Abstract: An upright vacuum cleaner having a housing with a handle at an upper end and a base at the bottom end. The base is pivotally attached to the housing and has a floor inlet nozzle facing generally downwardly from it. A dustcup assembly is associated with at least one of the housing and the base, and includes a sidewall defining an interior space having an open top end and a bottom end, a bottom wall extending across the bottom end and having a dustcup outlet therethrough, a dustcup inlet, a dustcup lid adapted to selectively cover the open top, and a fluid conduit formed separately from the bottom wall and attached to the bottom wall at the dustcup outlet. The fluid conduit extends into the interior space defined by the sidewall. The vacuum cleaner also has a vacuum source associated with at least one of the housing and the base. The vacuum source is adapted to create a working air flow that enters the floor inlet nozzle, passes into the dustcup assembly through the dustcup inlet, and exits the dustcup assembly through the dustcup outlet.

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VACUUM CLEANER DUSTCUP AND CONDUIT CONSTRUCTION

FIELD OF THE INVENTION

The present invention relates to vacuum cleaners, and more particularly, to a bagless dust cup assembly to be used with a vacuum cleaner apparatus in lieu of a disposable dirt collection bag.

BACKGROUND OF THE INVENTION

Floor cleaning devices, such as vacuums, have been produced in the prior art. These prior art devices are typically provided in canister, upright, hand-held and other portable configurations, and may be powered by an electrical cord or by batteries. In many cases, the device is provided with a bagless dustcup assembly that utilizes a cyclonic separation action and/or one or more filters to facilitate separation of the vacuumed debris and air. These bagless dustcup assemblies generally include, for example, a separation chamber having a dirty air inlet, a dirt separation system including a cyclone and/or a filter, and at least one outlet for removing cleaned air. In some cases the outlet may comprise a conduit passing through the chamber itself. Various systems for emptying dirt from the separation chamber are known in the art, such as an openable lower door, a dustbin located at the bottom of the separation chamber, or a removable lid that covers and may form part of the separation chamber.

Known bagless dustcup assemblies are often formed of a single integrated piece of plastic comprising a cup-like arrangement of walls. In some cases, a fluid conduit may be formed as part of this cup. An example of such a device is shown in U.S. Pat. No. 6,141,826, in which an outlet conduit is shown as being integrally molded with a cyclone chamber dustcup. While the outlet is often through the bottom of the cup, it may alternatively exit through the lid. For example, one such device is shown in European Patent Application EP 0 728 435, in which a clean air outlet is shown molded with the cyclone chamber lid. Other conduits may be integrally formed to the outside of dirt-receiving portion of the bagless dustcup,
such as in U.S. Pat. No. 5,779,745, which shows an integrally-molded outlet conduit, and U.S. Pat. No. 6,168,641, which shows an integrally-molded inlet conduit. All of the foregoing patents are incorporated herein by reference.

The prior art also discloses devices in which an outlet conduit is formed separately from the cyclone chamber, and attached thereto. For example, U.S. Pat. No. 2,684,125 shows an outlet conduit that appears to be welded or otherwise bonded to a cyclone chamber. U.S. Pat. No. 6,902,596 also discloses that an outlet conduit may be welded or removably attached to a cyclone chamber by mechanical locking means, but does not illustrate or describe how these locking means would operate. U.S. Pat. No. 6,578,230, discloses a outlet and bottom wall that are integrally formed with one another, and attached to the side wall of the cup by threaded engagement. While such threaded engagement may be useful to initially attach the two parts, it is likely that manufacturing tolerances and friction between the parts will make repeated disassembly and reassembly of the parts difficult. Furthermore, the presence of fine particles may rapidly deteriorate the integrity of the threads, as well as add to the difficulty in separating and joining the parts. The foregoing patents are incorporated herein by reference.

While the known cyclone chamber designs can be useful for providing dirt separation for vacuum cleaners and the like, the present inventors have discovered new and useful alternative cyclone chamber construction techniques to supplement and advance the prior art.

SUMMARY OF THE INVENTION

The present invention provides, in a first aspect, an upright vacuum cleaner having a housing with a handle at an upper end and a base at the bottom end. The base is pivotally attached to the housing and has a floor inlet nozzle facing generally downwardly from it. A dustcup assembly is associated with at least one of the housing and the base, and includes a sidewall defining an interior space having an open top end and a bottom end, a bottom wall extending across the bottom end and having a dustcup outlet therethrough, a dustcup inlet, a dustcup lid adapted to
selectively cover the open top, and a fluid conduit formed separately from the bottom wall and attached to the bottom wall at the dustcup outlet. The fluid conduit extends into the interior space defined by the sidewall. The vacuum cleaner also has a vacuum source associated with at least one of the housing and the base. The vacuum source is adapted to create a working air flow that enters the floor inlet nozzle, passes into the dustcup assembly through the dustcup inlet, and exits the dustcup assembly through the dustcup outlet.

In a second aspect, the present invention provides a vacuum cleaner with a housing, one or more air inlet nozzles associated with the housing, and a dustcup assembly associated with the housing. The dustcup assembly has a sidewall defining an interior space having an open top end and a bottom end, a bottom wall extending across the bottom end and having a dustcup outlet therethrough, a dustcup inlet, a dustcup lid adapted to selectively cover the open top, and a fluid conduit formed separately from the bottom wall and releasably attached to the bottom wall at the dustcup outlet, the fluid conduit extending into the interior space defined by the sidewalk. The vacuum cleaner also has a vacuum source associated with the housing, which is adapted to create a working air flow that enters the one or more inlet nozzles, passes into the dustcup assembly through the dustcup inlet, and exits the dustcup assembly through the dustcup outlet.

