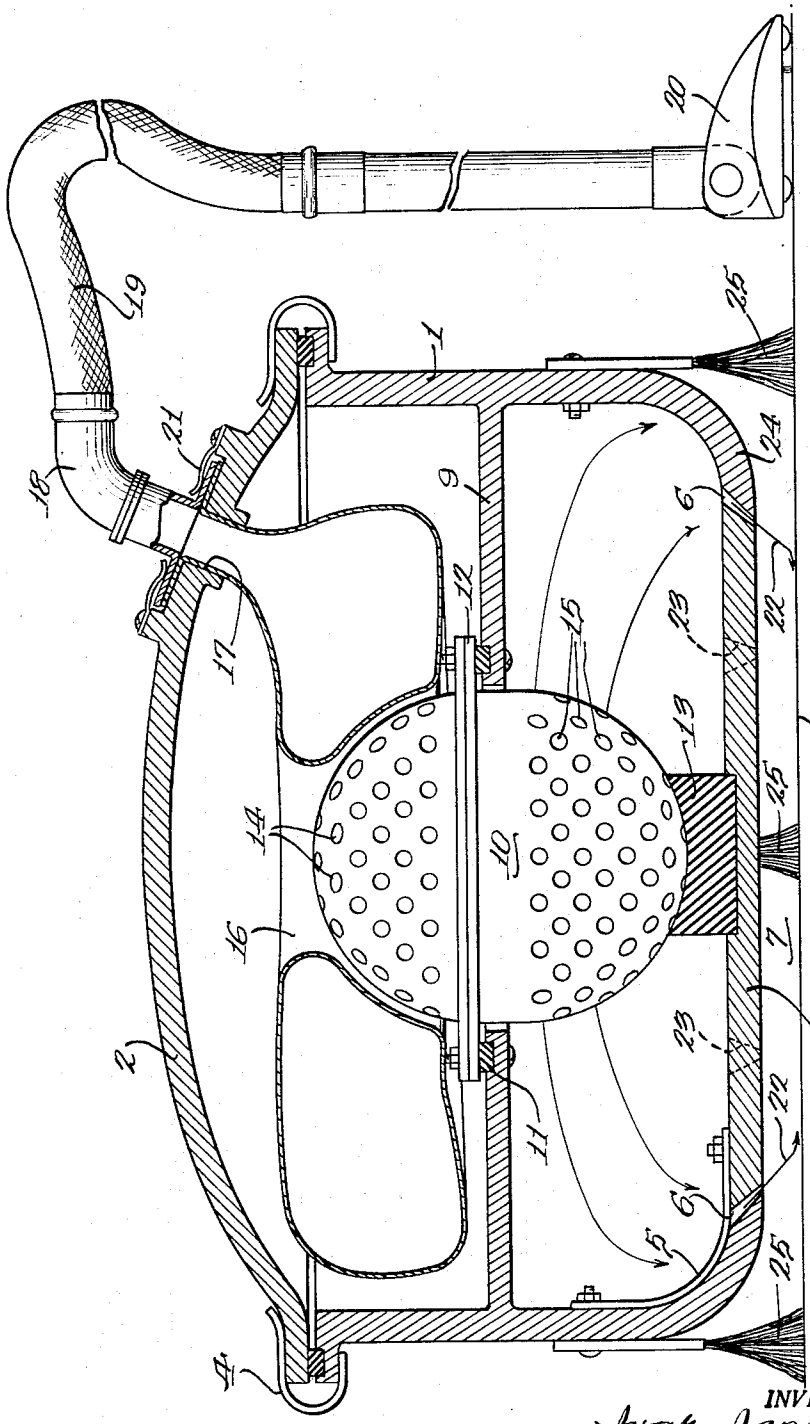
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GAS SUPPORTED DEVICES

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GAS SUPPORTED DEVICES

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1 Claim. (Cl. 15—327)

This application is a continuation of my pending patent application Serial No. 858,620, filed December 10, 1959, and now abandoned.

