US 20060090290A1

(19) **United States**

(12) **Patent Application Publication** (10) **Pub. No.: US 2006/0090290 A1**

Lau (43) **Pub. Date: May 4, 2006**

(54) **HANDHELD VACUUM WITH ACCELERATED CYCLONIC FLOW AND AIR FRESHENER**

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(21) Appl. No.: **10/979,055**

(22) Filed: **Nov. 1, 2004**

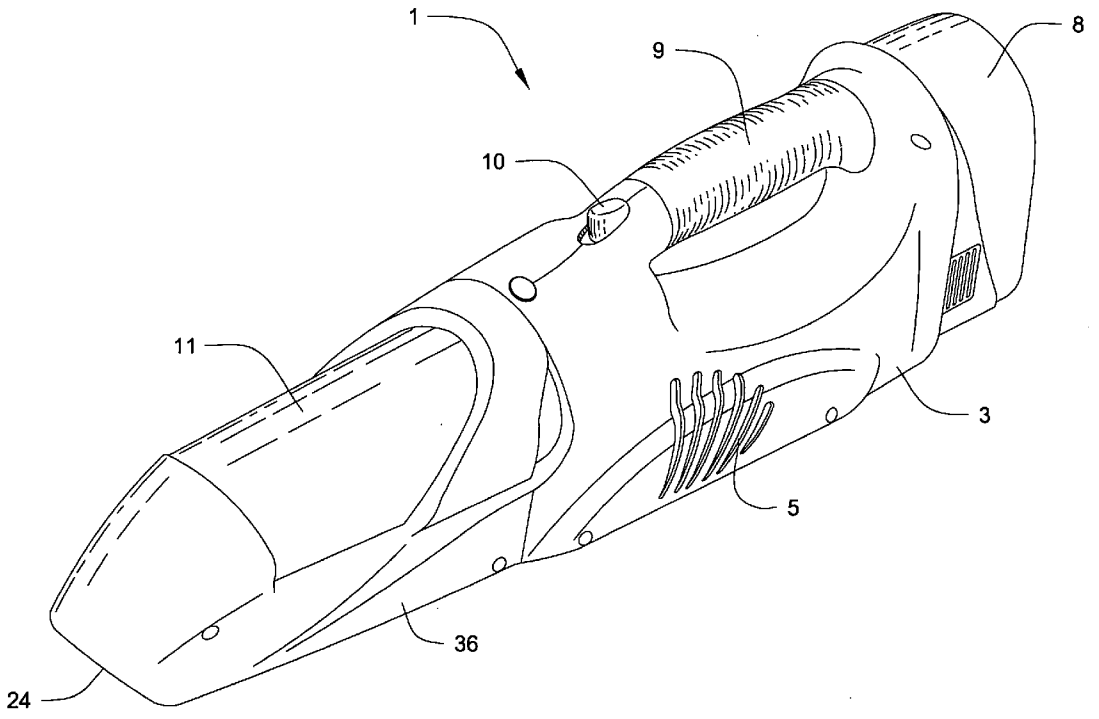
Publication Classification

(51) **Int. Cl.**
A47L 5/24 (2006.01)

(52) **U.S. Cl.** **15/344**

(57) **ABSTRACT**

A hand held vacuum having a tapered centrifugal chamber as its primary filter. The tapering causes the air stream within the centrifugal chamber to accelerate as it moves toward the distal end. The air steam will be able to retain more debris at higher speeds, thereby improving the efficiency of the centrifugal chamber. This will also keep more of the debris in the vicinity of the distal end of the centrifugal chamber and away from its outflow aperture. An air freshener in a filter housing is also provided. The air freshener will sublimate into the passing air stream and be emitted with the exhaust from the vacuum and/or any odor causing particles that may be in the air stream will be absorbed by the air freshener. The filter will prevent any dust and debris in the airstream from adhering to the air freshener and impeding its effectiveness.