In a third aspect, the present invention provides a vacuum cleaner having a housing, one or more air inlet nozzles associated with the housing, and a dustcup assembly associated with the housing. The dustcup assembly includes a sidewall defining an interior space having an open top end and a bottom end, a bottom wall extending across the bottom end and having a dustcup outlet therethrough, a dustcup inlet, a dustcup lid adapted to selectively cover the open top, and a fluid conduit attached to the bottom wall at the dustcup outlet, the fluid conduit extending into the interior space defined by the sidewall. The fluid conduit and at least a portion of the bottom wall form a combined conduit/ bottom wall part that is formed separately from the sidewall and attached thereto. The vacuum cleaner also includes a vacuum source associated with the housing. The vacuum source being
adapted to create a working air flow that enters the one or more inlet nozzles, passes into the dustcup assembly through the dustcup inlet, and exits the dustcup assembly through the dustcup outlet.

In various embodiments of the foregoing aspects of the invention, the fluid conduit or combined conduit/ bottom wall part may be attached by screws, a rotating cam lock arrangement, one or more flexible latching tabs, snap-fit engagement, an interference fit, bayonet fittings, or a fastening ring. The conduit/ bottom wall part may also be attached by a fastener that does not include threads formed on the conduit/ bottom wall part itself. A gasket may be interposed between the fluid conduit and the bottom wall or between the conduit/ bottom wall part and the sidewall. The fluid conduit may have an airfoil cross-section, one or more integrally formed contours to assist with dust separation, or one or more integrally formed airflow deflectors. The fluid conduit may also comprise a first section having a first geometric profile, and a second section having a second geometric profile that is different from the first geometric profile. The bottom wall may have an additional dustcup outlet with an additional fluid conduit attached to this outlet and extending into the interior space defined by the sidewall. The dustcup assembly may be releasably attached to the housing, with the dustcup lid formed by the housing or as a separate part that is removable with the dustcup assembly from the housing. Also, the dustcup inlet may pass through the lid or the sidewall. Finally, the fluid conduit or combined conduit/ bottom wall part may or may not be releasably attached.

**BRIEF DESCRIPTION OF THE DRAWINGS**

Figure 1 is a prior art upright vacuum cleaner suitable for use with an embodiment of the present invention.

Figure 2 is an exemplary prior art dustcup assembly.

Figure 3A is a partially exploded view of a first embodiment of a dustcup assembly of the present invention.
Figure 3B is an assembled view the embodiment of Figure 3A.

Figure 4A is a partially exploded view of a second embodiment of a dustcup assembly of the present invention.

Figure 4B is an assembled view the embodiment of Figure 4A.

Figure 5A is an exploded view of a third embodiment of a dustcup assembly of the present invention.

Figure 5B is a fragmented and exploded view of the attachment arrangement of the embodiment of Figure 5A.

Figure 6A is a fragmented, partially cut away, exploded view of a fourth embodiment of a dustcup assembly of the present invention.

Figure 6B is an assembled view of the embodiment of Figure 6A.

Figure 7A is an exploded view of a fifth embodiment of a dustcup assembly of the present invention.

Figure 7B is a fragmented, cross-sectional detail view of the embodiment of Figure 7A, showing the portion encompassed by circle A thereof.

Figure 8A is a partially exploded view of a sixth embodiment of a dustcup assembly of the present invention.

Figure 8B is another partially exploded view of the embodiment of Figure 8A.

Figure 8C is a top view of the embodiment of Figure 8A.

Figure 9A is a schematic representation of a variation of the locking mechanism of the embodiment of Figure 8A.

Figure 9B is a schematic representation of another variation of the locking mechanism of the embodiment of Figure 8A.
Figure 1OA is an exploded view of a seventh embodiment of a dustcup assembly of the present invention.

Figure 1OB is a fragmented, cross-sectional detail view of the embodiment of Figure 1OA, showing the portion encompassed by circle A thereof.

Figure 11 is an exploded view of an eighth embodiment of a dustcup assembly of the present invention.

Figure 12 is an alternative embodiment of an outlet tube that may be used with the present invention.

Figure 13A is a ninth embodiment of a dustcup assembly of the present invention.

Figure 13B illustrates the installation of the embodiment of Figure 13A in an exemplary vacuum cleaner housing.

Figure 14A depicts an embodiment of an outlet conduit with a rectangular cross-section.

Figure 14B depicts an embodiment of an outlet conduit with a square cross-section.

Figure 14C depicts an embodiment of an outlet conduit with a triangular cross-section.

Figure 14D depicts an embodiment of a multi-part outlet conduit with rectangular cross-sections.

Figure 14E depicts an embodiment of a multi-part outlet conduit with square cross-sections.

Figure 14F depicts an embodiment of a multi-part outlet conduit with circular and triangular cross-sections.
Figure 14G depicts an embodiment of an outlet conduit with an airfoil cross-sections.

Figure 15A is side view of another embodiment of a dustcup assembly of the present invention.

Figure 15B is a top view of the embodiment of Figure 15A, shown along line I-I thereof.

Figure 15C is an exploded view of the embodiment of Figure 15A, shown with the lid and filter removed.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

The present invention provides an improved cyclonic separation chamber for cleaning devices. Embodiments of the present invention may be used with any type of vacuum cleaning device, including, but not limited to, upright vacuum cleaners, canister vacuum cleaners, wet extractors, hand-held vacuum cleaners, so-called "stick" vacuum cleaners, and so on. The implementation of the present inventions with such devices will be within the understanding and skill of persons of ordinary skill in the art after review of the present disclosure and with routine experimentation with the present invention.