This invention relates to an improvement in gas supported devices, and more particularly, to an improvement in gas supported surface traversing devices. By the term "surface traversing device" is meant a machine or object which is to be moved over land, water, floors or other surfaces. The means for moving the device over such surfaces may comprise some form of power plant or the device can be moved about manually. By the term "gas supported" is meant supporting all or less than all of the weight of an object on a pocket or cushion of gas formed between the object and its supporting surface whether that surface be land, water, floors or the like.

Air supported surface traversing devices are not new per se. Prior art examples of such devices are Coons et al. vacuum cleaner Pat. No. 2,780,826 and Williams ship Pat. No. 2,842,084. My invention is likewise applicable to vacuum cleaners and boats and also to land vehicles.

In water vehicles by floating the boat on a pocket of air, friction between the bottom surface of the boat and the water is reduced whereby the boat can be propelled with less power. In land vehicles an air suspension provides the advantage that the wheels can be omitted as well as the axles and bearings, and the device can likewise be propelled about with less power. Also, in a fully air suspended device it will travel smoothly over rough terrain whereby the necessity for well paved highways becomes less important. An air suspension for a vacuum cleaner makes it possible to eliminate wheels or other rolling means which are conventionally used at the bottom thereof, and the device can likewise be moved about for relatively long distances with comparatively little effort. This is true whether the device is totally supported on a cushion of air or only partially supported thereby. For instance, if only part of the weight of a vacuum cleaner is supported on an air cushion, the friction which would normally be encountered between the bottom of the vacuum cleaner and the floor, rug or the like is substantially reduced whereby it is very easy to move the vacuum cleaner about.

In the prior art, the general approach to obtaining an air cushion support for the surface traversing device has been to form an air pocket in the bottom of the device and also to employ means to confine the air cushion created in the air pocket. One expedient has been to depress the central portion of the device to in effect provide an air pocket and a surrounding confining structure. In other instances plates or other equivalent means have been connected to the bottom of the device along the sides thereof to form the air pocket and provide the air confining means. The air pocket and air cushion confining means has been necessary for several purposes. The air pocket has been utilized as a chamber within which to create the initial air pressure necessary to raise or lift the device off its supporting surface. The air confining means has been used to retain the air cushion beneath the suspended device. Obviously, if air cushion retaining means are not employed then larger quantities of air would be required to maintain the object in a suspended condition.

The above-mentioned expedients are disadvantageous inasmuch as they require modifications or additions to the device whether it be a vacuum cleaner or a land or sea vehicle. Such modified or additional structure is undesirable inasmuch as it makes the device more complicated and increases the cost thereof.

It is an object of this invention to overcome the disadvantages of the above-discussed prior art.

It is a further object of this invention to provide an improved gas support for surface traversing devices.

It is a further object of this invention to provide an improved gas pocket defining and gas cushion confining means for gas supported surface traversing devices.

It is a further object of this invention to provide an improved gas pocket defining means for gas supported surface traversing devices.

It is a further object of this invention to provide an improved gas cushion confining means for gas supported surface traversing devices.

It is a further object of this invention to provide an improved air pocket defining and air cushion confining means for air floated vacuum cleaners.

I have discovered that the above-described prior art modifications or additions to the gas supported devices are not necessary in order to create a gas cushion therebeneath and retain the gas cushion. That is to say, giving a special configuration to the bottom of the device or attaching side flanges thereto to provide a gas pocket therebeneath as well as gas cushion confining means can be entirely dispensed with in practicing my invention.

For example, in one form of my invention the bottom surface of an air floated device can be perfectly flat. The air pocket defining means and air cushion confining means preferably comprises an annular jet of air which in effect provides an air curtain to define an air pocket beneath the device and create an air cushion in said pocket and additionally operates as confining means for the air cushion created within the air pocket.

The features of my invention which I believe to be novel are set forth with particularity in the appended claim. My invention itself, however, both as to its organization and mode of operation, together with further objects and advantages thereof, may best be understood by reference to the following description taken in connection with the accompanying drawing which is an illustration of a conventional form of vacuum cleaner having my invention incorporated therein.

