# United States Patent [19]

**Meyerhoefer**

[11] **3,750,221**

[45] **Aug. 7, 1973**


[54] **SONIC BEATER NOZZLE**


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[22] Filed: **Dec. 30, 1971**

[21] Appl. No.: **214,064**

[52] **U.S. Cl.** ..... **15/404,** 15/419

[51] **Int. Cl.** ..... **A47l 9/06,** A47l 11/40

[58] **Field of Search** ..... 15/404, 419



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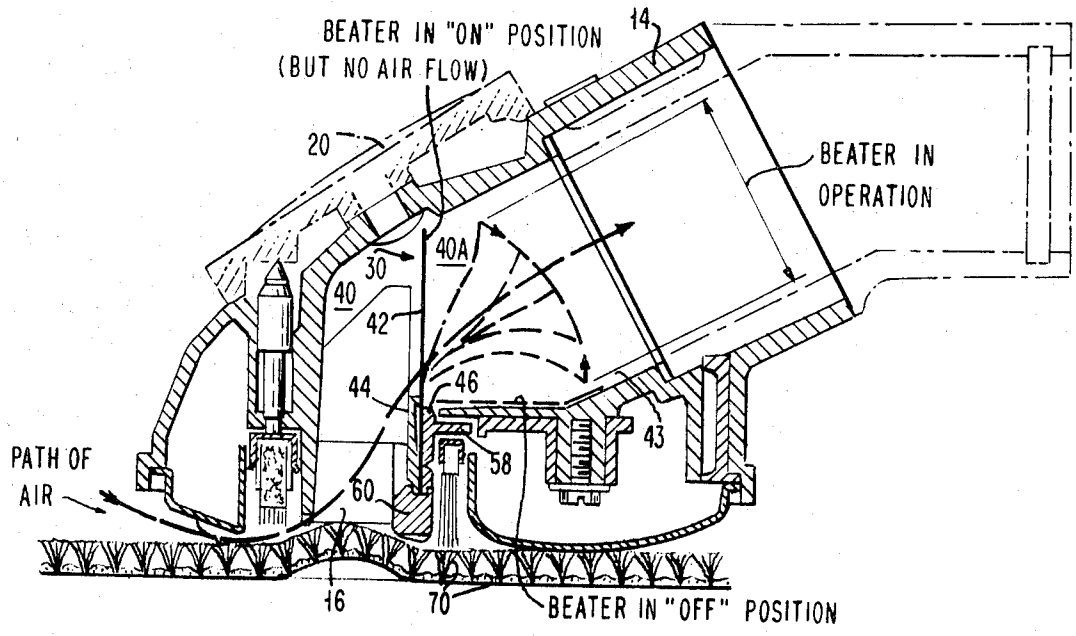
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[57] **ABSTRACT**

A vacuum cleaner suction nozzle which features a sonic beater, that is, a beating mechanism that relies on the pulsations in air flow produced by a vibratory member for directly achieving the requisite cleaning action. The beating mechanism dispenses with the use of a vibrating or agitating device in direct physical contact with the carpet surface. The vibrating member of the bearing mechanism is located near the discharge end of the suction nozzle such that is does not interfere with the removal of bulky objects as these are encountered in the cleaning operation. Moreover, the vibrating member, because of its whip-like movement, produces such marked changes in air pressure and air velocity that efficient cleaning of a carpet and the like is promoted. A disabling mechanism is also provided such that the vibrating member may be placed in a position where it will be unaffected by the air flow.