An example of a conventional upright vacuum cleaner to which the present invention may be applied is shown in Figure 1. The upright vacuum cleaner 100 generally includes a floor engaging base 102, an upright rear housing 104, and a handle 106. The base 102 typically includes a laterally extending, downwardly-facing inlet nozzle 108 that is positioned to lift dirt and debris from the floor. A known rotating brush element (not shown) may be located in the nozzle 108 to agitate the surface being cleaned and help with the cleaning operation. The rear housing 104 is pivotally attached to the base 102, and the handle 106 is attached to the rear housing 104. A conventional vacuum source (not shown) is located in the base 102 or rear housing 104, and is operated to generate a working air flow that is used to clean surfaces. The working air flow applies suction to the inlet nozzle 108,
causing dirt and debris to be entrained in the working air flow. The working air
flow then passes through a dirt cup assembly 110, which is typically mounted on the
rear housing 104, but may instead be on the base 102, to remove all or part of the
entrained dirt and debris. The dirt cup assembly 110 is typically located upstream of
the vacuum source so that it operates under negative pressure, but may alternatively
be downstream of the vacuum source so that it operates under positive pressure. A
hose 110 may also be provided to access and clean surfaces that are above the floor
or difficult to reach with the nozzle. Various pre- and post-motor filters may also be
added to the device to further filter the incoming and exiting working air.

Additional features of upright vacuum cleaners are known in the art, and shown, for
example, in U.S. Pat. Nos. 6,829,804, which is incorporated herein by reference. Any
such features, or other features known in the art or generally understood to be useful
for cleaning floors and other surfaces, may be included in embodiments of the
present invention.

Referring now to Figure 2, a typical prior art cyclone assembly 200 is shown.
The assembly 200 comprises a sidewall 202, a bottom wall 204, and a lid 206 that
form a generally air-tight chamber with the exception of an air inlet 208 and an air
outlet 210. All or part of the assembly 200 may be transparent so that a user can
view its operation and determine when it needs to be emptied, but the lid 206 is
typically opaque. In use, dirt laden air enters the assembly 200 through the inlet 208,
and travels in a cyclonic path to thereby separate dirt from the air in a known
manner. Various means may be used to generate cyclonic airflow. In the shown
device, the cyclonic airflow is generated by introducing the air in a tangential
direction, as shown by arrow A. In other devices, such as the device shown in U.S.
Pat. No. 6,829,804, the air may be introduced along a helical ramp in the lid to impart
the desired cyclonic motion. In still other devices the air may be introduced
perpendicular to the chamber, but diverted by a surface to travel in a tangential
direction, as shown in U.S. Pat. Nos. 6,341,404 and 6,436,160, which are incorporated
herein by reference. The present invention is applicable to these and any other
cyclone generation configurations.
In the cyclone assembly of Figure 2, the outlet 210 comprises a tube that extends through a portion of the assembly 200 and along its central axis, and exits through the bottom wall 204. In alternative embodiments, the outlet may extend through an upper wall or the lid 206, such as shown in U.S. Pat. No. 6,558,453, which is incorporated herein by reference. A filter (not shown), such as the one shown in U.S. Pat. No. 6,829,804, may be placed over or in the outlet 120 to further filter the air, as is known in the art. Various filters and filtration devices are known in the art, such as paper or sheet filters, mesh screens, perforated shrouds, HEPA (High Efficiency Particulate Air) filters, ULPA (ultra low penetration air) filters, and so on, which may be reusable and may have any shape, such as a porous foam block or a pleated air permeable filter. Any such filters may be used with the present invention, or the filter may be omitted as will be appreciated by those of ordinary skill in the art.

Prior art cyclone assemblies are operatively associated with vacuum cleaners in a variety of ways. For example, all or part of the cyclone assembly 200 may be formed as part of the vacuum cleaner's base 102 or rear housing 104 (or canister, in the case of canister-style vacuum cleaners), and intended to remain attached thereto during operation and emptying. However, in many instances the cyclone assembly 200, or portions thereof, is selectively removable from the rest of the vacuum cleaner. For example, referring to Figure 1, the cyclone assembly 110 of the device shown in U.S. Pat. No. 6,829,804, includes a sidewall 112 and bottom wall 114 that form a dirt cup upon which a removable lid 116 is positioned. The outlet 120 is in the form of a tube that is molded directly into the bottom wall 114, and a filter 122 removably secured to the top of the outlet 120. In addition to forming a cyclonic separation chamber, the sidewall 112, bottom wall 114, and outlet tube 120 form a cup-like structure that holds dirt captured by the device. When it is desired to empty the cup, the cup and lid are removed from the rear housing 104 as a unit, then the lid 116 is removed and the dirt cup inverted to empty its contents. One or more handles (not shown) may be provided to assist with handling the cyclone chamber, dirt cup, or lid.
In other devices, such as in U.S. Pat. Nos. 6,579,334 and 6,910,245, which are incorporated herein by reference, the cyclone assembly lid is formed as part of the rear housing, and only the cup portion of the cyclone assembly — that is, the portion formed by the sidewall and the bottom wall — is removable to empty it. In addition, while the foregoing embodiments describe the cup being removed from the lid to be emptied, the cyclone chamber may alternatively be emptied by opening or removing the lower wall, such as shown in U.S. Pat. No. 6,546,593, which is incorporated herein by reference. In still other embodiments, the cyclone assembly may deposit dirt and debris into a separate chamber by inertia, as in U.S. Pat. No. 6,168,641, or by the operation of a manual or automatic trapdoor, as in U.S. Pat. No. 6,344,064. These patents are incorporated herein by reference. The present invention may be used with any suitable configuration for attaching the cyclone assembly to the vacuum cleaner.