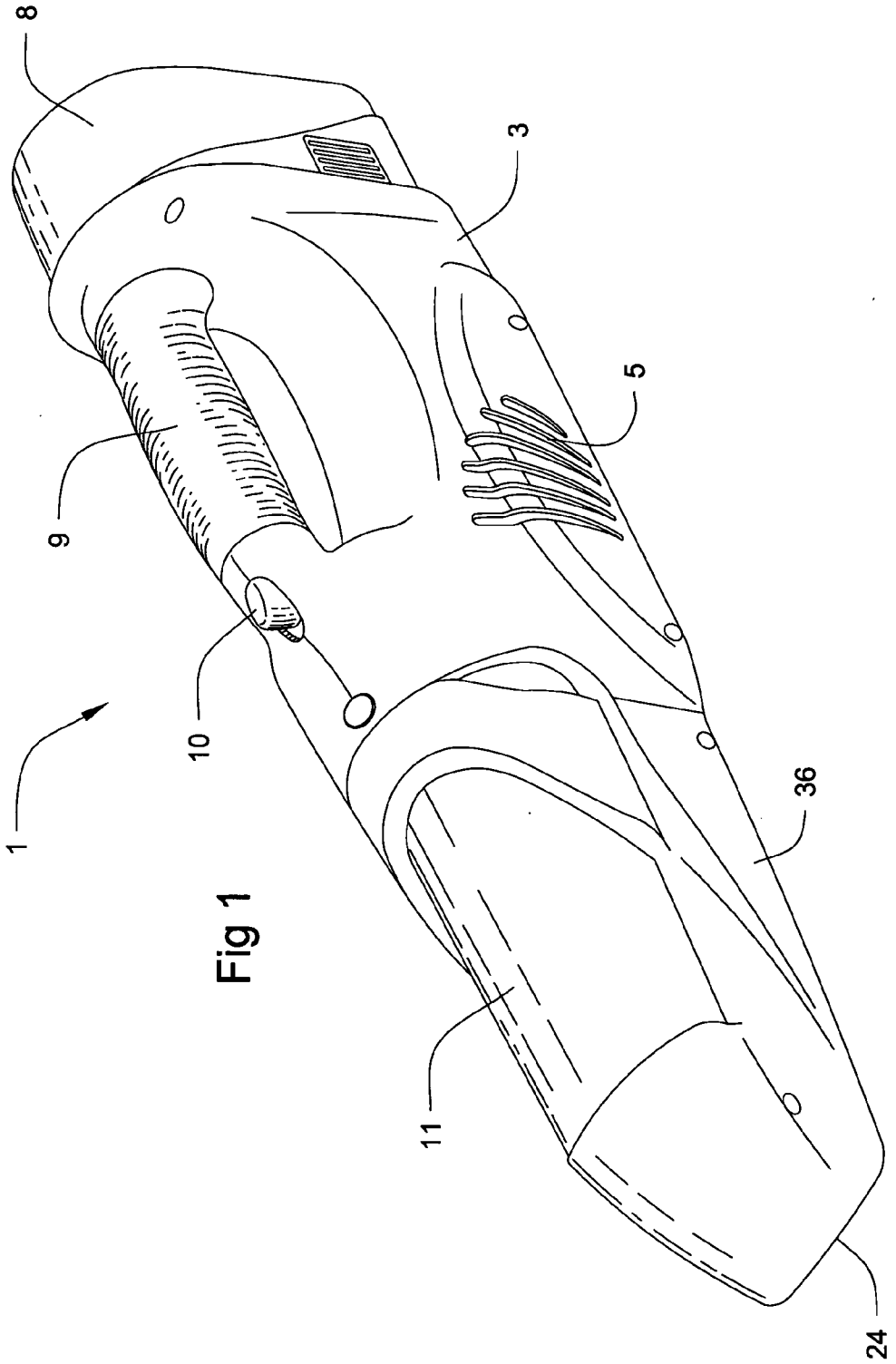


Fig 1

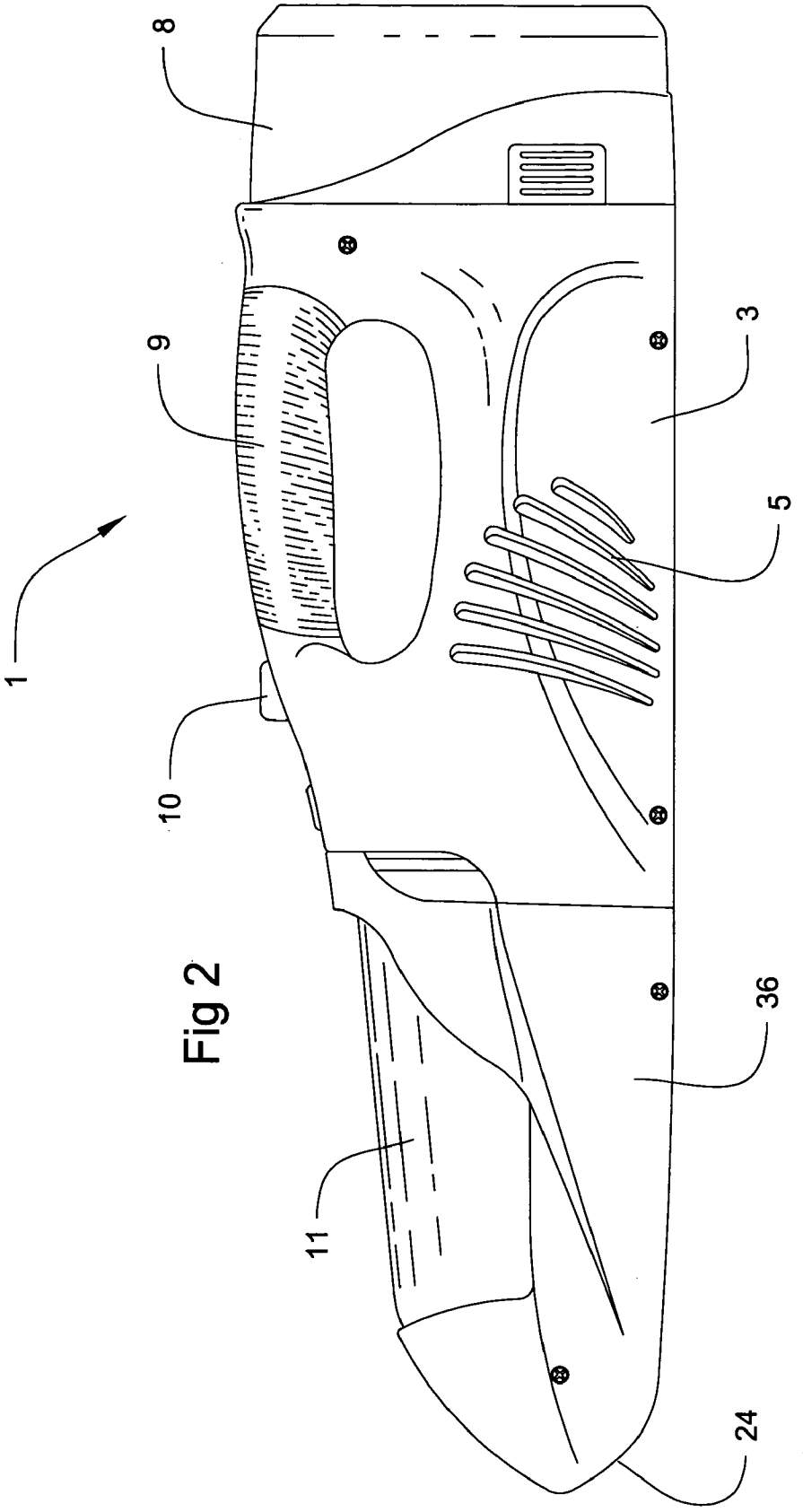