**7 Claims, 9 Drawing Figures**



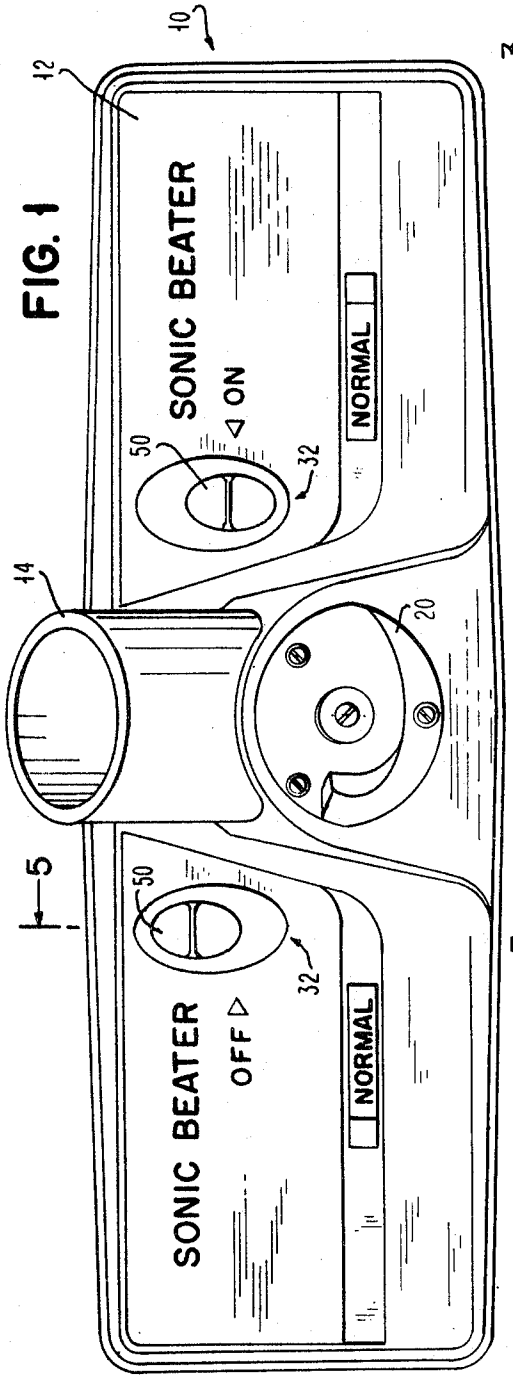



FIG. 1

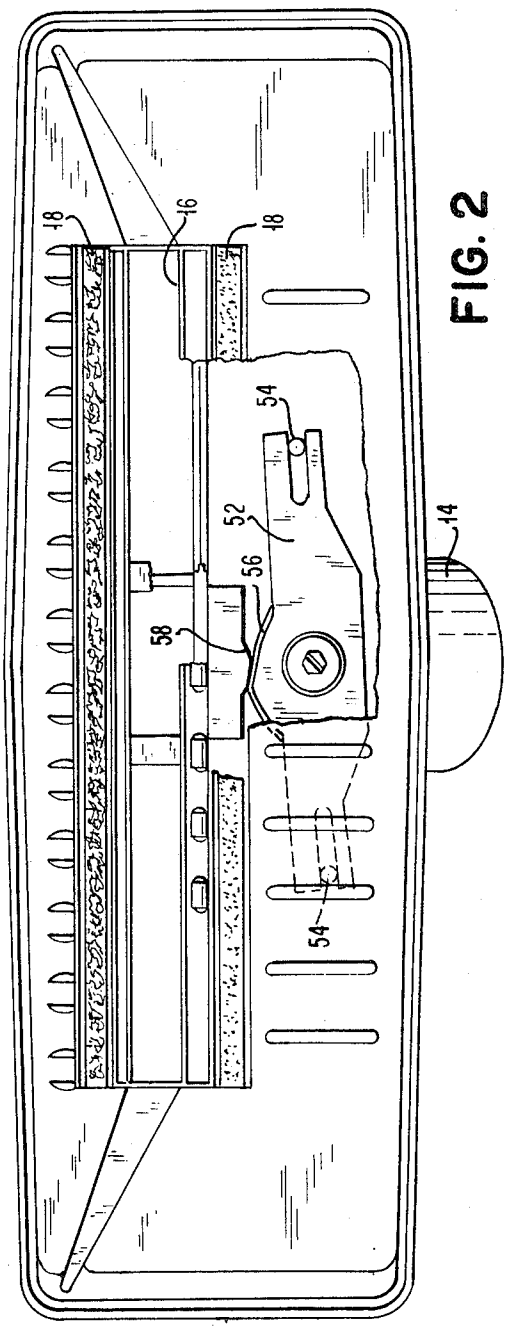