As noted before, the prior art contemplates forming the outlet 210 integrally with the bottom wall 204 and sidewall 202. The present inventors have found that using this one-piece construction can Emit the manufacturer's ability to economically produce desirable inlet and outlet conduit configurations. The prior art also contemplates welding an outlet conduit to a dirt cup, such as shown in U.S. Pat. No. 2,684,125. However this prevents removal of the outlet conduit, and may also require expensive manufacturing equipment and increased manufacturing time. The prior art also contemplates forming these parts separately, and joining them, but does so using threads formed on the parts being joined. For example, U.S. Pat. No. 6,578,230, which is incorporated herein by reference, discloses a outlet and bottom wall that appear to be integrally formed with one another, and attached to the sidewall by threaded engagement. The threads are located at the outer perimeter of the bottom wall, where it meets the lower edge of the cylindrical sidewall. This construction is believed to suffer from various disadvantages, such as thread degradation caused by the intrusion of dirt particles into the threads, and assembly difficulties caused by dirt accumulation, friction, misalignment and thread stripping. This configuration also appears to require relatively high manufacturing tolerances.
to ensure that the parts are close enough in shape to properly thread together, and
requires both parts to include threaded portions, which increases the thickness at
those locations, thus also increasing the weight and cost of the materials and their
manufacture. In view of these expected shortcomings, it is preferred, in at least
some embodiments of the invention, to avoid the use of such threads formed on the
parts that form the dustcup assembly itself.

The present invention provides alternative dustcup assemblies that provide
various advantages over the prior art, and may ameliorate or lessen the known and
expected shortcomings of the prior art. It will be understood that it is not required
for each embodiment of the claimed invention to address all, or even any, of the
listed shortcomings of the prior art.

A first exemplary embodiment of a dustcup assembly 300 of the present
invention is shown in Figures 3A and 3B. In this embodiment, the dustcup assembly
300 comprises a generally cylindrical sidewall 302 (although other shapes may be
used), a bottom wall 304, and an open top 303 to which a lid (not shown) may be
fastened in any conventional manner. For example in this embodiment, the lid is
fastened using bayonet fasteners, and one receiving slot 305 for the lid's bayonet
fastener tabs is visible at the upper end of the sidewall 302. It will also be
appreciated that the lid may be omitted, and the dustcup assembly 300 fastened
directly to the vacuum cleaner housing to close and seal the dustcup assembly 300,
such as in the device of U.S. Pat. No. 6,910,245. The dustcup assembly 300 also
includes an inlet (not shown) to generate the desired cyclonic air movement. The
inlet may enter the dustcup assembly 300 through the sidewall 302 (as, for example,
in the embodiment of Figures 4A and 4B), through the lid, or in any other manner.

The foregoing variations regarding the dustcup shape, lid attachment and inlet style,
and any other typical variations to these or other features, may be made to this or
any other embodiment of the inventions described herein, as will be appreciated by
those of ordinary skill in the art, and further reference to such variations is omitted
in the following discussion for the sake of brevity.
The embodiment of Figures 3A and 3B includes a fluid conduit 310, which in this case is an outlet tube, that is removably installed in a hole through the center of the bottom wall 304. When installed, the outlet tube 310 extends generally along the cylindrical axis 301 of the dustcup assembly 300. It is preferred that the outlet tube 310 extend a substantial distance, preferably along at least about 50% of the length of the sidewall 302, however this length are not strictly required for the invention. One or more screws 312 or other fasteners, such as quarter-turn fasteners, snaps, and the like, may be used to attach the two parts. To this end, the bottom wall 304 is provided with a recess 314 into which a corresponding flange 316 on the outer perimeter of the bottom end of the outlet tube 310 fits. An o-ring seal 326, or other type of sealing member (such as a foam gasket) is preferably provided to fit between the recess 314 and the flange 316 to prevent air from passing through this location. A supplemental adhesive and or sealant may also be provided between the parts, if desired. In some instances, however, it might be desirable to omit this seal 326, and even provide a small bleed air passage to ensure that air can pass to the vacuum source if the dustcup assembly 300 becomes blocked, and thereby prevent overheating. A second seal (not shown) may also be provided on the bottom side of the flange 316 to mate with a lip or other surface surrounding the inlet to the vacuum source. The flange may also serve as a mounting location for a filter installed in or at the bottom of the outlet tube 310. As noted before, a filter may also be located at the top of the outlet tube 310, if desired.

The recess 314 and flange 316 are preferably, but not necessarily, shaped so that the flange 316 cannot rotate relative to the recess 314 when it is installed therein. While any non-circular shape will suffice, relative rotation is prevented in the embodiment of Figures 3A and 3B by providing several protrusions 318 on the flange 316 that fit into corresponding openings 320 in the recess 314. These protrusions 318 and openings 320 also serve as screw mounting locations, and each protrusion 318 has a screw passage 322, and each opening 320 has a screw mounting boss 324. The mounting bosses 324 have internal threads to receive the screws 312 and hold the outlet tube 310 in place. The mounting bosses 324 may be provided
with inserts (not shown), such as metal nuts that are captured or molded in place, to assist with engaging and retaining the screws 312. Conveniently, when the flange 316 is fully seated in the recess 314, the screw openings 322 and mounting bosses 324 are aligned relative to one another by the engagement of the protrusions 318 in the openings 320, and no further manipulation of the parts is necessary to prepare them for the installation of the screws 312, which potentially saves manufacturing time and allows relatively simple automated assembly. As shown in Figure 3B, the flange 316 is preferably flush with the bottom wall 304 when it is fully installed to minimize the overall height of the dustcup assembly 300. To remove the outlet tube 310, the screws 130 are simply backed out of the mounting bosses.

Various modifications to this design are possible. For example, the screws could pass through the lower wall 304 and be installed into the flange 316. The screws may also be omitted, and the flange 316 and recess 314 may be adapted to have snap-fitting tabs and detents to allow the outlet tube 310 to simply be pressed into place. The flange 316 and recess 314 may also be slightly tapered or provided with interfering dimensions to allow them to be press-fit together. Furthermore, while releasable attachment is preferred, the outlet tube 310 may be permanently attached, such as by ultrasonic welding, spin welding, adhesives, and so on.

