

[54] VACUUM CLEANER HEAD WITH SUPERSONIC GAS JETS

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[51] Int. Cl. .... A47I 9/08

[58] Field of Search ..... 15/322, 345, 346, 354, 357, 15/402, 405-409, 420

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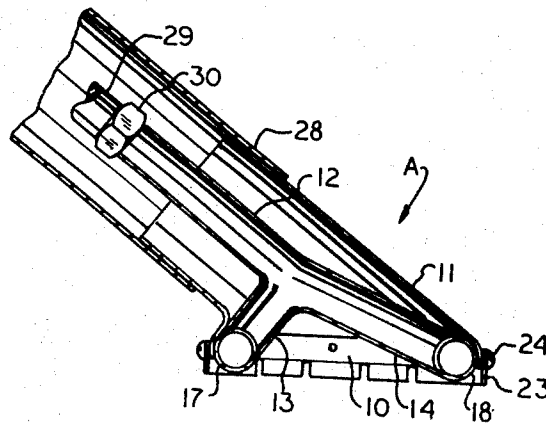
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ABSTRACT

A vacuum cleaner head has a high pressure gas line mounted therein said gas line having a plurality of orifices therein through which are emitted jets of a selected gas, such as air, at supersonic speeds. The jets are so directed that shock waves produced by the jet streams and the jet streams themselves impinge upon a surface being cleaned so as to dislodge from such surface stubborn dirt particles for removal by a vacuum line communicating with the interior of the head.

