Sept. 9, 1958 S. A. SWALLERT 2,851,213

COMPRESSED-AIR OPERATED VACUUM CLEANERS

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Fig. 1

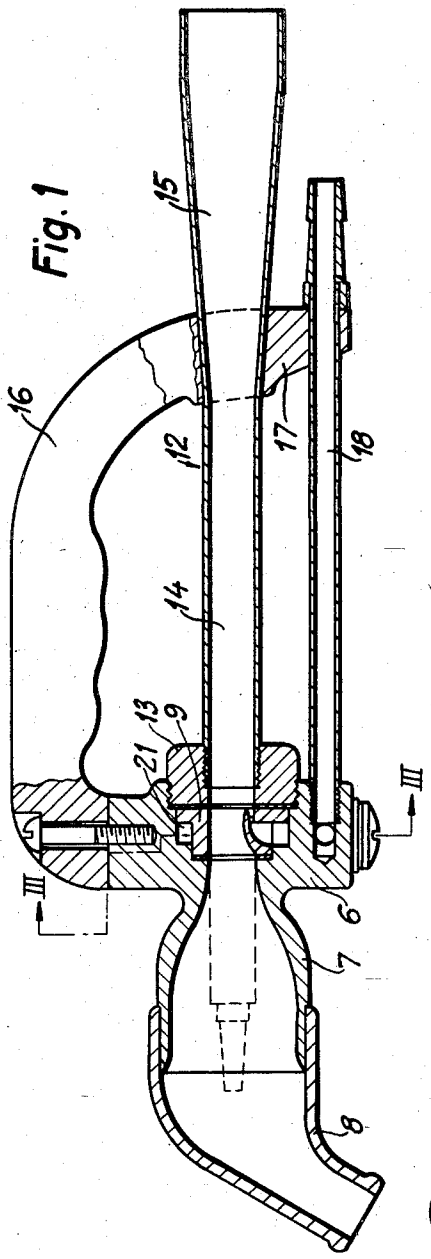

Fig. 2

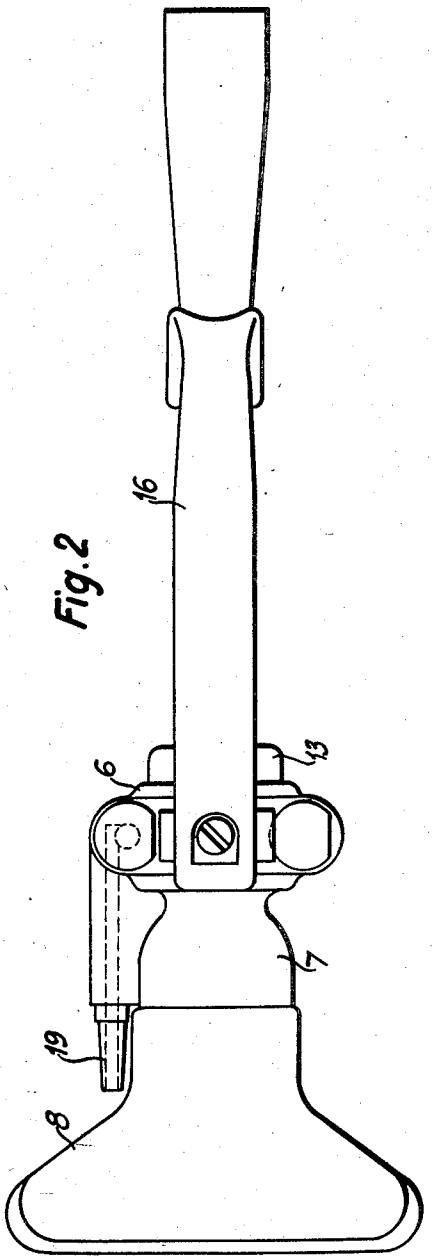

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Fig. 3

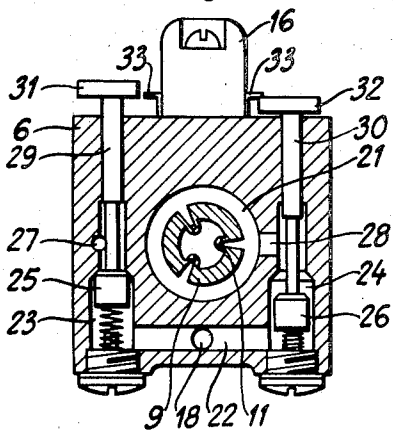


Fig. 4

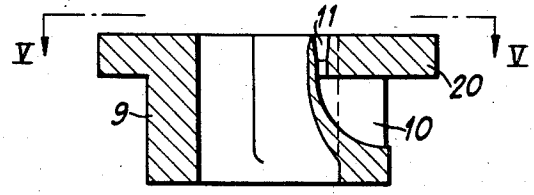
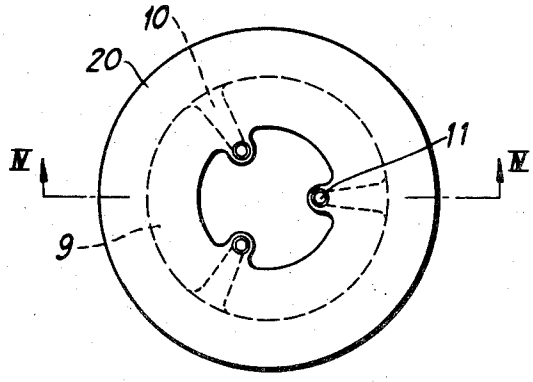


Fig. 5



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COMPRESSED-AIR OPERATED VACUUM CLEANERS

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Application December 4, 1951, Serial No. 259,822

Claims priority, application Sweden December 6, 1950

2 Claims. (Cl. 230—95)

The invention relates to a compressed-air operated vacuum cleaner of the type comprising an ejector, a suction nozzle and one or more jets for compressed air ending at the inner end of the ejector, said ejector having an inner cylindrical portion continued by an outer conical portion widened outwardly.

It has now been found that a considerably improved effect is obtained with such vacuum cleaners, if the ejector and especially its cylindrical portion are given certain dimensions which have not heretofore been proposed. Thus, experiments leading up to the present invention have shown that said cylindrical portion must be of a length of at least 7 times but preferably not more than 10 times its inner diameter, while the conical portion has a vertex angle of 5–9 degrees. The relation between the diameters at the outlet and inlet of said conical portion may be 1.5–3.0 or preferably 2.0–2.5.

Moreover, the jets for supplying compressed air to the ejector must be widened conically onto their orifices, the relation between their greatest and smallest cross section areas being 1.5–2.5 at a vertex angle of the cone of at most 15 degrees.

In this way it has been possible to increase the maximum vacuum, i. e. suction power, essentially, if a maximum consumption of compressed air is maintained, and correspondingly to decrease the consumption of compressed air, if the maximum vacuum obtained by prior devices is to be maintained. For most purposes this latter vacuum may be altogether sufficient.