FIG. 2

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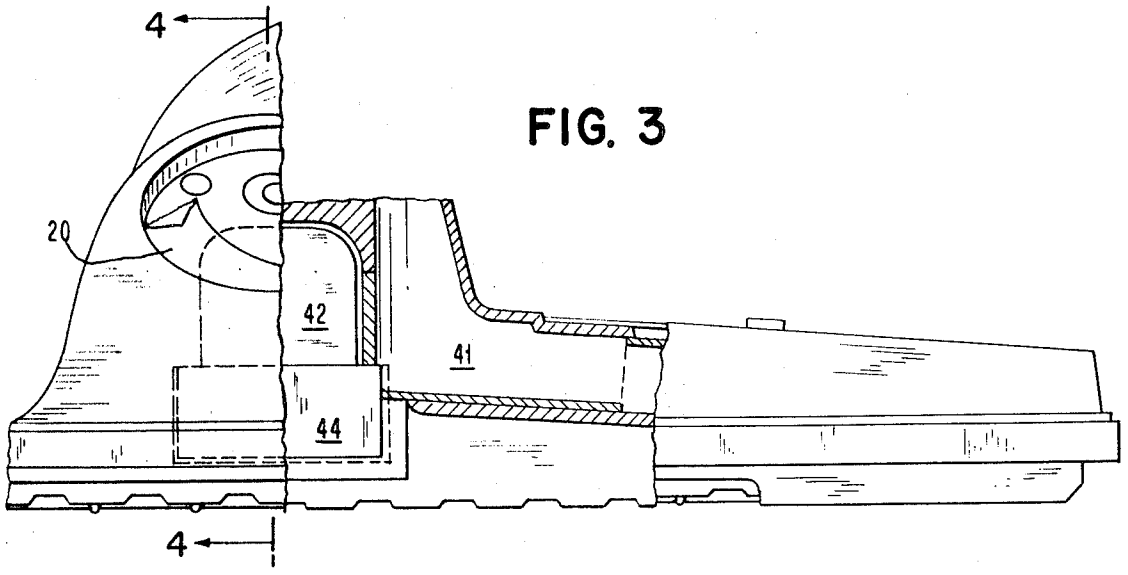