In addition, while the embodiment of Figures 3A and 3B illustrates the bottom wall 304 being integrally formed with the sidewall 302, and the recess 314 being formed in the bottom wall 304, it will be appreciated that all or a portion of the bottom wall 304 may instead be formed as part of the flange 316 and outlet tube 310 (or the flange may simply form the bottom wall), and this combined outlet tube/bottom wall part could then be attached to the lower periphery of the sidewalk 302 or to the remaining portion of the bottom wall 304. Other variations will be apparent to those of ordinary skill in the art in view of the present specification and with routine practice of the inventions described herein.

A second exemplary embodiment of the present invention is shown in Figures 4A and 4B as dustcup assembly 400. In this embodiment, the dustcup assembly once
again comprises a sidewall 402, bottom wall 404, and open top 403 that is covered by a removable lid (not shown), which may be a separate part, or simply part of the housing to which the dustcup assembly 400 is ultimately attached. The dustcup assembly 400 includes an air inlet 408 (Figure 4B) through the sidewall 402, and an air outlet tube 410 through the bottom wall 404. The outlet tube 410 and bottom wall 404 are preferably formed together as a single part, such as by plastic molding, and attached to the lower peripheral edge of the sidewall 402.

The bottom wall 404 is preferably attached by an arrangement including a latch 412 on one side of the sidewall 402, and a tab 414 on the opposite side of the sidewall 402. The tab 414 fits into a corresponding slot or opening 416 on a raised portion 418 of the bottom wall 404. This raised portion 418 preferably surrounds or abuts the lower edge of the sidewall 402 and includes a seal to form an airtight seal between the two parts when they are assembled. In the shown embodiment, the tab 414 is located in a recess 420 to help minimize the radial dimension of the assembly.

The latch 412 comprises a pivoting member including a hook 422 at its lower end, a button 424 at its upper end, and a pivot 426 or other fulcrum between the hook 422 and the button 424. The latch 412 is oriented on the sidewall 402 with the hook 422 located to engage a corresponding portion of the bottom wall 404. The combined engagement of the latch 412 on one side and the tab 414 and opening 416 on the other side of the bottom wall 404 prevent it (and the attached outlet tube 410) from being separated from the dustcup assembly 400. The pivot 426 is attached to the sidewall 402 so that the button 424 can be pressed radially inwardly, which moves the hook 422 radially outward, and out of engagement with the bottom wall 404, thereby allowing disassembly. A spring (not shown), is preferably captured between the button 424 and the sidewall 402 to resiliently bias the button 424 outward, and therefore the hook 422 inward, and in the locked position.

Like the tab 414, the latch 412 is preferably located in a recess 428 to help minimize the radial dimension of the dustcup assembly 400. Furthermore, the latch 412 preferably is positioned so that it is inaccessible when the dustcup assembly 400
is installed to the vacuum cleaner for use, such as by being located on the back side of the assembly along with the air inlet 408. As such, the latch is inaccessible in order to prevent accidental openings, and can only be activated when the dustcup assembly 400 is removed from the vacuum cleaner. In addition, while the latch 412 and tab 414 are illustrated as being on the sidewall 402, with the corresponding mating structures on the bottom wall 404, these positions can be reversed for the latch 412, tab 414, or both.

While it would be possible in the embodiment of Figures 4A and 4B to empty the dustcup assembly 400 by removing the lid and inverting the assembly, it may also be emptied by simply removing the bottom wall 404 and outlet tube 410. As such, in variations of this embodiment, the open top 403 may be covered by a lid (not shown) that is permanently affixed to the sidewall 402 (such as by being integrally formed therewith), or a lid that is not intended to be removed during normal use (such as by being screwed in place). In such an embodiment, the dustcup assembly 400 may be emptied by removing it from the vacuum cleaner, inverting it, removing the bottom wall 402 and outlet tube 410 (which, by virtue of the inversion of the assembly are now above the lid end), and then inverting the assembly once again to empty its contents. Reassembly would follow the opposite procedure. This procedure may prove to be advantageous, as the movement of the outlet conduit 410 relative to the sidewall 402 may help to dislodge dirt that becomes packed down in the dustcup assembly 400, and the outlet conduit 410 or a filter (not shown) located at the top end of the outlet conduit 410 may act as a piston to pull the dirt and debris out of the dustcup assembly 400 without requiring the user to otherwise mechanically agitate the assembly to dislodge the dirt.

Referring now to Figures 5A and 5B, a third embodiment of the present invention provides a dustcup assembly 500 comprising a combined lower wall 504 and fluid conduit 510 that is connected to the sidewall 502 by flexible latching tabs 512. The flexible tabs 512 extend, in a cantilevered fashion, from an annular wall 514 that protrudes upwardly from the bottom wall 504. Each tab 512 comprises a vertical wall 516 having an opening 518 therein, and a finger tab 520 that protrudes
away from the dustcup assembly 500 to allow a user easily manipulate the tab 512. Each opening 518 is positioned to overlie and engage a corresponding catch 522 formed on the outer surface of the sidewall 502. The catches 522 preferably include a ramped lower surface, and a flat upper surface. The ramped lower surfaces help press the flexible tabs 512 outward to allow the bottom wall/outlet tube assembly to be installed without manipulating the flexible tabs 512. Once in place, the openings 518 surround the catches 522, and the flat upper surfaces prevent disassembly until the user presses on one or both of the finger tabs 520 to release the openings 518 from the catches 522. While the latching tabs 512 are shown as having openings 518 that fit over catches 522 on the sidewall 502, the catches may instead be positioned on the tabs and adapted to fit into corresponding openings (or detents) on the sidewall. For simplicity, the term flexible latching tab will be understood to encompass any variation of a flexible tab that hold parts together by engagement between a catch and a detent or opening (or two catches), regardless of which part has the catch, and which has the opening or detent.