The vacuum cleaner illustrated in the drawing comprises a casing **1** which is closed on its top by a cover **2** and on its bottom by a plate **3**. The cover **2** can be held in closed position by means such as clips **4**, and the bottom plate **3** can be held in its mounted position by means such as brackets **5**. The outer peripheral portion of the bottom plate **3** is spaced from the inner peripheral edge at the bottom of casing **1** by a continuous gap **6**. The air which is drawn through the vacuum cleaner is exhausted through the opening **6** to in effect provide a closed air curtain or barrier about an air cushion which is created beneath the vacuum cleaner in the space indicated by reference numeral **7** between the bottom plate **3** and a supporting surface **8** which may be a floor, rug or the like. It will be appreciated that ordinarily the bottom plate **3** will rest directly on the supporting surface **8**.

A supporting flange **9** is formed in casing **1** for resiliently supporting a housing **10** which encloses a not shown motor and a pump which is driven by the motor for the purpose of creating the necessary vacuum for the vacuum cleaner. The housing **10** is supported on the flange **9** by resilient mounting means **11** which may comprise an annular ring of rubber or the like disposed between the flange **9** and a cooperating flange **12** formed on housing **10**. The housing **10** can be additionally re-

siliently supported by a block of rubber 13 or the like positioned between bottom plate 3 and the bottom of housing 10. The resilient mounting means 11 and 13 is for the purpose of damping vibrations created by the motor and pump contained within housing 10. Air is drawn through the housing 10 by way of a plurality of apertures 14 formed in the upper part of housing 10 and discharged from the housing 10 by way of a plurality of apertures 15 formed in the bottom of housing 10. That is to say, the upper part of housing 10 is the suction, intake, or vacuum side thereof; whereas, the bottom part of housing 10 is the exhaust or high pressure side thereof.

Positioned in the upper part of the vacuum cleaner, that is to say the part above flanges 9 and 12, is a dust collector 16. The duct collector can be in the form of a continuous tubular member which surrounds the intake side of housing 10. As will be obvious to those skilled in the art, dust collectors are conventionally designed to be replaceable and are constructed from a material which is permeable to air but not to dust, dirt and the like. The dust collector 16 has an integral portion thereof connected to an opening 17 in the cover 2. Although the opening is illustrated as being located in the cover 2, it could be located in a side wall of the casing 1. Also connected to this opening 17 is a connector member 18 for connecting a flexible hose 19 to the vacuum cleaner. The outermost end of hose 19 is adapted to receive vacuum cleaner attachments such as the illustrated brush 20. The dust collector 16 and the connector 18 can be connected to the opening 17 by movable spring retainers 21 or any other suitable means.

In normal operation of the vacuum cleaner dust and dirt will be drawn along with air into the vacuum cleaner through brush 20, hose 19, connector 18 and opening 17 into the dust collector 16. The dust and dirt will be retained within dust collector 16 but the air will pass therethrough and continue through the apertures 14 into the casing 10 and then out of the casing 10 through the apertures 15 into the bottom part of the vacuum cleaner casing which is separated from the upper part thereof by the flanges 9 and 12. The air which is exhausted into the bottom part of casing 1 will escape through the gap 6 in the form of a jet which is continuous and extends adjacent the outer periphery of casing 1. It will be obvious to those skilled in the art that the dimensions of the gap 6 are selected so that the jet of air indicated by arrow 22 escaping therefrom is in the form of a high velocity jet. Besides being directed downwardly, the jet 22 is also inclined toward the vacuum cleaner as contrasted to outwardly thereof. This annular jet of air will create a cushion of air between the bottom plate 3 and supporting surface 8 such as indicated by the reference numeral 7 so as to suspend or float the vacuum cleaner. The air cushion 7 besides being created by the jet 22 is also effectively retained or confined between the bottom 3 and surface 8 by the curtain of high velocity gas 22. Obviously, if the downwardly and inwardly inclined air curtain 22 were absent the air cushion 7 created beneath the vacuum cleaner would escape very easily. Therefore, it would be necessary to either increase the quantity of air delivered to the space 7 or to employ special means to confine the air cushion therein such as the retaining means of the prior art.