FIG. 3

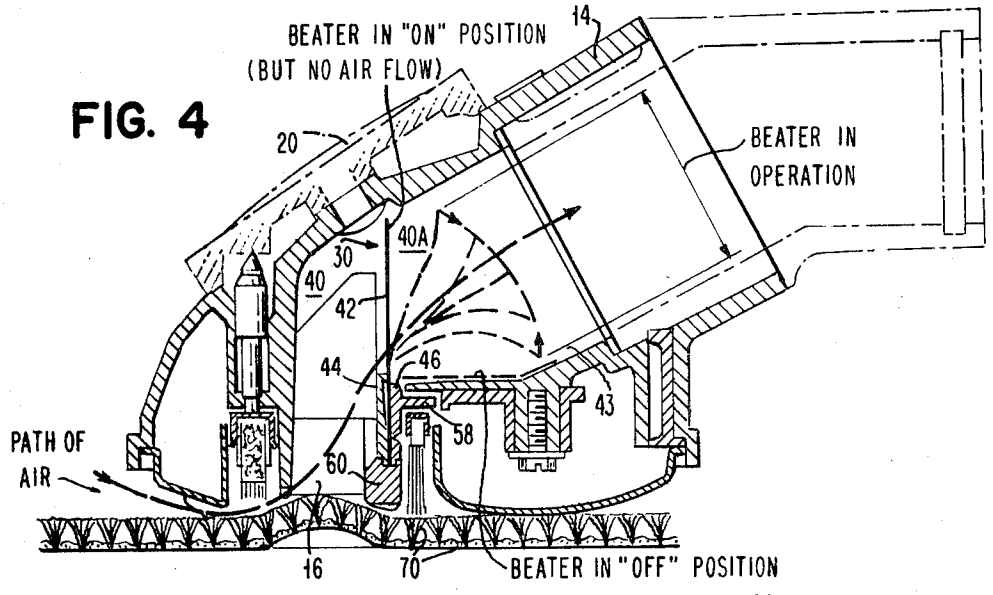



FIG. 4

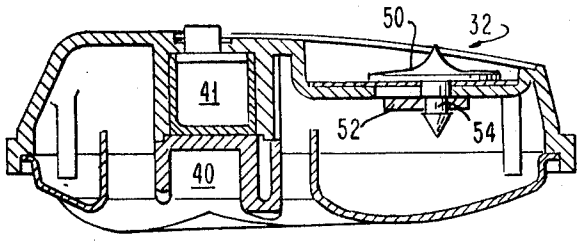



FIG. 5

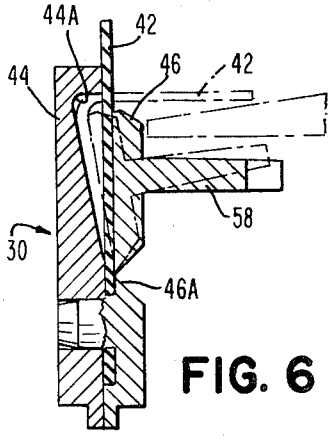



FIG. 6

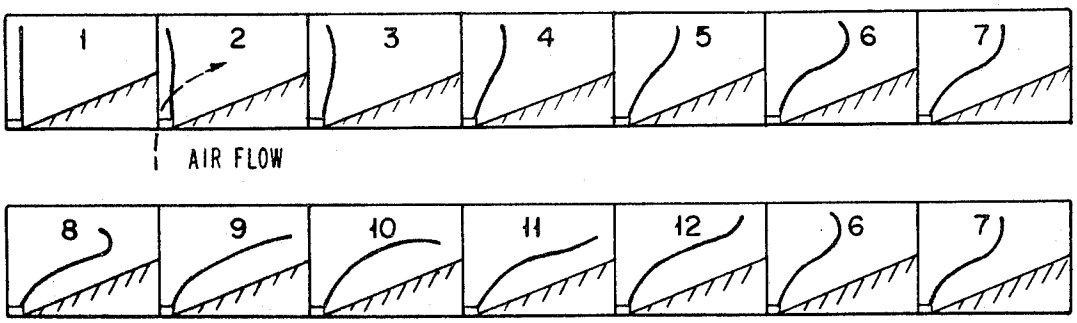



FIG. 7

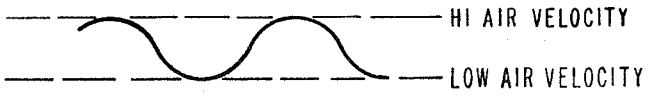



FIG. 8A

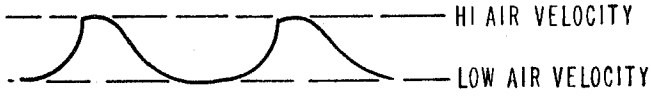



FIG. 8B

# SONIC BEATER NOZZLE

## BACKGROUND, OBJECTS, AND SUMMARY OF THE INVENTION

This invention relates to a suction nozzle especially adapted for use with a vacuum cleaner. More particularly, the invention relates to a suction nozzle which has an elongated inlet opening, or wide mouth, and is further provided with a beating mechanism for producing the desired cleaning action on carpets and the like.