To exemplify the improvement in effect obtained by the invention it may be mentioned that a vacuum cleaner having the dimensions as stated above gives a vacuum of a 1455 millimeter water column at a working pressure of 7 atmospheres gauge pressure and a consumption of air amounting only to 201 liters per minute. In using one of the most effective conventional vacuum cleaners of this type at the same working pressure a maximum vacuum of 1345 mm. water column is obtained at an air consumption of 501 liters per minute.

The vacuum cleaner according to the invention will be described in greater detail in the following description and with reference to the accompanying drawings which show a preferred embodiment.

In the drawings:

Fig. 1 shows a longitudinal section of the apparatus,

Fig. 2 shows a top view of the apparatus in Fig. 1,

Fig. 3 shows a section along the line III—III in Fig. 1,

Figs. 4 and 5 show, in an enlarged scale, a detail in section and a top view thereof respectively.

As seen in Figs. 1, 2 and 3 the vacuum cleaner includes a compact body **6** supporting the other elements of the apparatus. Said body is preferably made by casting and is provided with a central bore as well as channels for supplying air. One portion of the body projects to the form of an extended pipe socket **7** to carry a suction nozzle **8**. A cylindrical element or sleeve **9** (see also Figs. 4 and 5) inserted in the central bore is provided with three passages for injecting pressure gas. Each of these

passages consists of a channel **10** passing through the envelope surface of the cylinder **9** and connected to a jet **11** directed axially and ending at one end of the cylinder. The jets are of the dimensions as stated above and are adapted to blow pressure gas into an ejector tube **12** mounted in front of them. As seen in Figs. 4 and 5 the jets are provided in bulges projecting from the inner wall of the cylinder **9**, the inner diameter of which is equal to the inner diameter of the cylindrical portion of the ejector. The purpose of this device is that the inner surface of the ejector **12** may form a direct continuation of the main part of the inner surface of the cylinder **9** so that a smooth passage for air from the suction nozzle **8** is obtained. The cylinder **9** is kept in position by means of a bushing **13** threaded in the body **6**. The ejector tube **12** is in turn threaded in this bushing.

