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SUCTION NOZZLE

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This invention relates to suction nozzles and more particularly to nozzles useful on rugs, carpets or the like. The nozzles contemplated herein may be provided with relatively fixed brushes at or near the suction opening. While such fixed brushes have some degree of motion relative to the nozzle, nevertheless they may be considered as more or less fixed.

In cleaning carpets by suction, two extreme conditions must be provided for. Thus, deep cleaning of carpets requires that air be pulled through the carpet so that deeply embedded dust and dirt may be removed. Surface cleaning requires that lint, pieces of paper and the like on top of the carpet be pulled up and away from the carpet surface. Both types of cleaning require different operating conditions and thus might require different nozzles. However, it is impractical to expect a change of nozzles, since few people would make the change.

For deep cleaning, it is necessary to have the suction opening substantially sealed against the carpet so that the suction is exerted over the enclosed carpet area. The effective or equivalent nozzle area is the integrated sectional areas of the pores or passages through the carpet taken by whatever air is pulled in. This deep cleaning equivalent nozzle area is small in comparison to the smallest sectional area in the rest of the suction system and thus represents a concentrated air flow resistance large in comparison to that of the rest of the system. It is obvious therefore that the pressure drop or suction lift will be concentrated at the equivalent nozzle and in conventional cleaners may attain a value of thirty or forty inches of water.

The suction will be exerted on the carpet and tend to pull air therethrough. Because of the high flow resistance, a small volume of air will be pulled through and this air will travel at a high velocity from the carpet due to the steep pressure gradient. However as the air emerges inside of the suction tool body the cross section of the effective air path is greatly increased. This means a sharp decrease in air flow resistance and naturally a greatly reduced speed of air flow.

The work done by an air propeller is a function of the mass of air moved. Hence when deep cleaning conditions obtain, the reduced air flow in the suction generating means results in a light load on the propeller. This reflects itself in a decidedly higher motor speed, the motor generally being a series type.

For surface cleaning however, a powerful blast

of air along the carpet surface is necessary. Such a blast will pull off lint, hair, etc. both from the carpet and from the brush. The present type of cleaner nozzles do not provide a satisfactory blast so that reciprocatory movements of the nozzle over a carpet merely result in transfer of dirt, lint, etc. from carpet to brush and back again. For both surface and deep cleaning, it is desirable to have the cleaning air move at maximum velocity. This means therefore that the air flow resistance at the cleaning nozzle should be large in comparison to the resistance of the rest of the suction system. Hence the equivalent nozzle area for surface cleaning should not be too large in comparison to the sectional area of the air paths in other parts of the suction system.

As the equivalent nozzle area for surface cleaning is increased, the suctional lift in the nozzle region will decrease and the volume of air moved will increase. To have an equivalent nozzle area for surface cleaning about equal to that for deep cleaning is generally undesirable and in fact practically impossible to attain. As a rule, the equivalent nozzle area for surface cleaning may be many times that for deep cleaning.

The nozzle area for surface cleaning is only effective at the carpet surface. Hence any nozzle opening extending above the carpet surface loses its effectiveness as the distance above the carpet increases. In practice, the nozzle opening must have an appreciable dimension perpendicular to the carpet surface to permit surface dirt to remain in the surface air stream and enter into the nozzle interior. This vertical dimension may vary within wide limits.

Obviously the length of the nozzle opening along the carpet surface will have an important bearing on the permissible vertical dimension.

The desirable area of the surface cleaning nozzle will naturally vary in accordance with the overall characteristics of the suction system. Thus if the system maintains a more or less uniform lift for a certain nozzle opening independently of the dirt in the filter or storage part of the system then a definite nozzle area will have uniform surface cleaning properties. Such a suction system is disclosed in Yonkers' Patents 2,198,568; 2,242,277, and 2,242,278. However, with a conventional bag type of cleaner for example, as the dirt content increases, the air flow resistance of the filter goes up. With such a system, it is possible for the bag to be full and have such a high air flow resistance that the resistance of any surface cleaning nozzle could

not be high in comparison to the rest of the system. This would result in little air at a low velocity coming into the surface cleaning nozzle. This represents an extreme case. In practice, an average bag resistance may be assumed. Then the surface cleaning nozzle may have a definite equivalent area and on the average perform in a definite predetermined manner.

For the above reasons, the exact area and dimensions of the surface cleaning nozzle is a matter of design dependent upon the characteristics of the suction system as a whole, assuming of course that equal surface cleaning results are contemplated. In all suction systems, however, the equivalent nozzle area should remain at the predetermined values. Thus an increase in the nozzle area results in a reduction of the flow resistance and generally a decrease in the air velocity at the cleaning nozzle. It should be borne in mind that as the nozzle resistance goes down and approaches that of the remainder of the system that the air velocity in the nozzle goes down while the air velocity in the rest of the system may go up. Since it is the air velocity at the cleaning nozzle which must pull off dirt from the surface of the carpet, a decrease there may be serious. Where the nozzle along the carpet surface has a substantial length, a slight increase in the vertical dimension is equivalent to a great increase in nozzle area.

It is clear therefore that while present types of nozzles may be manually tilted for surface cleaning, nevertheless the tilting must be very accurate for effective operation.