In use, it is likely that the operator will only have to operate a single one of the flexible latching tabs 512, and therefore the other flexible tab 512 may optionally be replaced by an inflexible tab, such as the one shown in the embodiment of Figures 4A and 4B. Of course, many variations are possible, and additional tabs may be used, or the 512 may be located on the sidewall 502 and the catches 522 located on the bottom wall 504.

The upper end of the dustcup assembly 500 comprises an open end 503 that is covered with a removable lid (not shown). The dustcup assembly 500 is emptied by removing it from the vacuum cleaner, and inverting it to drop out the contents. This is done without disassembling the bottom wall 504 and outlet tube 510 from the sidewall 502. However, as with the embodiment of Figures 4A and 4B, the latching arrangement for the bottom wall 514 and outlet tube 510 allows relatively quick and simple disassembly, and therefore this may alternatively be used as the primary emptying means. In such a case, the upper end may be closed or a provided with a
permanent or semi-permanent lid, and the emptying procedure described above with respect to Figures 4A and 4B could be used to empty it.

In the embodiments described thus far herein, the outlet tube is attached to the dustcup assembly by inserting it from below the sidewalls. However, the opposite assembly is also possible with the present invention. An embodiment of such a construction is illustrated in Figures 6A and 6B. In this embodiment, the dustcup assembly 600 comprises a sidewall 602, a bottom wall 604, and outlet tube 610. The bottom wall 604 and outlet tube 610 are formed as a single part that is assembled with the sidewall 602 by advancing it downward through the sidewall until it snaps into place or is otherwise attached.

The embodiment of Figures 6A and 6B is held together in a similar manner as the embodiment of Figures 5A and 5B — namely, by the use of flexible tabs 612. The flexible latching tabs 612 extend downwardly from the bottom wall 604, and each tab 612 includes a catch 614 that protrudes radially outward. When the bottom wall 604/outlet tube 610 part is fully seated, the catches 614 engage a corresponding structure on the sidewall 602 to hold the parts together. While four tabs 612 are preferred (the fourth being omitted from the figures by virtue of them being cutaway views taken along the centerline of the device), more or fewer tabs 612 may be used.

While the structure with which the catches 614 engage may simply comprise the lower edge of the sidewall 602 or an inwardly-extending lip on the sidewall 602, it is preferred to provide the sidewall 602 with a radially inwardly-extending flange 616 with a downwardly-extending annular wall 618. The catches 614 engage the annular wall as shown in Figure 6B. The use of this inwardly-extending flange 616 allows the radially outermost portion of the bottom wall 604' to overlie the flange 616 and create a serpentine passage to prevent dirt from escaping through the bottom of the dustcup assembly 600, and prevent air from entering the dustcup assembly 600 through this juncture during operation. A gasket or other seal (not shown) may be provided between the parts to assist with sealing any air gap. Similarly, the bottom wall is provided with an annular recess 622 into which a gasket
624 is fitted to seal against a corresponding annular wall on the vacuum cleaner housing (not shown) to which the dustcup assembly is attached. Alternatively (or in addition), a seal (not shown) may be provided in the annular space 626 between the annular wall 618 and the sidewall 602, which, when engaged by a corresponding portion of the vacuum cleaner housing, could effectively seal the entire bottom of the dustcup assembly 600 against air leaking into the assembly during operation of the vacuum source.

The manufacture of the bottom wall 604, the flexible tabs 612 and the catches 614 may be facilitated by creating the bottom wall 604 with small openings 620 over each catch 614, which allows injection molding the part with only two mold portions. The bottom wall 604 may also include an annular wall that lies adjacent to annular wall 618, although this is not shown in the Figures. As with the embodiment of Figures 5A and 5B, the flexible tabs 612 are shaped and sized to allow them to be flexed inwardly, as shown by the arrows A, far enough to allow the catches 614 to bypass the annular wall 618 as the part is installed, but firmly snap back approximately into their unflexed position to hold the parts together. The precise considerations of length, with and material thickness will depend on the material selected for the part, as will be appreciated by those of ordinary skill in the art. The annular wall 618 may also include ramps or slightly tapered surfaces (not shown) along which the catches 614 may ride as they are being installed to gradually flex them inwardly, which should decrease the amount of effort required to attach the parts. Such ramps may be particularly useful if it is desired to make the flexible tabs 612 resilient enough to attach the parts together, but difficult to flex them back by hand to disassemble the parts, thereby providing a somewhat more permanent assembly. If it is desired to orient the outlet tube 610 and bottom wall 604 in a particular angular orientation relative to sidewall 602, the parts may be provided with one or more keys and slots that engage with one another to prevent assembly in any but the desired position, as will be appreciated by those of ordinary skill in the art in view of the present disclosure.
A fifth embodiment of the invention is shown in Figures 7A and 7B. In this embodiment, the dustcup assembly 700 comprises a sidewall 702 having a plurality of openings 712 arranged in an annular pattern around the bottom end of the sidewall 702. The bottom wall 704 and outlet tube 610 are again constructed as a single part, although, as with other embodiments, they may be separately formed and connected together. The bottom wall 704 includes an annular sidewall 714 that is constructed such that its exterior surface fits within the interior surface of the dustcup sidewall 702. A plurality of tabs 716 extend radially outward from the sidewall 714. Each opening 712 is adapted to receive a corresponding tab 716, as illustrated in Figure 7B in order to secure the bottom wall 704 and outlet tube 710 the sidewall 702 to form the dustcup assembly 700. Of course, the openings 712 may be replaced by indentations on the inner surface of the sidewall 702 that do not pass all the way through the sidewall 702.