Fig 2

Fig 3

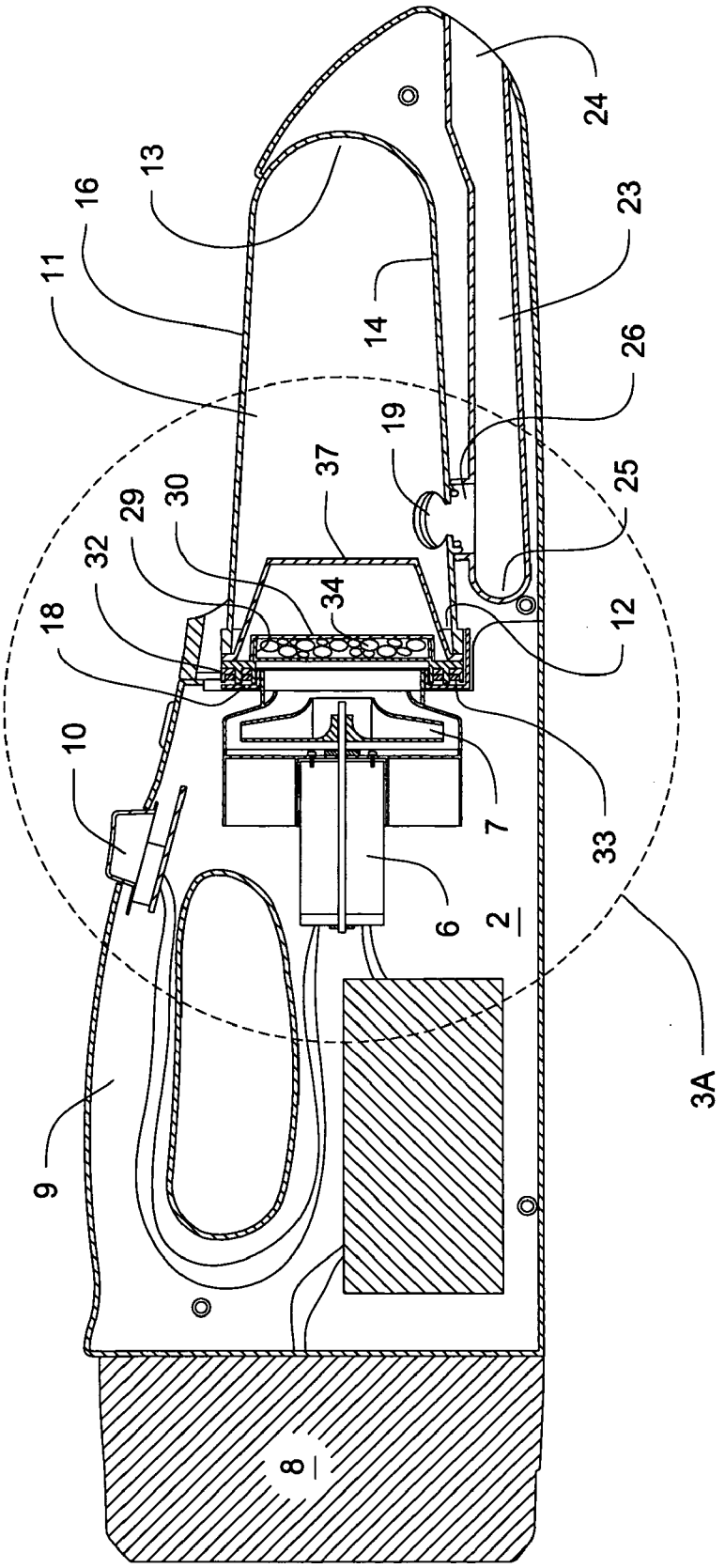
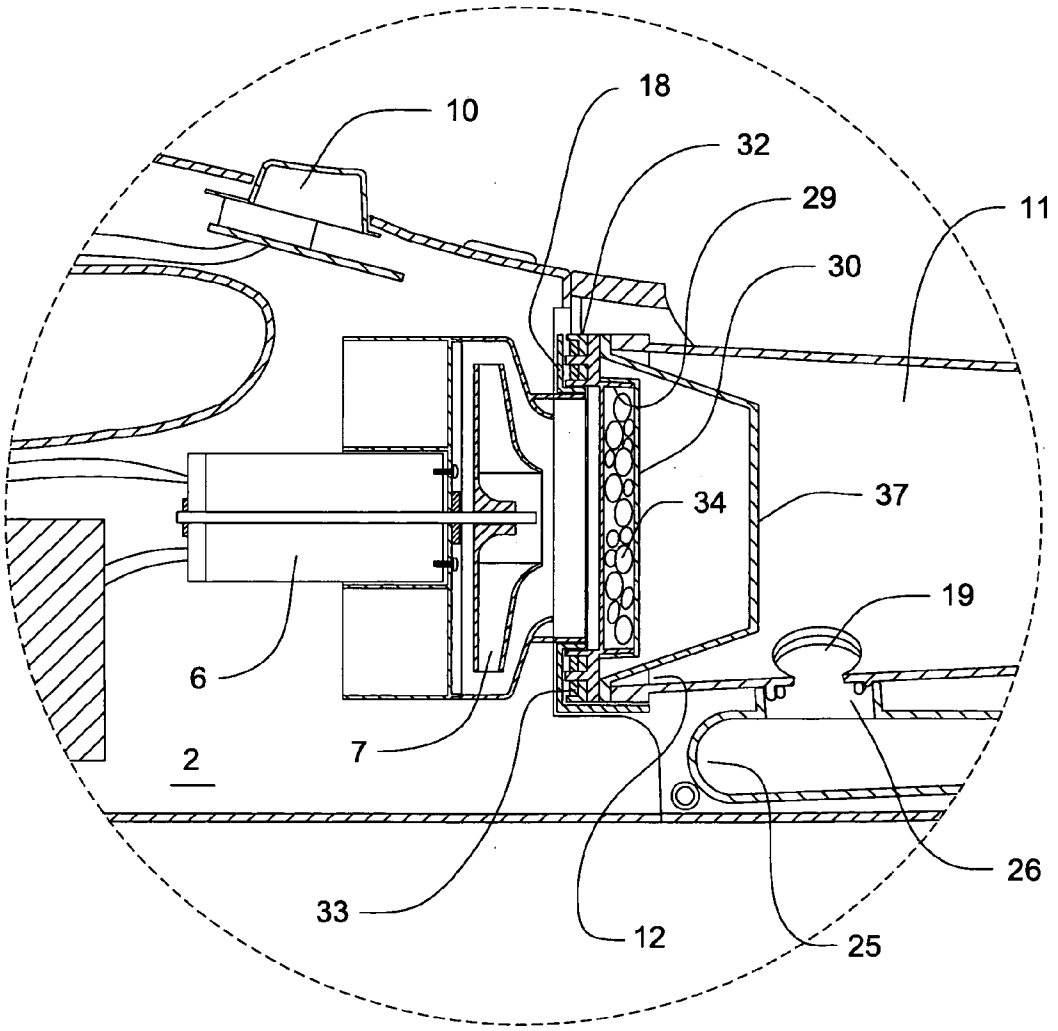