It is well known in the vacuum cleaner art to provide a suction nozzle which is movable across an object to be cleaned, the suction effect created at the opening in the nozzle resulting in picking up free pieces of dirt accumulated on the object. However, ground-in dirt is frequently encountered with carpets or the like and reliance on simple suction for removal of such ground-in dirt has proven to be unsatisfactory.

For an understanding of some of the approaches taken to solving the aforesaid difficulty with ground-in dirt, reference may be had to U. S. Pat. Nos. 1,034,260 and 2,031,957.

In order to improve upon the cleaning action of vacuum cleaners in the context of removing ground-in dirt from a carpet, certain prior art constructions have provided a means for physically beating upon the carpet surface. It will be appreciated, of course, that wherever a means of physically beating upon the carpet surface is involved there is, as a necessary consequence, subjection of the carpet to such abuse as will inevitably result in shortened carpet life.

Prior art constructions have also been afflicted, regardless of the specific approaches that have been taken, with a seriously impaired efficiency because of clogging due to the accumulation of bulky items, such as hair, threads, and paper which are not able to pass around the beating means conventionally utilized and disposed at the nozzle mouth.

Accordingly, it is a primary object of the present invention to overcome the deficiencies and drawbacks in the prior art kinds of suction nozzles, as outlined above.

Another object of the present invention is to produce efficient removal from a carpet of ground-in dirt while avoiding direct physical contact of the beating mechanism with the carpet.

A further object is to promote efficient cleaning by keeping the nozzle mouth free of all mechanisms which would tend to inhibit passage of bulky items therethrough.

Another object is to permit disabling the beating mechanism when so desired.

The above objects are fulfilled by the several features of the nozzle of the present invention. Thus, the present invention provides within the nozzle a mechanism for directly beating the carpet by the pulsations produced in the flow of air in the passageway between an elongated inlet opening and an outlet opening. This beating mechanism takes the form of a flexible vibratory member movably mounted in the "throat" portion of the passageway. The vibratory member is capable of being disposed in two extreme positions, in one of which the vibratory member extends substantially transversely to the passageway. The vibratory member assumes this position when the beating mechanism has been placed, by a suitable selector device, in the operative or ON state, but conditions are such that there is no air flow through the passageway. The second extreme position



is assumed by the vibratory member when the beating mechanism has been placed in the disabled or OFF state. In this position the vibratory member extends longitudinally of the passageway in such a manner that it is unaffected by the air stream.

Further objects, features and advantages of the invention will be apparent from the following description considered in connection with the accompanying drawings which form a part of this specification.

## BRIEF DESCRIPTION OF DRAWINGS

FIG. **1** is a top plan view of one embodiment of the present invention.

FIG. **2** is a bottom plan view partly broken away and particularly illustrating the activating means for the beating mechanism.

FIG. **3** is an elevational view, partly in cross section, particularly illustrating the beating mechanism.

FIG. **4** is a sectional view taken on the line **4—4** of FIG. **3.**

FIG. **5** is a sectional view taken on line **5—5** of FIG. **1.**

FIG. **6** is an enlarged sectional view of the beating mechanism, particularly illustrating the disabling means provided.

FIG. **7** is a series of time frames depicting in slow motion, the movement of the vibrator device of the invention.

FIG. **8** depicts several waveforms, which illustrate the action of prior art devices and of the device of the invention.