In this embodiment, one or both of the dustcup sidewall 702 and the bottom wall sidewall 714 must flex in a manner to allow the parts to be pushed together for assembly. To this end, one or both parts may be made of a somewhat flexible material, or may be provided with slots between the openings 712 and/or tabs 716 (not shown) that increase the local flexibility of the material in the region proximate to the openings 712 and/or tabs 716. The tabs 716 may also be beveled to ease their entry into the sidewall 702, and the sidewall 702 may be provided with a chamfered interior edge or ramps for the same purpose. A seal (not shown) may also be provided between the parts to assist with forming an air- and dirt-tight connection. As with the foregoing embodiment, it will be appreciated that the number and size of the tabs 716 and openings 712 can be varied according to the manufacturer's desires. Generally, the use of more tabs 716 and openings 712 provides a more positive lock between the parts, but may require greater manufacturing tolerances or steps to produce the parts. A greater number of tabs 716 and openings 712 also increases the difficulty of disassembling the parts, making it a one-shot snap-fit, which may be preferred if it not desired for the end-user to be able to perform such disassembly. For example, one instance in which disassembly may not be desired is
when the parts are provided with an airtight seal by an adhesive tape or epoxy that could be damaged or destroyed by disassembly.

Figures 8A to 8C show a sixth embodiment of a dustcups assembly 800 of the present invention, in which rotating cam locks are used to hold the parts together. This embodiment comprises a sidewall 802 and bottom wall 804 that are integrally molded as a single part, and an outlet conduit 810 that is attached to the bottom wall 804 by a cam lock mechanism. Like the embodiment of Figures 4A and 4B, the dustcup assembly 800 includes an inlet 808 through the sidewall 802, and an open top 803 that is covered by a lid (not shown), but variations of these features are within the scope of the invention, as explained previously herein. One or more ribs 811 are provided on the sidewall 802 to fit into corresponding slots (not shown) on the vacuum cleaner housing to help orient the dustcup assembly 800 for proper installation.

The bottom of the outlet tube 810 includes three cam followers 812 (two of which are visible in Figure 8A) that extend radially from the outlet tube wall. The outlet tube 810 also has an outwardly-extending flange 814 at its end. There is a small gap between each cam follower 812 and the flange 814. Each cam follower 812 includes a small tab 820 that extends downward into this gap. A seal (not shown) may be positioned between the cam followers 812 and the flange 814 to seal the dustcup assembly 800 when the outlet tube 810 is installed.

As shown in Figures 8B and 8C, the bottom wall 804 has a central opening 816 into which the outlet tube 810 fits. The central opening 816 has three notches 818 that are arranged in the same pattern as the cam followers 812 so that the cam followers 812 can be received therein. As shown most clearly in Figure 8C, each notch is located circumferentially adjacent a portion of the upper surface of the bottom wall 804 that includes an upwardly-extending catch 822, and a cam stop 824. (The outlet tube 810 is shown inserted into the central opening in Figure 8C, but not yet rotated into place.)
To secure the outlet tube 810 to the dustcup assembly 800, the tube 810 is
inserted into central opening 816 along the longitudinal axis 801 of the dustcup
assembly until the cam followers 812 pass through the notches 818, and the flange
814 is seated against the bottom wall 804. If a seal is provided, some compression of
the seal may be necessary to reach this point, but this is not required. The outlet tube
810 is then rotated relative to the sidewall 802 and bottom wall 804, preferably by
about 1/8 th of one turn (45 degrees). As this happens, the cam followers 812 and the
downwardly-extending tabs 820 are pushed against and over the upwardly-
extending catches 822, after which, the sides of the cam followers 812 abut the cam
stops 824. The contact between the tabs 820 and the catches 822 creates a physical
obstruction to hold the outlet tube 810 in place. The cam stops 824 prevent over-
rotation of the outlet tube 810, and thereby ensures proper installation. Removal is
done by simply reversing the rotation of the outlet tube 810 and overcoming the
retaining force generated by contact between the tabs 820 and the catches 822.
Providing relatively gentle ramps on the tabs 820 and catches 822 will reduce the
force necessary to assemble and disassemble the parts. If it is desired to provide a
more permanent installation, the tabs 820 and catches 822 may be made with square
back sides that lock together once the parts are rotated into place. A schematic of
this variation is shown in Figure 9A.

In a variation of this embodiment, shown in Figure 9B, the portion of the
bottom wall 804 between the notches 818 and the catches 822 is made with a
gradually thickening profile 902 that is ultimately nearly equal or greater in
thickness than the size of the gap between the cam followers 812 and the flange 820
(or the seal, if one is provided) on the outlet tube 810. In this variation, the catches
822 are replaced with detents 904 into which the tabs 820 fit when the outlet tube 810
is rotated to the desired installation position. It will be understood, of course, that all
of these variations essentially use a rotating cam lock arrangement having a tab on
one part, and a catch, ramp or notch (or a combination thereof) on the other part.

Other variations of rotating cam locking devices may be used with the present
invention. In addition, as with other embodiments described herein, the outlet tube
may actually be formed integrally with the bottom wall, and these parts may be cam
locked to the sidewall. The bottom wall may also be formed in two parts, one of
which is attached to the sidewall, and the other of which is attached to the outlet
tube, and which are attached together by cam locks to form the dustcup assembly.

Other variations of the cam locking devices and their location and use to form a
dustcup assembly will be appreciated by those of ordinary skill in the art in view of
the present disclosure, and with routing experimentation with the present invention.

Referring now to Figures 10A and 10B, a seventh embodiment of a dustcup
assembly 1000 of the present invention comprises a combined outlet tube 1010 and
bottom wall 1004 that is attached to a sidewall 1002 by a fastening ring 1012. The
fastening ring 1012 includes a lower radial wall 1014, an upper radial wall 1016, and
an annular wall 1018 that connects the upper and lower radial walls. The upper
radial wall 1016 includes a number of notches 1020 extending therethrough. The
sidewall 1002 includes a number of radially-extending catches 1022, which are
spaced and sized to fit into the notches 1020.