8 Claims, 6 Drawing Figures



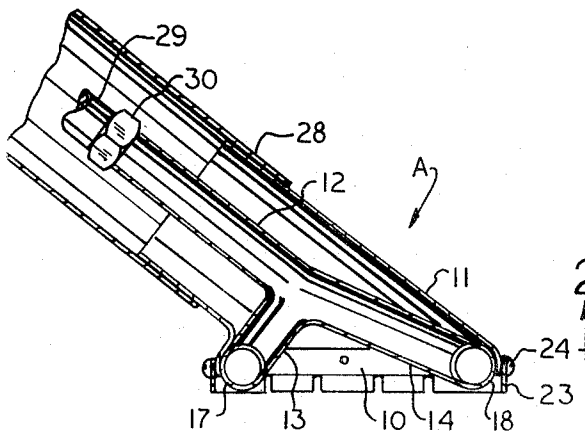


FIG. 2

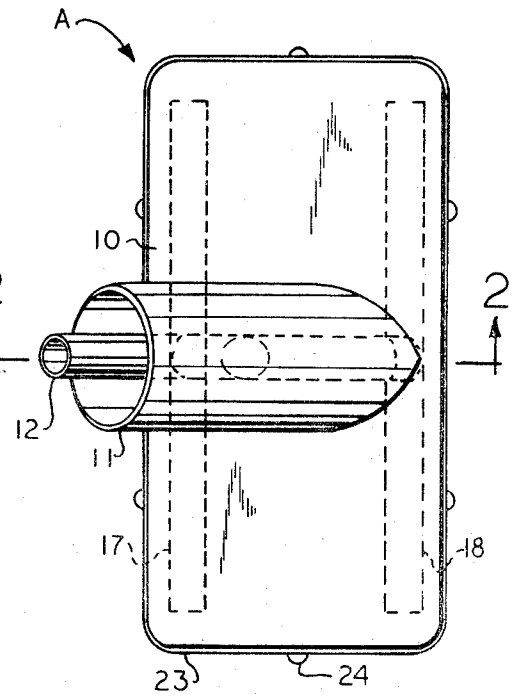


FIG. 1

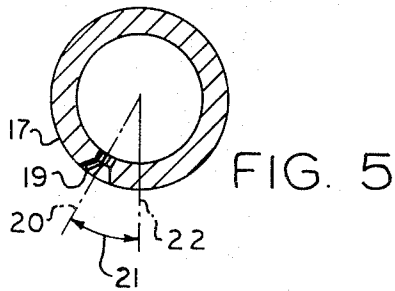


FIG. 5

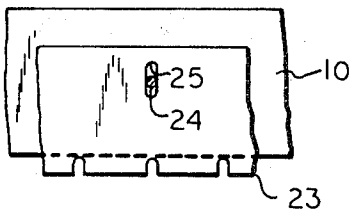


FIG. 6

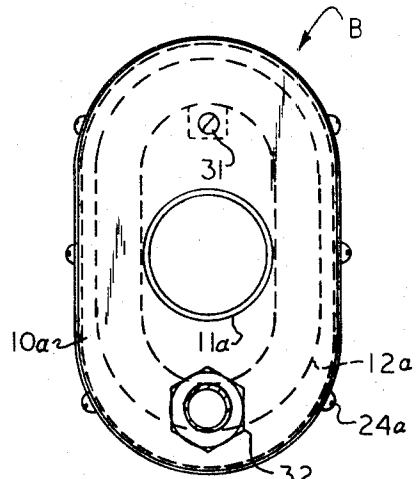


FIG. 3

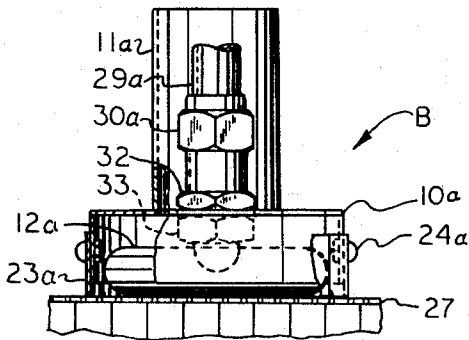


FIG. 4

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# VACUUM CLEANER HEAD WITH SUPERSONIC GAS JETS

## BACKGROUND OF THE INVENTION

While the art of vacuum cleaning has been practiced for many years, and it is also known to combine with a vacuum cleaner head means for discharging steam onto a surface being vacuum cleaned, such cleaning mechanisms have not proven entirely satisfactory for cleaning some surfaces having insoluble dirt particles or coatings firmly attached thereto or embedded therein.

One such surface is that of an acoustical honeycomb panel of the type comprising a honeycomb core, one side of which core is covered with a thin, imperforate facing sheet, and the other side of which is covered with a similar facing sheet having a multiplicity of small perforations therein communicating with the cells of the honeycomb core. The cells act as resonant chambers to dissipate and transform into heat sonic energy entering the cells through the porous face sheet.

In use the porous faces of these panels frequently get dirty, and the perforations become clogged or reduced in size, thereby impairing the sound absorptive properties of the panels. Known types of cleaning mechanisms have proven inadequate to properly clean these panels so as to restore their sound absorptive properties without danger of damaging the panels.

## PURPOSE OF THE INVENTION

A primary objective of the invention is to provide a cleaning mechanism wherein high velocity air jets are caused to impinge on a soiled surface to dislodge and render airborne stubborn dirt particles and incrustations which are then removed by suction. A further objective of the invention is to combine supersonic jets of a selected gas with vacuum to provide a cleaning mechanism capable of cleaning without damage soiled acoustical honeycomb panels and other soiled surfaces.

## BRIEF DESCRIPTION OF THE DRAWINGS

The foregoing objectives and advantages of the invention will be apparent from the following description and the accompanying drawings, wherein:

FIG. 1 is a plan view of a vacuum cleaner head embodying the invention.

FIG. 2 is a sectional view taken along line 2—2 of FIG. 1.

FIG. 3 is a plan view of a modified form of the invention.

FIG. 4 is an end elevational view of FIG. 3, portions being broken away, and includes a section of a surface being cleaned.

FIG. 5 is an enlarged, cross sectional view of the high pressure gas tube taken axially through one of the supersonic jet orifices.

