the housing, being received in aperture 54 in the front wall 55 and aperture 56 in rear wall 57. The air supply tube 32 passes through the hollow handle 53 and the nozzle 22 is at the base of the handle. The tube 21 is straight and of rigid material projecting from the housing 52 to provide the essential length of influent section of the tube. A suction nozzzle 60, is sleeved on the tip of the influent section 49, over the suction mouth and is turnable thereon. The nozzle 60 is flared outwardly at 61 and provided with an elongated suction slot 62 at the terminal end thereof. The bag 33 is of the Electrolux type and mounted on the tube outside the housing.

In FIGURE 4 another embodiment is shown, wherein the housing 70 is of small size but just large enough to hold a miniature type vacuum cleaner bag 71 about four inches in length. The tube 72, corresponding to tube 21, is of minimum length for diameter D, namely about two and one half inches. The housing 70, supports the tube in the front wall 73 of its base portion 74 and is provided with the cover 75 threadedly connected to base portion 74 at 76, so that the cover may be removed to replace the bag. Cover 75 has the usual air discharge aperture 76, the handle 77 is integral with the base portion 74 and contains the nozzle and air tube.

FIGURE 5 is a front view of the device of FIGURE 3 and shows the slight lateral angle of the nozzle which creates the helical, cyclone air path.

What is claimed is:

1. An air pressure actuated ejector device of the hand carried vacuum cleaner type, said device comprising:
- an elongated, unitary hollow tubular body of rigid, self-supporting material, said body having a fluid inlet at one end, a fluid outlet at the other end, and a longitudinally extending, unobstructed flow passage of uniform cross section connecting said inlet and outlet;
- a single tapered fluid ejector nozzle mounted in said body about midway of said ends with the orifice thereof alongside, and connecting with, said passage, said nozzle being angled toward said fluid outlet at an angle of about thirty degrees to the central longitudinal of said passage and being angled at about five degrees laterally to create a slightly helical flow path therein;
- integral handle means on said body including an upstanding base portion proximate said nozzle and a hand grip portion extending in parallelism with said body at a spaced distance therefrom;
- fluid pressure supply means including a flexible tube leading to a conduit within said handle means, said conduit connecting with said nozzle to deliver pressurized fluid therefrom; and
- collection means including an air pervious receptacle and an integral projection on said body proximate the fluid outlet end thereof, said receptacle being detachably secured on said integral projection.

2. An air pressure actuated ejector device comprising:
- an elongated, hollow body having a fluid inlet at one end, a fluid outlet at the other end and a longitudinally extending, unobstructed flow passage of uniform cross section connecting said inlet to said outlet;
- a single tapered, fluid ejector nozzle mounted in said body, intermediate of said ends, with the orifice thereof alongside and communicating with said passage, said nozzle being angled toward said fluid outlet at an angle of about thirty degrees to the central longitudinal axis of said passage, and being angled laterally at an angle of about five degrees to direct fluid under pressure along said passage toward said outlet in a slightly helical, or cyclonic, swirling flow path;

a handle integral with said body, said handle having a base extending outwardly therefrom proximate the location of said nozzle and then extending rearwardly, in parallelism with said body, toward said outlet, to form a hand grip at a spaced distance from said body;

conduit means within said handle, extending from said nozzle along said hand grip, said means including a flexible tube;

and fluid pressure supply means connected to said flexible tube for delivering fluid under pressure from said orifice to urge any contents within said flow passage from the inlet to the outlet thereof.



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ROBERT W. MICHELL, *Primary Examiner.*

U.S. Cl. X.R.

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