## DESCRIPTION OF PREFERRED EMBODIMENT

Referring now to the drawings, there is illustrated in FIGS. **1–6** a preferred embodiment of the sonic beater mechanism of the present invention. Reference character **10** generally designates a suction nozzle comprising a body member or casing **12** and having a connector member **14** adapted to be connected to a suitable source of suction such as a vacuum cleaner. The suction nozzle **10** is conventionally provided with a central inlet opening **16** and a pair of side suction openings, not shown. The central opening **16** is flanked by a pair of brushes **18** or the like, actuatable by a dial **20** mounted on the top of the casing **12.**

It will be particularly noted that the inlet opening **16** is an elongated opening or "wide mouth," which is completely free of impediment; that is to say, there is no mechanism arranged and disposed so as to obstruct the wide mouth operation of the nozzle. Consequently, various kinds of litter as for instance buttons, paper matches, pieces of cookies, candy, wrappers and other bulky items cannot form obstructions and cause clogging of the nozzle mouth and passages.

A passageway **40** is defined within the casing **12** and extends from the inlet opening **16** to the outlet opening **43.** An optional passageway **41,** which merges with passageway **40,** extends from side suction openings not shown. Passageway **40** is provided with a restricted cross sectional area in the throat portion **40A,** adjacent the outlet opening **43.**

The beating mechanism in accordance with the present invention comprises a vibratory member **30** and an activating means **32.** The activating means is so designed that, when desired, the vibratory member can be placed in the normal, or operative, state such that powerful pulsations in air flow are produced. On the other

hand, when such pulsations are not desired, the vibratory member can be disabled by means to be described.

It will be seen, particularly by reference to FIGS. 4 and 6 that the vibratory member 30 is located at a significant distance from the inlet opening 16. As will be seen, the vibratory member normally extends transversely to the passageway 40 formed within the casing 12, being located at the restricted throat position 40A.

The vibratory member 30 is in the form of a three piece cartridge assembly comprising the vibrator 42, and the plates 44 and 46. The vibrator 42 is preferably made of natural rubber, while the plates 44 and 46 are formed of polypropylene material. It will be seen that the plate 44 has a scooped out or recessed portion 44A, further, it will be appreciated that the plate 46 is a "back-up" plate and is provided with a hinged portion 46A. As a consequence, the back-up plate 46 may be moved so as to force the vibrator 42 into the scooped-out portion of the rigid plate 44, thereby causing the vibrator to flip over at approximately a right angle (shown in dot-dash lines in FIGS. 4 and 6). Thus the vibrator 42 can be placed into a disabled position, which is its second extreme position, and which is perpendicular to the first extreme position, or upright position, already noted.

The first extreme position for the vibrator corresponds to the ON position for the beating mechanism of the present invention, under conditions of no air flow, while the flipped over position corresponds to the OFF position for the beating mechanism. The disabling means for achieving the flipped over condition, whence the vibrator 42 is not affected by air flow, will be understood from the fact that selector buttons 50 are mounted on the top of the nozzle 10. These buttons 50 cooperate with a walking beam lever 52 which is situated within the nozzle casing 12, as best seen in FIG. 2. Movement of the lever 52 by either of the buttons 50 is effected by reason of the rods 54 provided for this purpose. The lever 52 is provided with an integral cam 56 which is so constructed that, when the OFF position has been selected by moving the off button 50, the cam presses against projection 58 integrally carried by the hinged portion 46A of the back-up plate 46. Accordingly, upon selection of the OFF position, the cam 56 will move the hinged portion of the back-up plate 46 so as to flip the rubber vibrator 42 out of the air stream.

The vibratory member 30, including the rubber vibrator 42 and the two plates 44 and 46, is made in the form of a cartridge for easy assembly and replacement purposes. The entire cartridge or assembly slides into a dovetailed cutout or channel in a trough-like inserted member 60 which is used to define the nozzle mouth or opening 16. When the trough 60 is assembled to the casing 12, the cartridge is automatically locked in against displacement, whereby no special fastener is required.

It should also be noted that the parts of the cartridge are fitted together by a very simple round-peg-in-square-hole arrangement. Thus as seen in FIG. 6, a projecting peg 46B on the back-up plate 46 is suitably received by openings in the vibrator 42 and the rigid plate 44. This arrangement of course enables easy press fitting of the three parts of the cartridge.