As pointed out before, surface cleaning is preferably carried out with a larger volume of moved air than deep cleaning. The increased volume of air for surface cleaning naturally represents an increased load on the fan and motor and results in the motor slowing down. If the change from deep to surface cleaning is made suddenly, the increased speed at light load represents a certain amount of kinetic energy in the system which tends to keep the fan and motor going at a higher than normal speed for the surface cleaning load. This of course represents a temporary increase in power of the blower system and results in a sharp and more powerful suction at the surface nozzle. Hence a sudden change from deep to surface cleaning results in temporary but powerful suctional forces tending to pull dirt into the cleaner system.

This invention provides a construction whereby a suction nozzle may be effectively used for deep cleaning or surface cleaning. By virtue of the invention, the relationship between the tool and surface to be cleaned is changed to provide effective operating conditions for either type of cleaning.

In its more generally aspect, the invention provides a nozzle which when moved in one direction operates for deep cleaning and when moved in the reverse direction operates for surface cleaning. When used for deep cleaning, the nozzle has its suction opening edges in contact with the carpet surface so that a more or less perfect seal against air coming along the carpet surface is provided. For surface cleaning, at least one edge of the opening is raised above the carpet surface for a distance to provide desirable surface cleaning action.

Various means for accomplishing the change of nozzle position may be provided. As disclosed herein, frictional means engaging the carpet surface are utilized. Such frictional means, in one

position, permit a sealing contact of suction opening on carpet for deep cleaning and, in the other position, provide an air path along the carpet surface into the nozzle interior for surface cleaning.

Referring now to the drawing:

Figure 1 shows a sectional elevation from the rear of a cleaning nozzle;

Fig. 2 is a top view looking down on nozzle;

Fig. 3 is a side view of a nozzle in a surface cleaning position;

Fig. 4 is a view similar to Fig. 3 but showing the nozzle in a deep cleaning position; and

Fig. 5 is a detail of one of the cams.

The nozzle comprises a discharge portion 10 and body 11. Discharge portion 10 may have a reduced circular section and may lead directly to a blower mounted with the nozzle for movement on a floor or through a pipe to a tank carried blower. In any event, a handle, not shown, is used for moving the nozzle along a rug or carpet.

Body 11 extends on each side of discharge portion 10 and includes front wall portion 12, rear wall portion 13 connected by side walls 14 and 15. The entire nozzle may be formed in one piece of metal or plastic and may have a variety of shapes and sizes. Front wall 12 has a forwardly extending lip 16 whose bottom surface 17 normally lies on the floor surface. Sides 14 and 15 have their free edges also normally on the floor surface.

The free edges of the front, rear and side walls define a suction opening. The relationship of this suction opening to the surface to be cleaned, such as a carpet for example, is controlled by the following means: Side walls 14 and 15 have a portion thereof, here shown as adjacent rear wall 13, finished smooth and support bolts 20 extending outwardly therefrom. Sleeves 21 are disposed around bolts 20 and form journal surfaces upon which eccentric rollers 22 and 23 may turn. These rollers may have milled outer surfaces if desired. The roller size and eccentricity is such that in one roller position, the suction opening may rest flat on a carpet surface for substantial sealing engagement. This is shown in Fig. 4. The other roller position tilts the nozzle so that one transverse edge, here the rear edge, is raised clear of the carpet for a predetermined distance. Thus, optimum surface cleaning conditions may be obtained. This position is shown in Fig. 3.

In order to provide definite roller positions corresponding to the two nozzle positions, it is preferred to have sides 14 and 15 cut out to form stop portions 25 and 26 to limit roller turning movements. Hence, when the nozzle is moved along a carpet for normal cleaning, the rollers will be turned to their end positions and then slip.

Carried by the nozzle and preferably by the wall near the suction opening, here wall 13, is a removable brush assembly 30. This may include pins 31 extending from a brush body 32 from which bristles 33 extend. Pins 31 are slidable up and down in slots 35 on rear wall 13. A cover plate 36 locks the brush assembly to the nozzle wall. The entire brush assembly is biased down against a floor surface by leaf spring 37 cooperating with an ear 38 extending from plate 36. A manual catch 40 operating in slot 39 may be used for locking the brush to an upraised position.

When the nozzle is in the surface cleaning position of Fig. 3, reverse movement of the nozzle on the carpet will have a tendency to pull off

lint and dirt from the bristles. This is partly due to suction through the bristles and partly due to the carpet pulling the dirt from the bristles and thence losing it because of the air blast along the carpet surface. It is understood that the bristle density and location is such as to permit air flow therethrough. Upon forward nozzle movement, deep cleaning will occur while the bristles pick up dirt from the carpet.

The means disclosed for changing the suction opening are simple, away from dust paths and may be readily applied to more or less standard nozzle structures.

What is claimed is:

1. A suction nozzle comprising a nozzle body having an elongated suction opening transverse to the line of normal nozzle travel during cleaning, a brush carried by said body outside of the suction opening and adjacent one transverse edge of said opening, one eccentric roller for each side of said nozzle body and adjacent said trans-

verse edge, said rollers engaging a carpet or the like during cleaning and in one position thereof raising said one transverse edge a limited predetermined distance above a carpet and in another position dropping said one edge to said carpet in substantially sealing engagement, said other transverse edge remaining in sealing engagements at all times and means for limiting said roller travel to a range whose end points are said two positions, said rollers being adapted to be turned to one position during nozzle travel in one direction and to the other position during nozzle travel in reverse direction and being prevented from passing beyond a position because of excessive nozzle travel in either direction.

2. The structure of claim 1 wherein said limiting means comprise stops on said nozzle body for limiting rotation of said rollers in either direction.

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