Fig 3A



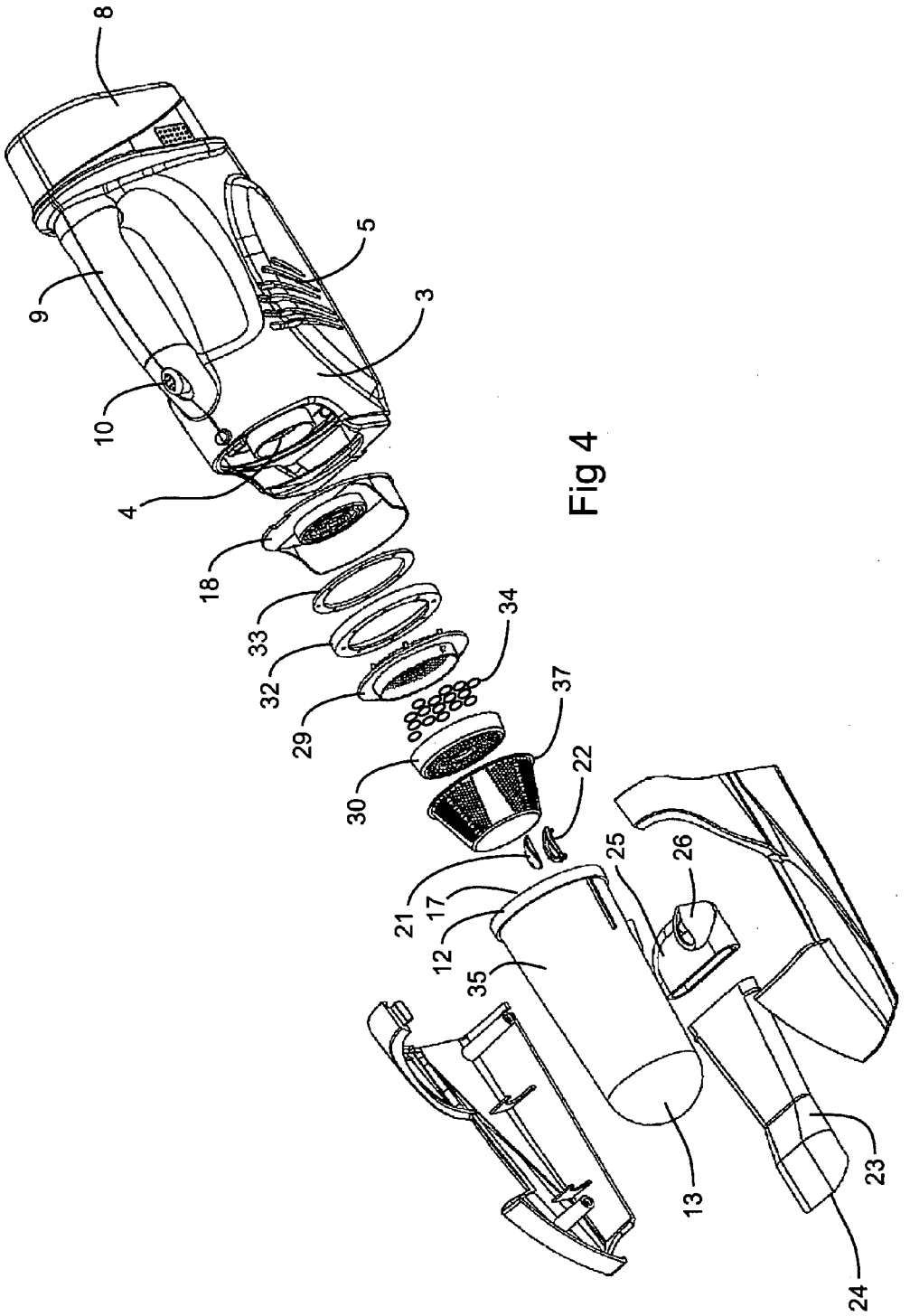


Fig 4

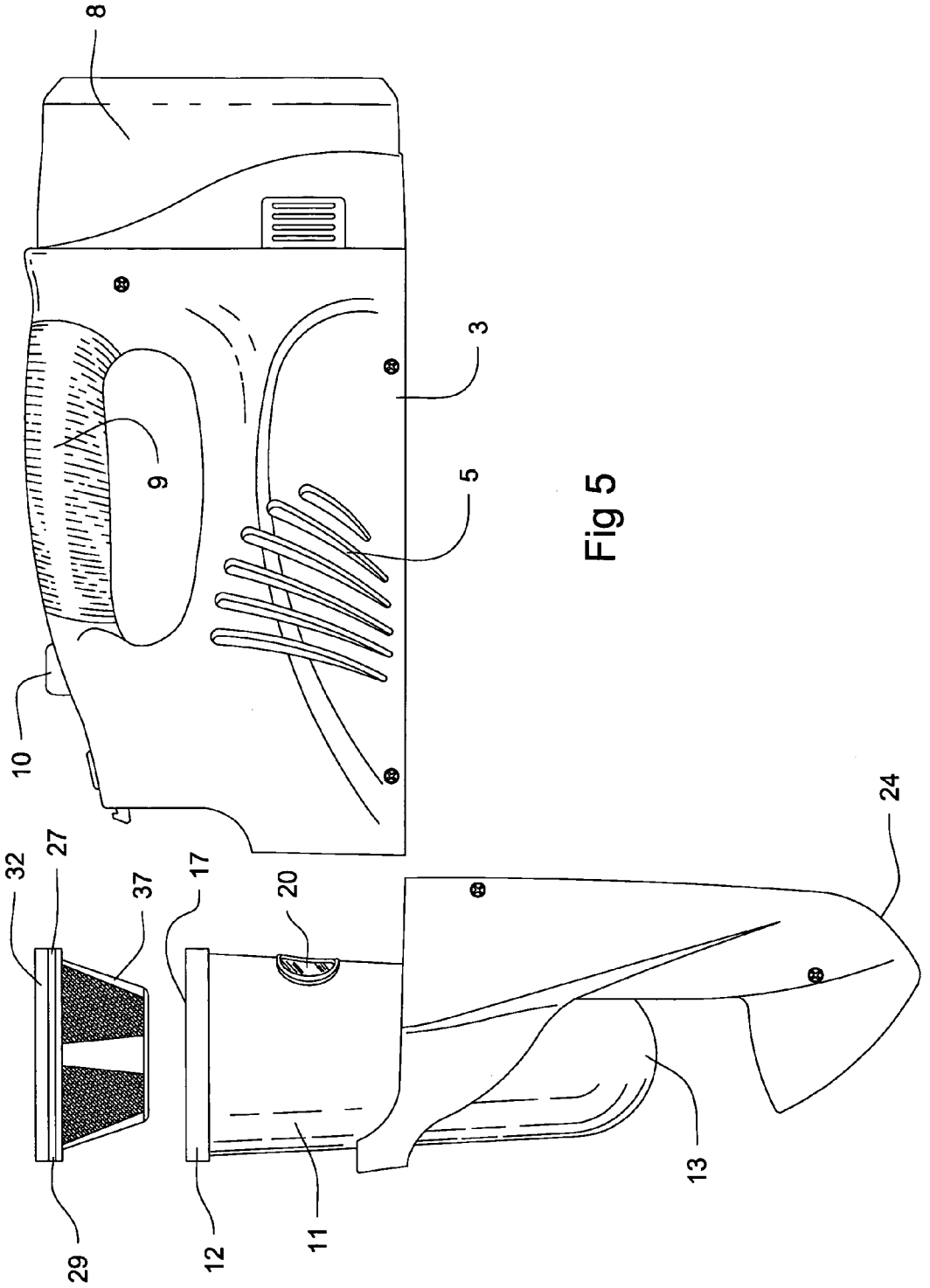


Fig 5

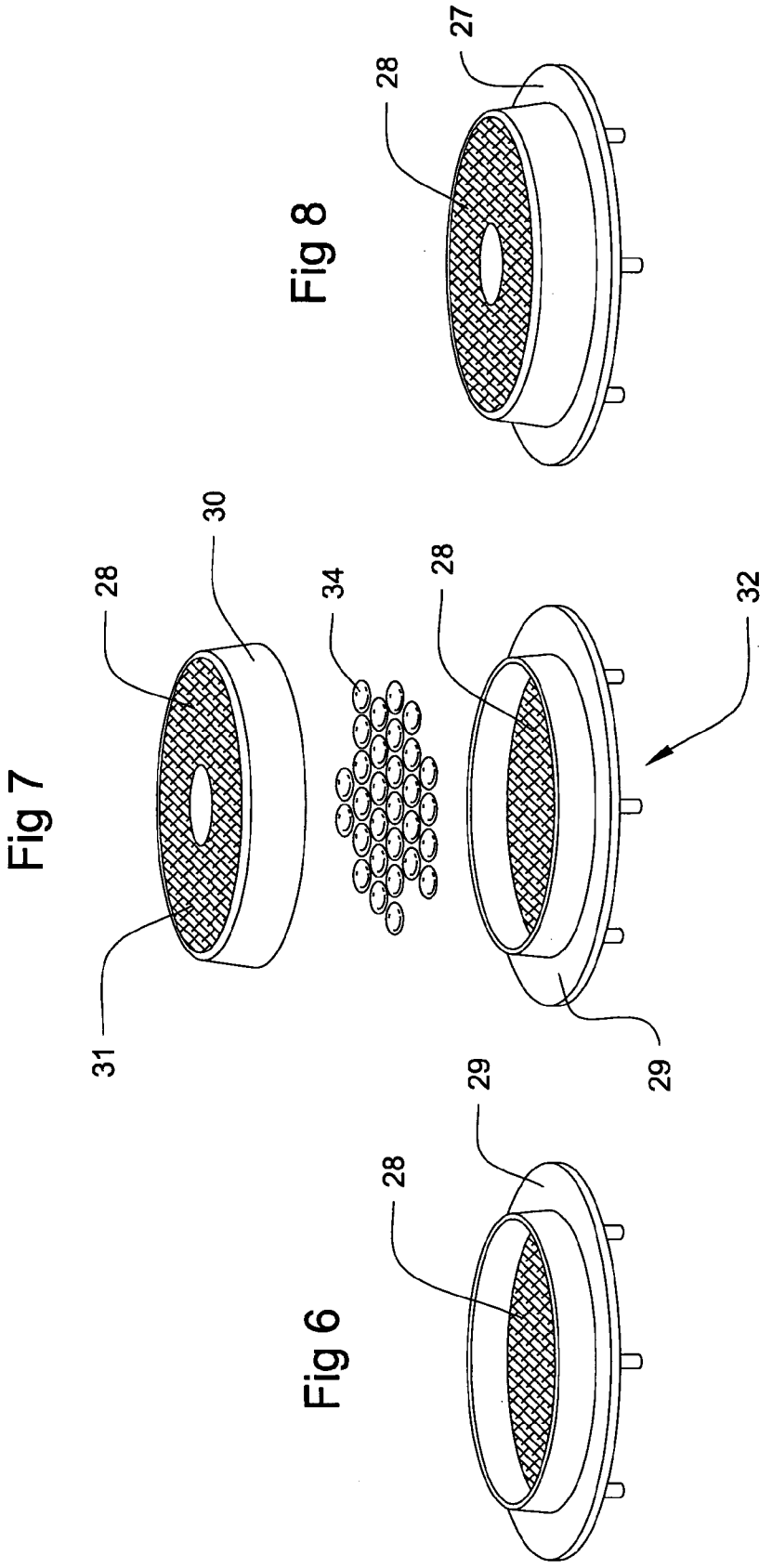


Fig 6
28
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Fig 7
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34
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Fig 8
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27

HANDHELD VACUUM WITH ACCELERATED CYCLONIC FLOW AND AIR FRESHENER

BACKGROUND OF THE INVENTION

[0001] 1. Field of the Invention

[0002] The invention relates to vacuums in general and hand held vacuums in particular.

[0003] 2. Prior Art

[0004] Cyclonic vacuums are known in the art. See, e.g., U.S. Pat. No. 4,373,228. In cyclonic vacuums, an air stream enters a cyclonic chamber and rotates as in a vortex. Essentially, centrifugal force drives the debris particles in the air stream to the outside of the vortex. The outlet from the cyclonic chamber is located near the center of the vortex. Thus, the motion of the air pushes the particles in the vortex to the outside, while relatively clean air exits the cyclonic chamber from a central location. However, most applications of this technology are used with upright vacuums.

[0005] Problems arise when cyclonic chambers are moved out of a vertical orientation. To appreciate this, it is important to consider the path taken by the air stream within the cyclonic chamber. There are generally two paths of motion: air moving in a circular spiraling path and air moving in a linear path toward the outlet. However, it is not accurate to consider these two paths as separate from each other. Each path influences the other such that the path of air leading toward the outlet has rotational qualities - rotational qualities that are augmented by the motion of the fan that typically drives all air flow in the vacuum. More importantly, the linear outflow affects the spiraling air stream as well such that objects entrained in the spiral air stream are constantly being pulled by the outflowing airstream.