In my invention additional apertures such as indicated by dot-dash lines 23 can be formed in the bottom plate 3 for creating the air cushion and replenishing air to the space 7 inasmuch as obviously some of the air will escape therefrom through the air cushion 22. However, in the absence of the curtain 22, the apertures 23 would have to deliver a much larger quantity of air inasmuch as considerably more air would escape from between the plate 3 and surface 8. Thus, my invention does not require large quantities of air to be delivered by the vacuum cleaner to maintain it in an air suspended condition. The amount of air delivered could be readily increased by increasing the size of the motor and the pump in the casing 10. However, besides being more expensive, this is not always feasible. This is because if the suction created by the pump is too great, then the brush 20 will tend to stick to the objects being cleaned instead of running over the same smoothly.

In my invention it is possible to raise the vacuum cleaner off the surface 8 by as much as of the order of ¼ of an inch or more. That is to say, the entire weight of the vacuum cleaner can be supported by the air cushion 7. In such condition of the device, it will readily pass over the edges of rugs and the like and for this purpose the lower corners 24 of the casing 1 are rounded off. My invention can be practiced without supporting the entire weight of the cleaner on the air cushion. That is to say, part of the bottom of the casing 1 could touch or make slight contact with the surface 8 so that less than all of the weight of the cleaner is supported by the air cushion. However, even in such practice of my invention, substantial benefits are derived therefrom. Partial support of the weight of the cleaner on an air cushion will substantially reduce friction between the bottom of the cleaner and the supporting surface 8 so that it can be very easily moved about with very slight effort. Also, such practice of my invention would not require great quantities of air to be delivered to beneath the bottom of the cleaner nor require the special configurations or air cushion retaining means of the prior art.

During the operation of the cleaner, rotation of the fan and motor in housing 10 may tend to cause the vacuum cleaner to spin or move about or the vibrations of the fan and vacuum cleaner may tend to cause the cleaner to chatter or rock on the surface 8. This is not a serious objection. However, if it is so desired this can be readily overcome. The tendency of the cleaner to spin or move about or to chater or rock during its condition of air flotation during normal operation thereof can be overcome by means such as three or four spaced brushes 25 which are connected to the casing 1 and make light contact with the surface 8. The bristles of the brushes 25 are very pliable and have practically no weight supporting effect on the vacuum cleaner. That is to say, when the vacuum cleaner is turned off, the bristles of brushes 25 will readily collapse so that the bottom 3 returns to the supporting surface 8. The bristles of the brushes 25 are only sufficient to create a slight drag on the surface 8 when the cleaner is air floated so as to prohibit it from chattering, rocking, spinning or moving about on the floor. Also, the brushes 25 play no effect in confining the air cushion 7 beneath the cleaner inasmuch as it is necessary to use only a few of them to obtain the required drag and they are widely spaced with respect to each other. Obviously, it will be preferable to arrange them in an equally spaced or symmetrical manner about the cleaner.

Although the curtain indicated by reference numeral 22 in the preferred form of the invention is continuous, this is not absolutely necessary in practice of the invention. That is to say, instead of the continuous annular jet opening 6, a plurality of apertures could be arranged about the bottom of the casing 1 near the outer periphery thereof and these openings could be spaced sufficiently close to each other to in effect provide the equivalent of a continuous air curtain or at least have a substantial effect on retaining the air cushion 7 beneath the cleaner. Such arrangement would have the advantage that the bottom 3 could be integrally formed with the casing 1 rather than being a separate plate which must then be connected to the casing 1 by means such as brackets 5.

Additionally, preferably the curtain for confining the gas cushion is made as wide as possible so as to provide a gas cushion which covers a large surface area so as to increase the stability of the cleaner. In this regard, it will be obvious to those skilled in the art that the invention is most successfully practiced if the cleaner is designed

to have a relatively short height with respect to its bottom dimensions and also a low center of gravity. For instance, if the casing **1** were relatively high as compared to its bottom dimensions or did not have a low center of gravity then it would have a tendency to tip over when pulled about by the hose **19**. It may be possible to overcome such tendency towards instability or tipping by locating the hose connection to as near the bottom of the cleaner as possible. However, this tendency towards instability or tipping can be overcome in the initial design of the cleaner by properly correlating its weight, center of gravity, and dimensions whereby the location of the hose connection to the cleaner is not limited.