FIG. 6 is an enlarged, fragmentary view showing a portion of the vacuum head shell wall with the notched, boundary strip in vertically adjusted position thereon.

## DETAILED DESCRIPTION

Referring to the drawings in detail, a preferred illustrative embodiment of the invention shown in FIGS. 1, 2, 5 and 6 comprises a vacuum cleaner head A having a generally rectangular, box-like shell 10, open on its under side and with a large diameter suction tube 11 mounted on, and openly communicating with the interior thereof.

A high pressure gas tube 12, which may be of suitable metal such as copper or steel, is divided into two branches 13 and 14 in the form of a "Y," see FIG. 2, and two straight, perforated tubes 17 and 18 are mounted, one on the end of each of these branches. The tubes 17 and 18 are parallel to each other, and are located within the forward and rear walls, respectively, of the shell 10.

The tubes 17 and 18 are in open communication with the interior of their respective branches of the "Y," and their ends are sealed closed. Each tube 17 and 18 has a row of jet orifices

19, see FIG. 5, through the wall thereof, the orifices preferably being arranged in a row with their axes defining a radial plane indicated by the dash-two-dot line 20 in FIG. 5 at an angle 21 of the order of 15° from an upright radial plane indicated by the dash-dot line 22 in FIG. 5.

A skirting strip 23 is mounted for vertical adjustment around the outside of the marginal wall of the shell 10, and is secured in adjusted position thereon by screws 24, which pass through holes provided in the shell 10 and ride in slotted holes 25 in the skirting strip 23. Adjustment of the skirting strip 23 upon loosening the screws 24 adjusts the relative height of the outlets of the jet orifices 19 from a surface being cleaned, such as the surface of an acoustical honeycomb panel 27 shown in FIG. 4.

## OPERATION

In using the form of the invention shown in FIGS. 1 and 2, a conventional, flexible, vacuum cleaner type hose, not shown, having a usual slip connector 28, see FIG. 2, on an end thereof is connected to the vacuum head suction tube 11, the other end of such hose being connected to the inlet or suction side of a conventional vacuum cleaner mechanism, not shown, of selected capacity. A high pressure gas hose 29, which may be of a type commonly used on gas welders, is introduced through a sealed fitting, not shown, into the interior of the suction hose employed, and is connected in sealed relation to a suitable supply of compressed gas, such as air, by a fitting 30, FIG. 2. Usual valve means, not shown, are provided to control admission to the tube 12 of a selected gas, such as air, at a selected pressure, for example, of the order of 40 p.s.i. The kind and pressure of the gas employed, and the size and shape of the orifices 19 are such that jets of the selected gas issuing from the orifices are traveling at supersonic speed. In tests, an orifice diameter of the order of 0.010—0.040 inch and spacing of the order of 0.10 inch between centers has been found satisfactory.

The skirting strip 23 is adjusted vertically on the shell wall upon loosening the screws 24 to position the tubes 17 and 18 at a selected height above a surface to be cleaned which provides maximum cleaning effect for the type of material being cleaned, after which the screws are retightened. In most cases this height is such that the tubes 17 and 18 just clear a surface being cleaned.

In the modified form of the invention shown in FIGS. 3 and 4 the structure and operation of a vacuum cleaning head B is generally similar to the head A shown in FIGS. 1 and 2. Various parts of the structure shown in FIGS. 3 and 4 which correspond to parts of the head A shown in FIGS. 1 and 2 are, therefore, designated by the same reference numerals as used with respect to the head A with the suffix "a" added.

The vacuum head B of FIGS. 3 and 4 is generally oval, and the high pressure tube 12a is also oval and is secured to the shell 10a by a screw 31 and a pair of nuts 32 and 33, see FIG. 4, screwed onto the inlet to the high pressure gas tube 12a. The latter inlet, as well as the high pressure gas hose 29a connected thereto, see FIG. 4, are outside of the vacuum tube 11a.