[0006] When a cyclonic chamber is vertically oriented, the effect of gravity on objects entrained in the spiraling air stream will be relatively constant at all point in the air stream. However, if the cyclonic chamber is tilted away from the vertical, gravity will be working against objects entrained in the air stream to a greater extent during the climbing portion of the object's rotation around the cyclonic chamber. This will cause objects to slow during their rise, which can cause the effect of the outflowing air stream to predominate. Thus, objects which may have remained entrained in the spiraling air stream when the cyclonic chamber was vertical may escape into the outflowing air stream when the cyclonic chamber is tilted. The greater the tilt, the greater the chance that debris in the air stream may escape. This is particularly problematic with hand held vacuums—vacuums of less than about three feet in total length and less than about one foot in any other dimension. Such vacuums are designed to be operated in many varying positions, vertical and otherwise. Constant movement of the cyclonic chamber will exacerbate the aforementioned problem. Of course, the goal of the cyclonic chamber is to retain debris in the chamber, so the loss of debris from the air stream is undesirable.

[0007] The use of air fresheners in the vacuum cleaner field is also known. See, e.g., U.S. Pat. No. 6,231,647. Such air fresheners are typically fragrances or deodorizing agents contained within oil or wax based carriers which are sublimated into the air stream. Alternatively, air fresheners may be odor absorbing material such as activated charcoal used absorb odor causing particles from the air stream. Of course, combinations of the two types may be used as well. The air freshener, regardless of the type, is placed in the air stream of the vacuum. Effective operation of the air freshener requires contact between the air stream and the air freshener contents. This can be inhibited when the air stream is not clean. If particles of dust and other debris are in the air stream as it passes over the air freshener, such particles may coat the air freshener. This can restrict or stop the sublimation of further air fresher into the air stream. Similarly, it can reduce or prevent air from reaching odor absorbing components of the air freshener. Depending upon the placement of the air freshener, debris clogging the air freshener can also act as a choke point in the over all air stream, reducing the effectiveness of the entire vacuum. In view of the foregoing problems a vacuum meeting the following objectives is desired.