As mentioned above the ejector has a cylindrical portion **14** adjacent the jets continued by a conical portion **15** in which the traversing flow of air is retarded in increasing the static pressure. In the embodiment shown the distance from the orifices of the jets **11** to the inner end of the conical tube portion **15** is about 8.5 times as large as the inner diameter of the cylindrical tube portion **14**. The conical portion is of the same length and has a vertex angle of about 8 degrees. The ratio of the diameter of the outlet to the diameter of the inlet is 2–1.

Besides, to obtain the maximum suction from the arrangement as herein described and illustrated, the jets **11** will have the form and dimensions indicated above. In fact, these dimensions are calculated such that the pressure of the air emerging from the orifices of the jets will be quite as great as the static pressure at the beginning of the mixing passage (in front of the inner end of the tube **12**), provided that the static pressure is half the maximum vacuum.

To collect dust a bag of fabric or similar material, not shown, is fixed in the usual manner to the outer end of the ejector **12**.

A handle **16** is provided with one of its ends fixed to the outside of the body **6** and its other end has two bores to support the ejector **12** and a tube **18** for supplying compressed air to the jets **11** through a valve. The apparatus is also provided with a blower jet **19** connected to the tube **18** by means of another valve.

The end of the cylinder **9** adjacent to the bushing **13** is provided with an outer flange **20**, which together with the envelope surface of the cylinder and the inner wall of the bore in the body **6** forms an annular channel **21** (Fig. 3) for distributing compressed air to the channels **10**.

The channels for supplying pressure air to the channel **21** and to the blower jet **19** are shown in Fig. 3. The tube **18** discharges into a traversing channel **22**, the two ends of which are in communication with channels **23** and **24** respectively. The channel **23** is connected to a channel **27** communicating with the blower jet **19** and is normally closed by a spring-actuated valve member **25** inserted between the channels **22** and **27**. The channel **24** is in a similar way connected to a channel **28** communicating with the annular channel **21** for supplying pressure air to the jets **11** and is normally closed by a spring-actuated valve member **26** inserted between the channels **22** and **28**. The two valves **25** and **26** may be opened by depressing knobs **31** and **32** fixed to the outer ends of valve spindles **29** and **30** respectively. The upper portions of these spindles are rotatably connected to the lower portions to make possible a rotation of the knobs. As appears from Fig. 2 each knob has a chamfered edge to allow its depression, when turned into a certain position, without engaging a stop member **33** projecting from the handle **16**. When depressed the knob may be turned somewhat to be retained in such position by the stop **33**

so that the valve is kept opened. The device is such that both knobs **31,32** may easily be operated by the thumb of the hand grasping the handle. Hereby the other hand is free to be used for other operations.

The apparatus described above and shown in the drawing may, of course, be modified as to a variety of alternate constructions without departing from the scope of invention.

I claim:

1. An ejector for use with a compressed-air vacuum cleaner, said ejector having a smooth inner surface along its entire length and consisting of a plurality of jets directed in the direction of the axis of the length of said ejector, a cylindrical inlet portion extending directly from the jets and a conical outlet portion which is widened outwardly, said cylindrical portion having a length of 7–10 times its inner diameter, and said conical portion having a vertex angle of 5–9 degrees and a ratio between its diameters at the outlet and inlet of about 2.0 to about 2.5.

2. An ejector for use with a compressed-air vacuum cleaner, said ejector having a smooth inner surface along its entire length and consisting of a plurality of jets directed in the direction of the axis of the length of said ejector, a cylindrical inlet portion extending directly from the jets and a conical outlet portion which is widened outwardly, said cylindrical portion having a length of about 8.5 times its inner diameter, and said conical portion having a vertex angle of 5–9 degrees and being substantially the same length as the cylindrical portion.

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