The operation of the modified form B of the invention shown in FIGS. 3 and 4 is generally similar to that described previously herein for the form A shown in FIGS. 1 and 2 and will be obvious to anyone having an understanding of the latter.

While not illustrated it is obvious that the injection of a suitable solvent into the gas employed for the jets will assist in the removal of viscous and other residues from a soiled surface.

The invention provides a simple, effective and economic cleaning mechanism having an effectiveness on adhered types of soiling agents beyond that of known prior art vacuum cleaners.

Having thus described my invention, what I claim as new and desire to secure by U.S. Letters Patent is:

1. A vacuum cleaner head with supersonic gas jets comprising:

a shell having a top and side walls forming a sealed enclosure and having a bottom opening therein, the portion of the bottom having the opening therein defining a plane,

a suction tube mounted on the shell and openly communicating with the interior of the shell for connecting the latter to a source of vacuum,

at least one high pressure gas tube mounted within the shell parallel to, and substantially tangent to, a plane defined by the shell bottom portion having the opening therein, said gas tube having a plurality of small diameter jet orifices through the under side thereof, said orifices being of such size and shape, and so directed as to eject jets of gas at supersonic speed from the interior of the gas tube outwardly through the shell bottom opening when supplied with gas at a predetermined pressure, the portion of the tube having the jet orifices therein being sufficiently close to such plane that the jets impinge at supersonic speed against a surface on which the shell is supported, and means for connecting a supply of pressurized gas to the gas tube at said predetermined pressure to eject jets of such gas at supersonic speed through such orifices and against such surface of an article being cleaned.

2. A vacuum cleaner head as claimed in claim 1 wherein the pressurized gas is to be supplied to the gas tube at a pressure of the order of 40 p.s.i.

3. A vacuum cleaner head as claimed in claim 1 wherein the axes of the orifices are aligned to define a plane.

4. A vacuum cleaner head as claimed in claim 3 wherein the plane defined by the orifice axes is disposed at an angle of the order of 15° to an upright plane perpendicular to the plane defined by the shell bottom portion having the opening therein.

5. A vacuum cleaner head as claimed in claim 1 wherein each orifice has a diameter at its inward end of the order of 0.010 - 0.040 inch and flares outwardly toward its discharge end.

6. A vacuum cleaner head as claimed in claim 1 wherein the shell is substantially rectangular in plan form and the high

pressure gas tube comprises two intercommunicating straight portions, one of said straight portions being disposed adjacent and parallel to one side of the shell, and the other straight portion being disposed adjacent and parallel to an opposite side of the shell.

7. A vacuum cleaner head with high speed gas jets comprising:

a shell having a top and side walls forming a sealed enclosure and having a bottom opening therein, the portion of the bottom having the opening therein defining a plane, a suction tube mounted on the shell and openly communicating with the interior of the shell for connecting the latter to a source of vacuum,

at least one high pressure gas tube mounted within the shell parallel to, and substantially tangent to, a plane defined by the shell bottom portion having the opening therein, said gas tube having a plurality of small diameter jet orifices through the under side thereof, said orifices being of such size and shape, and so directed as to eject jets of gas at supersonic speed from the interior of the gas tube outwardly through the shell bottom opening when supplied with gas at a predetermined pressure,

means for connecting a supply of pressurized gas to the gas tube at said predetermined pressure to eject jets of such gas at supersonic speed through such orifices onto a surface of an article being cleaned, and

a marginal band fitted around the sides of the shell for slidable adjustment thereon, the bottom edge of the band having a plurality of notches therein, and means for releasably anchoring the band to the shell with a selected portion of the width of the band projecting below the plane defined by the bottom portion of the shell having the opening therein.

8. A vacuum cleaner head as claimed in claim 1 wherein means are provided for adjusting the height of the discharge ends of the high pressure gas tube discharge orifices relative to a surface to be cleaned upon which the vacuum head shell is supported, thereby to provide maximum impact upon such surface of shock waves from the supersonic jets discharged from such orifices.

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