OBJECTS OF THE INVENTION

[0008] It is an object of the invention to provide a hand held vacuum with a functional centrifugal debris separation chamber.

[0009] It is another object of the invention to provide a hand held vacuum with a centrifugal debris separation chamber that remains efficient when the centrifugal debris separation chamber is displaced from a vertical orientation.

[0010] It is still another object of the invention to provide a hand held vacuum with a centrifugal debris separation chamber that remains efficient when the centrifugal debris separation chamber undergoes a substantial amount of movement.

[0011] It is yet another object of the invention to provide a hand held vacuum with an air freshener for the air stream exiting the vacuum.

[0012] It is still another object of the invention to provide a hand held vacuum with an air freshener that will not become clogged with debris from the air stream of the vacuum.

SUMMARY OF THE INVENTION

[0013] A hand held vacuum having a centrifugal chamber that serves as its primary filter is disclosed. The centrifugal chamber is tapered from its base to its distal end. The tapering will cause the air stream within the centrifugal chamber to accelerate as it moves toward the distal end. Debris entrained within the air steam will be less likely to fall out of the air stream at the higher speeds, thereby improving the efficiency of the centrifugal chamber as the vacuum is moved into various non-vertical positions.

[0014] The centrifugal chamber preferably has an outflow aperture that is proximate to its base and most preferably coextensive with the base. The tapered design of the centrifugal chamber will cause the air speed within the centrifugal chamber to increase as the air moves in the direction of the distal end of the centrifugal chamber. This will keep more of the debris in the air stream in the vicinity of the distal end of the centrifugal chamber and away from its outflow aperture, which will also improve the efficiency of the centrifugal chamber.

[0015] In the preferred embodiment, the vacuum is also provided with a filter housing. The filter housing contains a

filter and is positioned so that air leaving the centrifugal chamber must pass through the filter housing. The filter acts as a secondary filter, preventing any dust and small debris that may escape from the cyclonic air stream from actually escaping from the centrifugal chamber itself.

[0016] The preferred embodiment also contains an air freshener in the filter housing. The air freshener will sublimate into the passing air stream and be emitted with the exhaust from the vacuum and/or any odor causing particles that may be in the air stream will be absorbed by the air freshener. The filter in the filter housing will prevent any dust and debris that may be in the airstream from adhering to the air freshener and thereby impeding its effectiveness.

BRIEF DESCRIPTION OF THE DRAWINGS

[0017] **FIG. 1** is perspective view of a preferred embodiment of the vacuum of the present invention.

[0018] **FIG. 2** is a left side view of a preferred embodiment of the vacuum of the present invention.

[0019] **FIG. 3** is a cut-away of a right side view of a preferred embodiment of the vacuum of the present invention.

[0020] **FIG. 3A** is an enlarged cut-away view of the circled portion of **FIG. 3**.

[0021] **FIG. 4** is an exploded perspective view of a preferred embodiment of the vacuum of the present invention.

[0022] **FIG. 5** is a partially exploded view of a preferred embodiment of the vacuum of the present invention.

[0023] **FIG. 6** is a perspective view of a preferred embodiment of a filter base of the present invention.

[0024] **FIG. 7** is an exploded perspective view of a preferred embodiment of a filter housing and air freshener of the present invention.

[0025] **FIG. 8** is a perspective view of a preferred embodiment of a filter housing of the present invention.

DETAILED DESCRIPTION OF THE BEST MODE

[0026] The invention is primarily directed toward hand held vacuums **1**, that is vacuums **1** of less than about three feet in length and less than about one foot in either width or height. In the preferred embodiment, vacuum **1** includes a suction chamber **2**. Suction chamber **2** comprises a suction housing **3** which will preferably include at least one intake aperture **4** and at least one outflow vent **5**. Suction housing **3** will preferably include at least one motor **6**. Motor **6** is configured to drive at least one fan **7** when motor **6** is activated. Fan **7** is positioned and configured to draw air into intake aperture **4**, through suction housing **3** and out vent **5** when fan **7** is rotated. A power source **8** is provided in or on suction housing **3**. Power source **8** may be a battery or batteries, an electrical line leading to a wall or automotive outlet, or any other conventional source of power suitable for operation of motor **6**. Suction housing **3** will also preferably include a handle **9** and a switch **10** for activating and deactivating motor **6**.

[0027] In the preferred embodiment, a centrifugal chamber **11** in fluid communication with suction chamber **2** is provided. Centrifugal chamber **11** preferably has a base end **12** opposite a distal end **13**. Sidewalls **14** extend between base end **12** and distal end **13**. Sidewalls **14** are preferably circular in cross section, although other shapes may be used if desired. Regardless of their shape, sidewalls **14** have a circumference. The circumference is preferably greater proximate base end **12** and smaller proximate distal end **13**, such that sidewalls **14** form a tapered housing **16**. Housing **16** preferably has a taper of between about three and about thirty-five degrees and most preferably of about fifteen degrees. In one preferred embodiment of centrifugal chamber **11**, the diameter of distal end **13** is about fifty-six millimeters and the diameter of base end **12** is about sixty-three millimeters and the length of centrifugal chamber **11** is about one hundred forty-eight millimeters. In another preferred embodiment of centrifugal chamber **11**, the diameter of distal end **13** is about sixty-three millimeters and the diameter of base end **12** is about seventy-four millimeters and the length of centrifugal chamber **11** is about one hundred forty-eight. Base end **12** may also be provided with a flange for better securing it to suction housing **3**, if desired.

[0028] Centrifugal chamber **11** is preferably provided with an outflow aperture **17** in fluid communication with intake aperture **4** of suction housing **3**. Outflow aperture **17** is preferably positioned at base end **12**. In the most preferred embodiment, base end **12** is open such that base end **12** and outflow aperture **17** are co-extensive. Communication between centrifugal chamber **11** and suction chamber **2** is preferably provided by positioning open base end **12**/outflow aperture **17** over intake aperture **4** of suction housing **3**. Centrifugal chamber **11** should be mounted to suction housing **3** in a substantially air tight fashion, such that air entering intake aperture **4** may only come from centrifugal chamber **11**. In the preferred embodiment, a suction plate **18** is provided over intake aperture **4** to facilitate the seal and engagement between centrifugal chamber **11** and suction chamber **2**. Base plate **18** is preferably made of soft rubber or rubber-like plastic for enhanced seal formation.

[0029] Centrifugal chamber **11** further comprises an inflow aperture **19**. Inflow aperture **19** is preferably provided in sidewalls **14**, proximate to base end **12**. Inflow aperture **19** is most preferably positioned about one fourth of the length of centrifugal chamber **11** from base end **12**.