## OPERATION

As indicated heretofore, the operation of the beating mechanism of the present invention is such that there is no physical striking of the carpet surface in order to dislodge ground-in dirt particles. Rather, when the vacuum motor is energized, the air stream flowing over the top of the flexible vibrator 42 causes it to move as indicated by the dash lines on the drawing. The vibrator 42 which, as can be seen, is in the form of a rubber tongue, closely matches in contour and size the restricted throat portion 40A of the passageway 40. The cross-sectional area of the throat portion 40A is much reduced in comparison to the portion of the passageway 40 immediately contiguous that opening. As a consequence of the close matching of the vibrator 42 with the restricted throat portion 40A, the movement of the vibrator alternately decreases and increases the free opening in the passageway. This makes the suction pressure alternately rise and fall while at the same time, and as a direct result, the velocity of air flow increases and decreases alternately and in rapid succession. It must be pointed out that the end of the flexible vibrator 42 does not merely flutter lazily but rather, it snaps back and forth violently, much in the manner of a "cracking whip," thus making the changes in air pressure and in air velocity extremely abrupt. It must be emphasized that the air flows over the vibrator 42 from the heel or bottom portion to the tip, causing the vibrator to "whip," that is, the tip moves beyond the deflection limit of the air stream. The successive stages of flexing that the vibrator goes through may be seen by reference to FIG. 7 in which the movement of the vibrator 42 is depicted in slow motion such that the deflection progress is illustrated by 14 time frames. The time frames 1–7 represent equal time intervals while time frames 8–12 together represent the same time interval as any one of the earlier time frames. In other words, each of the frames 8–12 is equal to one-fifth of the time interval shown by frames 1, 2, 3, etc. Frames 8–12 represent the "whip" portion of the fluttering movement. Such fluttering movement, which is common to all prior art devices, can be likened to a smooth sine wave, as shown in FIG. 8A. In contrast thereto, the action of the vibrator 42 is depicted by a wave such as is shown in FIG. 8B.

In the time frame sequence shown in FIG. 7, the time frames 1–5 show only the start of the movement of the vibrator 42. Once the movement has begun, frames 6–12 will repeat; hence it will be seen that following frame 12 frame 6 occurs and then frame 7. Frames 1–5 do not repeat. The "whip" of the tip starts at time frame 8 and is forced to the position shown in time frame 9 by the combined action of the air flow forces and the release of stored energy built up during time frames 2–8 due to the flexing of the resilient vibrator material.

In time frame 10 the tip has snapped beyond the air-induced deflection limit, causing the vibrator to bulge up at its heel into a relatively low pressure void. Such void is caused by the bending of the air stream at that point. At time frame 11 the tip begins to backlash and at time frame 12 it has fully snapped back into the air stream. The bulge at the heel becomes stressed as the air stream acts against the tip, as in time frame 6. In time frame 7 the bulge undulates toward the tip under the continued air stream pressure, until at time frames 8 and 9, the stored energy is again released. Thus, the cycle repeats. If it were not for the whipping action, which causes the bulging at the heel (in time frame 10), thereby storing energy, and the subsequent release of

that energy, thereby triggering another "whip," the action started in time frames 1–5 would quickly find equilibrium where vibrator tension balances the force of air — and the vibrator would simply be bent over in the direction of the air stream with no further action taking place.

As will be appreciated, particularly by reference to FIG. 4, the suction applied causes a small portion of the carpet 70, directly under the mouth or inlet opening 16 of the nozzle, to lift off the floor. By causing the suction pressure to rapidly rise and fall, the carpet under the nozzle mouth will be lifted and dropped in rapid alternations, that is, the carpet will be violently shaken. This tends to loosen dirt particles which may be trapped by the carpet tufts. In addition, the concurrent, alternate rapid changes in air velocity tend to loosen dirt particles which may be resting on the top surface of the carpet nap and may be clinging to the frayed ends of some of the nap fibers. Such a situation particularly obtains in the area immediately in front of and under the entrance restriction to the nozzle mouth at which point the air stream reaches its highest velocity. Rapid air pulsations will shake the nap fibers horizontally, in contrast to the vertical shaking described immediately above. Thus the carpet is subjected to intense agitation as an aid in the cleaning operation; however, the carpet is not subjected to mechanical abuse which, no matter how it is done, can only shorten the carpet life.