The air which is exhausted into the lower part of the casing **1** has energy in the form of above atmospheric gas pressure. The jet forming means **6** converts this pressure energy into velocity energy. After the air of the jets is deflected into the space **7** the energy will be reconverted into above atmospheric gas pressure. This gas pressure has an upward force on the cleaner to support all or less than all of the weight of the cleaner. However, it is to be noted that a substantial weight supporting effect is also derived from the air jets in and of themselves. This is because they are downwardly directed and have an upward force of reaction on the cleaner. Therefore, the invention is not restricted to gas supported vehicles in which the gas cushion is the sole weight supporting contributor.

If the gas jets were inclined outwardly they would still react upwardly on the cleaner but they would have no gas cushion creating and confining function, and if they were directed horizontally they would have no weight supporting effect. Furthermore, if they were directed horizontally inward, besides having no weight supporting effect they would tend to converge into a turbulent gas cushion of reduced area which would be difficult to confine and provide a less stable air support for the cleaner. Therefore, the jets should be inclined inwardly but the angle of inclination should not be too sharp, and for optimum practice of the invention the jets probably should not be inclined at an angle of about less than of the order of 45 degrees with respect to the supporting surface.

Although the invention has been specifically illustrated with respect to a vacuum cleaner, it is believed that it will now be obvious to those skilled in the art that my teachings are not restricted in their applicability to vacuum cleaners, but are also useful in other devices which are to be propelled about. For instance, may invention can be used in gas suspended land and water vehicles. Also the gas for the curtain and cushion need not necessarily be air, but can be the exhaust gases of the power plant for propelling the vehicle about. If the power plant for propelling the vehicle is a rocket or the like which has high pressure exhaust gases this would provide a convenient supply of gas for the curtain and cushion. In the case of water vehicles the confining curtain for maintaining the boat in a gas floated condition can comprise a fluid curtain such as water jets inasmuch as this fluid is readily available. For these reasons, my teachings in their broadest aspects are not confined to air curtains or air cushions.

While there has been shown and described a particular embodiment of the invention, it will be obvious to those skilled in the art that changes and modifications may be made without departing from the invention, and that it is intended by the appended claim to cover all such changes and modifications as fall within the true spirit and scope of the invention.

What I claim as new and desire to secure by Letters Patent of the United States is:

In a vacuum cleaner, a closed shallow casing, said casing having a flat horizontally disposed bottom, an open top, a removable cover for said open top, and vertically disposed side walls extending between said bottom and cover, a motor driven fan unit in said casing, a housing for said fan unit, said housing being disposed centrally of said casing, air inlet and outlet openings formed in the top and bottom respectively of said housing, and means for supporting said housing inside said casing and sealing said inlet and outlet openings from direct communication with each other, said means comprising an inwardly extending annular support flange formed on said side walls, a central aperture formed in said flange, an outwardly extending annular support flange formed on said housing, said housing being disposed in said aperture and said housing flange overhanging said casing flange, a sealing gasket disposed between said flanges, and means for clamping said flanges together against said gasket, said flanges and gasket together dividing said casing into upper and lower isolated compartments whereby said air inlet and outlet openings are in direct communication solely with said upper and lower compartments respectively, an air intake opening formed in said upper compartment which is adapted to have a vacuum cleaning tool connected thereto, an air permeable dust collecting vacuum cleaner bag disposed in said upper compartment, said bag being connected to said air intake opening and surrounding said air inlet openings, and means for supporting said vacuum cleaner on a cushion of air, said last mentioned means comprising a continuous narrow annular opening formed in the bottom of said casing adjacent the circumference thereof, said annular opening having a jet nozzle shape which is adapted to expel air exhausted by said fan unit into said lower compartment downwardly and inwardly of said bottom in the form of a high velocity jet curtain of air, said jet curtain of air by impingement on a support surface underlying said bottom being converted into an above atmospheric pressure air cushion beneath said bottom, said jet curtain of air surrounding and confining said air cushion to beneath said bottom, and means for replenishing air leakage from said air cushion, said replenishing means comprising auxiliary openings formed in said bottom above said air cushion.

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A. HARRY LEVY, *Primary Examiner.*