[0030] Inflow aperture **19** is preferably provided with a one way valve **20**. One way valve **20** preferably comprises a flexible hinged gate **21** and a frame **22** mounted in inflow aperture **19**. Gate **21** is preferably made of rubber or rubberlike plastic. When motor **6** and fan **7** are activated, the suction they generate will pull hinged gate **21** into centrifugal chamber **11** so that inflow aperture **19** is open and air may enter. However, as air circulates around centrifugal chamber **11** in a cyclonic fashion, as described in more detail below, the air stream will encounter gate **21** as it approaches inflow aperture **19**. Gate **21** will divert debris in the air stream away from inflow aperture **19**, thereby precluding debris in centrifugal chamber **11** from escaping. Of course, the air stream entering inflow aperture **11** will also make it difficult for debris to reenter inflow aperture **19**. However, upon the cessation of suction from motor **6** and fan **7**, it would otherwise be possible for debris within centrifugal chamber **11** to reenter inflow aperture **19**. With one way

valve **20** in place, hinged gate **21** will close over inflow aperture **19** when motor **6** and fan **7** stop. This will prevent debris from exiting centrifugal chamber **11** via inflow aperture **19** when vacuum **1** is off.

[**0031**] In the preferred embodiment, centrifugal chamber **11** is made from a clear plastic such as Polymethylmethacrylate (PMMA). However, it will be appreciated that the transparency of centrifugal chamber **11** is a cosmetic feature of vacuum **1** and is not essential to the operation of centrifugal chamber **11** or vacuum **1**.

[**0032**] A nozzle **23** having a mouth end **24** and a discharge end **25** is also provided. Nozzle **23** is positioned generally parallel to sidewalls **14**. Discharge end **25** is fluidly connected to inflow aperture **19**. In the preferred embodiment, an adaptor **26** is provided to connect discharge end **25** of nozzle **23** to inflow aperture **19**. Adaptor **26** is preferably positioned to direct air into centrifugal chamber **11** in an air stream that is generally tangential to centrifugal chamber **11**. It will be appreciated that by tangential, the inventor does not mean that the air stream will literally touch sidewall **14** at only one point. Rather, the inventor means that the air stream will enter centrifugal chamber **11** at approximately a right angle to sidewalls **14** at the point in their curvature where inflow aperture **19** provides access to centrifugal chamber **11**.

[**0033**] It will also be appreciated that adaptor **26** will, in most embodiments of the invention, effect a substantial change in direction for the air stream. Thus, adaptor **26** will be a potential location for debris in the air stream to become lodged, forming a clog in vacuum **1**. To minimize such blockages, the internal diameter of adaptor **26** should be made as large as practicable.

[**0034**] The entry of the air stream into centrifugal chamber **11** on a tangent will entrain the air stream in a cyclonic path around centrifugal chamber. The taper of cyclonic chamber **11** toward distal end **13** will shorten the path of the air stream around the interior of cyclonic chamber **11** as the air stream approaches distal end **13**. This will cause the air stream to accelerate as it approaches distal end **13** of centrifugal chamber **11**. This increased air speed will help keep dust and debris entrained in the air stream. It will also carry dust and debris toward distal end **13**, keeping it away from outflow aperture **17** at base end **12**. This will be particularly helpful as handheld vacuum **1** is moved out of a upright vertical position and into other positions in which gravity may more readily affect the debris entrained within cyclonic chamber **11**. The ability of the accelerated air stream to keep debris near distal end **13** will be especially useful when vacuum **1** is used in conditions which require vacuum **1** to be inverted such as when vacuuming drapes or any area above the user's head. All of the foregoing will keep the air leaving centrifugal chamber **11** and entering intake aperture **4** of suction chamber **2** cleaner.

[**0035**] As should be clear from the foregoing, centrifugal chamber **11** serves as a primary filter in vacuum **1**. Additional filters will not be necessary in all embodiments of vacuum **1**. However, additional filters may be provided where it is desirable that the exhaust from vacuum **1** be extremely clean. In the preferred embodiment a filter housing **27** is provided between centrifugal chamber **11** and suction chamber **2**. Filter housing **27** may be any conventional frame with a filter **28** disposed in or extending from it. Filter housing **27** is preferably positioned so that air entering suction chamber **2** from centrifugal chamber **11** must pass through filter **28**. Filter **28** will preferably be a filter media such as paper of HEPA quality commonly used in the vacuum field.

[**0036**] In the preferred embodiment, filter housing **27** comprises a filter base **29** and a filter cap **30**. The top surface **31** of filter cap **30** and the bottom surface **32** of filter base **29** will both preferably be perforated to allow the passage of air and covered with filter media to prevent the passage of dust particles.

[**0037**] Filter cap **30** and filter base **29** will join together to form filter housing **27**. A plastic suction frame **32** is preferably provided on the bottom of filter base **29**. A gasket **33** is preferably fitted to the bottom of suction frame **32**. Gasket **33** is preferably made of rubber or rubberlike plastic. Gasket **33** and suction frame **32** help centrifugal chamber **11** make an substantially air tight seal to suction housing **2**. In the preferred embodiment, gasket **33** forms a seal with suction plate **18**.

[**0038**] As will be appreciated from the foregoing, filter housing **27** will include an internal volume or chamber between filter cap **30** and filter base **29**. This space can be used to house an air freshener **34**. Air freshener **34** may be a fragrance or deodorizing agents contained within oil or wax based carriers or other suitable carriers. Alternatively, air freshener **34** may be odor absorbing material such as activated charcoal used absorb odor causing particles from the air stream. Of course, combinations of the two types may be used as well. In the preferred embodiment, air freshener **34** is a granulated solid sold by Fantasy Fragrances, Inc. of 739 River Street in Peckville, Pa. under its "Gardenia" trade name.

[**0039**] By placing air freshener **34** in filter housing **27**, the air stream may be scented before leaving vacuum **1**. Alternatively or additionally, odor causing particles may be removed from or neutralized within the air stream before it leaves vacuum **1**. By placing air freshener **34** within filter housing **27**, air freshener **34** may be protected from any dust or debris that may still be in the air stream. Similarly, air freshener **34** may be protected from any dust that may enter via suction housing **2** when vacuum **1** is off.

[**0040**] In the preferred embodiment, filter housing **27** fits within open base end **12** of centrifugal chamber **11**. When filter housing **27** is in place, the debris within centrifugal chamber **11** cannot be removed. It will be appreciated that in this way, centrifugal chamber **11** serves as a dust collection chamber **35**. In the preferred embodiment, the nose portion **36** of vacuum **1** is either fully removable or hinged to suction housing **2**. By opening vacuum **1**, centrifugal chamber **11**/dust collection chamber **35** may be removed from vacuum **1**. When filter housing **27** is removed from base end **12**, the debris within centrifugal chamber **11**/dust collection chamber **35** may be discarded. By replacing filter housing **27**, centrifugal chamber **11**/dust collection chamber **35** may be returned to service.