It has been found most desirable to adjust the period of vibration to 50 or 60 Hz. In this speed range, suction pressure variations are maximized. At lower speeds, the vibrations become undesirably erratic and at higher speeds, the variations in suction pressure become less pronounced, which is also undesirable. The speed of vibration is governed by the velocity of the air rushing past the vibrator, by the length, thickness and resiliency of the vibrator tongue and by the angle of the air stream to the vibrator top surface.

In the event that it is desired to stop the air beater action, as for instance when cleaning bare, hard surface floors, this can be readily accomplished by the means already described. Thus, the rubber tongue or vibrator 42 is flipped on its side against the base wall of the passageway 40, where it is completely out of the air stream and hence is effectively disabled so that it does not pulsate under conditions of air flow.

From the preceding description of the beating mechanism of the present invention, it will now be fully appreciated that the beating mechanism so provided fulfills the objects previously set forth, that is, to provide means for directly beating a carpet or the like by the pulsations produced in the air flow of a passageway formed in a vacuum cleaner nozzle; furthermore, to so arrange and locate the vibratory device and its associated parts so that efficient beating of a carpet is promoted and to permit disabling the vibratory device, when required, by very simple and accessible means. Moreover, the present invention provides a vibratory device which in contrast to prior art proposals, does not in any way interfere with objects picked up by the nozzle because the vibratory device is in a location away from the nozzle mouth or opening and does not in any way interfere with the cleaning operation, since even very large pieces of dirt which can get through the wide nozzle mouth will be able to move past the vibrator. This occurs because the extremely flexible tongue forming the vibratory member is readily deflected out of the way.

What is claimed is:

1. A vacuum cleaner nozzle comprising:
a casing having an elongated inlet opening, an outlet opening, and an elongated passageway connecting said inlet and outlet openings, said elongated passageway having a portion restricted in cross sectional area at a location removed from said inlet opening;
means for directly beating the object to be cleaned by pulsations produced in the flow of air in said passageway, including a flexible member mounted at one end, the other end being free for vibratory movement in the restricted area portion of said passageway, said member extending transversely with respect to said passageway under conditions of no air flow, and said member producing said pulsations by means of a whip-like motion toward the upper end of the passageway under conditions of air flow.

2. A vacuum cleaner nozzle as defined in claim 1 in which said elongated inlet opening is free of any beating mechanism.

3. A vacuum cleaner nozzle as defined in claim 1 further comprising activating means for placing said flexible member in either of two extreme positions, in the first of which said member extends transversely of said passageway and in the other of which it extends longitudinally against a wall of said passageway and toward the upper end thereof.

4. A vacuum cleaner nozzle as defined in claim 3 in which said activating means includes means for placing said flexible member in the other extreme position so as to disable said flexible member whereby it does not pulsate under conditions of air flow.

5. A vacuum cleaner nozzle as defined in claim 4 in which said means for placing said member in the other extreme position includes a selector device and two plates associated with said vibratory flexible member, the first of said plates being a back-up plate having a hinged portion and a projection adapted to be engaged by said selector device.

6. A device as defined in claim 5, in which said vibratory member is held between said plates and is forced, upon movement of said first plate, into a recess provided in said second plate so as to assume its second extreme position, thereby disabling said vibratory member.

7. A device as defined in claim 5, further comprising a pair of selector buttons, a walking beam cooperating with rods connected to said buttons for moving said back-up plate so as to disable said vibratory member.

* * * * *