[**0041**] If air freshener **34** gets low or if the user simply wishes to replace it, he or she may open vacuum **1** in the same manner described above and remove filter housing **27** and open the same. When filter cap **30** is removed from filter base **29**, the old air freshener **34** may be removed and new

air freshener **34** may be added. Filter **28** may be changed in the same way, if needed. Filter housing **27** will then be reassembled and returned to centrifugal chamber **11**/dust collection chamber **35**.

[**0042**] In the preferred embodiment, a filter cover **37** is provided over filter housing **27**. Filter cover **37** is largely decorative. However, it will protect filter **28** and filter housing **27** from large or sharp objects which may become entrained in the air stream inside centrifugal chamber **11**. When filter cover **37** is used, it should be removed with filter housing **27** when vacuum **1** is emptied.

[**0043**] In operation, when motor **6** and fan **7** are activated, they will draw air and debris in through nozzle **23**, through inflow aperture **19** and into centrifugal chamber **11** and further into suction chamber **2** via intake aperture **4** and out vents **5**. Because of the positioning of inflow aperture **19**, air will enter centrifugal chamber **11** tangentially, which will entrain the air stream and debris in a cyclonic path within centrifugal chamber **11**. The circular motion of the air stream will keep the debris near the outer portion of centrifugal chamber **11**. Because centrifugal chamber **11** tapers toward its distal end **13**, the air stream within centrifugal chamber **11** will accelerate as it approaches its distal end **13**. This acceleration will help keep dust and debris particles entrained in the air stream and it will help to concentrate them near distal end **13** and away from base end **12** where outflow aperture **17** is located. Dust and debris will thereby be retained in centrifugal chamber **11**, which thereby serves as a primary filter and as a dust collection chamber **35**. As air exits centrifugal chamber **11**, it will pass through filter housing **27** and filter **28**. Any fine particles of dust remaining in the air stream may be removed by filter **28**. When air freshener **34** is used, the air stream passing though filter housing **27** may be scented and/or deodorized by air freshener **34**.

[**0044**] Except as otherwise indicated above, the components of nose portion **36** of vacuum **1** are preferably made of ABS plastic and are be injection molded, although other plastics or other conventional materials and construction methods maybe used. The preferred nose portion **36** may be used with any suction housing **3**.

[**0045**] In one preferred embodiment, nose portion **36** is provided with a powered rotary attachment as disclosed in pending U.S. patent application Ser. No. 10/100,727, which is hereby incorporated by reference in its entirety.

[**0046**] Although the invention has been described in terms of its preferred embodiment, other embodiments will be apparent to those of skill in the art from a review of the foregoing. Those embodiments as well as the preferred embodiments are intended to be encompassed by the scope and spirit of the following claims.

I claim:

1. A hand held vacuum comprising

(a) a suction chamber comprising a suction housing having an intake aperture and an outflow vent, said suction chamber further comprising a power source configured to power a motor and a fan operatively connected to said motor whereby operation of said motor will rotate said fan, said fan positioned and configured to draw air into said intake aperture, through said suction housing, and out said outflow vent upon rotation of said fan;

(b) a centrifugal chamber, said centrifugal chamber comprising a tapered housing having a base end opposite a distal end and sidewalls extending therebetween, said sidewalls having a circumference, wherein said circumference is smaller proximate to said distal end than proximate to said base end, said centrifugal chamber further comprising an inflow aperture proximate to said base end and an outflow aperture in fluid communication with said intake aperture of said suction chamber, whereby air drawn into said intake aperture of said suction chamber must pass through said centrifugal chamber and said inflow aperture; and

(c) a nozzle having a mouth end and a discharge end, said discharge end fluidly connected to said inflow aperture of said centrifugal chamber, whereby air entering said centrifugal chamber will be drawn through said nozzle and whereby refuse proximate to said mouth end of said nozzle may be drawn into said vacuum with air entering said nozzle; and

wherein said connection between said discharge end of said nozzle and said centrifugal chamber is substantially tangential to said centrifugal chamber, whereby air and refuse entering said centrifugal chamber may be entrained in a cyclonic path within said centrifugal chamber.

2. A hand held vacuum according to claim 1 further comprising a filter housing comprising a filter positioned between said centrifugal chamber and said suction chamber, whereby air exiting said centrifugal chamber and entering said suction chamber must pass through said filter housing.

3. A hand held vacuum according to claim 2 wherein said filter housing further comprises an air freshener.

4. A hand held vacuum according to claim 3 wherein said air freshener is positioned in the path of air entering said suction chamber through said intake aperture whereby substantially all air entering said suction chamber through said intake aperture will pass through said air freshener.

5. A hand held vacuum according to claim 4 wherein said filter is positioned relative to said air freshener so that substantially all air passing through said air freshener into said suction chamber must first pass through said filter.

6. A hand held vacuum according to claim 1 wherein said inflow aperture is provided with a one way valve configured to open when said motor and fan are on and to close when said motor and fan are off, said one way valve further configured to allow air and debris to enter said centrifugal chamber when said one way valve is open and to preclude debris from entering said inflow aperture when said one way valve is closed.

7. A hand held vacuum according to claim 1 wherein said sidewalls of said centrifugal chamber have a taper between about three and about thirty five degrees.

8. A hand held vacuum according to claim 1 wherein said sidewalls of said centrifugal chamber have a taper of about fifteen degrees.

9. A vacuum comprising

(a) a suction chamber comprising a suction housing having an intake aperture and an outflow vent, said suction chamber further comprising a power source

configured to power a motor and a fan operatively connected to said motor whereby operation of said motor will rotate said fan, said fan positioned and configured to draw air into said intake aperture, through said suction housing, and out said outflow vent upon rotation of said fan;

(b) a dust collection chamber, said dust collection chamber comprising a housing having a base end opposite a distal end and sidewalls extending therebetween, said dust collection chamber further comprising an inflow aperture and an outflow aperture in fluid communication with said intake aperture of said suction chamber, whereby air drawn into said intake aperture of said suction chamber must pass through said dust collection chamber and said inflow aperture;

(c) a filter housing comprising a filter positioned between said dust collection chamber and said suction chamber, whereby air exiting said dust collection chamber and entering said suction chamber must pass through said filter housing, wherein said filter housing further comprises an air freshener; and

(c) a nozzle having a mouth end and a discharge end, said discharge end fluidly connected to said inflow aperture of said dust collection chamber, whereby air entering said dust collection chamber will be drawn through said nozzle and whereby refuse proximate to said mouth end of said nozzle may be drawn into said vacuum with air entering said nozzle.

10. A vacuum according to claim 10 wherein said air freshener is positioned in the path of air entering said suction chamber through said intake aperture whereby substantially all air entering said suction chamber through said intake aperture will pass through said air freshener.

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