The dustcup assembly 1000 is assembled by positioning the bottom wall 1004
to abut the lower edge of the sidewall 1002, and installing the fastening ring 1012
over the bottom wall 1004. The catches 1022 pass through the notches 1020 in the
upper radial wall 1016, and the fastening ring 1012 is rotated until the catches are
located under the upper radial wall 1016. In this position, the bottom wall 1004 is
captured in place between the fastening ring 1012 and the sidewall 1002, and secured
by the catches 1022. One or both of the catches 1022 and the lower surface of the
upper radial wall 1016 may include detents, cam surfaces, or other devices to
provide a compression force or a locking engagement to hold the parts together, as
described above with reference to Figures 8A to 9B, or as otherwise known in the art.
For example, in one embodiment, the foregoing arrangement may comprise bayonet
fittings. The foregoing arrangement may alternatively comprise threads, rather than
catches 1022, which is made more practical in this embodiment than in the known
art by locating the threads where they do not risk substantial contact with dirt and
debris from the dustcup assembly 1000. One or more seals (not shown) may be
provided between one or more of the sidewall 1002, bottom wall 1004 and fastening ring 1012.

The foregoing embodiments and variations thereof provide several performance advantages in dustcup assemblies. For example, the use of such heterogeneous parts can provide weight savings, improved cleanability, additional options for emptying the dustcup assembly, improved aesthetics, and so on. This construction also allows the dustcup assembly to include specialty materials without unduly raising the cost of the device. For example the outlet conduit may be produced with an anti-microbial additive, such as MICROBAN (available from Microban International, Ltd. of New York, New York), to assist with keeping the dustcup assembly microbe free, but the sidewall may not be treated to reduce expense.

In addition, the present invention can provide a number of manufacturing and engineering benefits. For example, in many instances, the parts can be manufactured as two simple assemblies using two-part injection molds. This two-part construction allows the parts to be made from different materials, with different thicknesses, or with different colors or graphics. Other manufacturing advantages may include quicker molding time, reduced tooling cost, reduced molding scrap, eliminating the need for providing a mold-griping surface on the parts, and so on. The two-part construction of the present invention also allows, if desired, the parts to be disassembled for more economical shipping, as removal of the outlet tube from the center of the dustcup assembly can allow additional parts of the device to be shipped within the dustcup assembly itself. Still another benefit of using a separate part for the outlet tube is that the outlet tube can be replaced with different shaped tubes (e.g., longer, shorter, wider, or narrower) to facilitate the use of different filter sizes and to make different end products, without requiring an entirely new dustcup assembly mold to be produced. This has one particular advantage of improving product development lead times.
In addition, while the embodiments described herein describe the outlet tube as being an air passage for air to exit the dustcup assembly, the present teachings are also applicable to air inlet passages that are attached to or pass through the dustcup assembly, and are also applicable to dustcup assembly inserts that do not actually carry an airflow therethrough.

Still other benefits of the two-piece construction of present invention are described below with respect of various additional embodiments, which may be used with any of the foregoing embodiments.

Referring now to Figure 11, the use of a separate outlet tube according to the present invention allows practical formation of airflow-enhancing shapes on the dustcup assembly sidewall and outlet tube. In this embodiment, the dustcup assembly 1100 comprise a sidewall 1102 and a combined bottom wall 1104 and outlet tube 1104. The bottom wall 1104 attaches to the sidewall, as in any of the foregoing embodiments or variations thereof, at or near the outer edge of the sidewall 1102. This allows airflow-enhancing contours 1112 to be molded into the inner surface of the sidewall 1102 using a conventional injection molding techniques, and may even be performed using simple two-part molds. This construction similarly allows airflow-enhancing contours 1114 to be molded on the outlet tube 1110. As with the contours 1112 on the sidewall 1102, these contours 1114 can be molded much more readily than if the outlet tube 1110 were molded with the remainder of the dustcup assembly 1100. Either set of contours 1112, 1114 may also be provided on a separate sleeve that is assembled with the dustcup assembly 1100.

An alternative embodiment of an outlet tube that may be used with the present invention is shown in Figure 12. In this embodiment, the outlet tube 1210 comprises an airflow deflector 1212 that is integrally molded with the outlet tube 1210. In embodiments in which the outlet tube 1210 is installed through a hole through the bottom of the dustcup assembly (not shown), the airflow deflector 1212 is limited in size and shape to being insertable through the installation hole, but in embodiments in which it is installed through the open top end of the dustcup
assembly, the airflow deflector 1212 may be larger. The airflow preferably has a flat, disk-like shape, which allows the outlet tube 1210 to be made by clamshell molds that form either lateral side of the outlet tube 1210 with an third mold insert to form the hollow interior of the outlet tube 1210. However, the deflector 1212 may be made with a compound, curved or angled surfaces, or any other deflector shapes known in the art. The proper molding techniques for such shapes will be understood to those of ordinary skill in the art based on the present disclosure.

Another embodiment of a dustcup assembly of the present invention that is facilitated by the use of a two-part assembly is shown in Figures 13A and 13B. In this embodiment, the dustcup assembly 1300 comprises a sidewall 1302, a bottom wall 1304, and an outlet tube 1310 that exits through the sidewall 1302. The outlet tube 1310 is installed using screws, cam-lock fasteners, or the like, as described previously herein. This construction would be relatively difficult or expensive with conventional injection molding techniques, but is greatly simplified by forming the outlet tube 1310 separately. Since the outlet tube 1310 is manufactured separately from the sidewall 1302, it can also be economically manufactured with a plurality of perforations 1312 around its end to act as a fine or coarse filter, or to act as an emergency screen to prevent the filter (not shown), if used, from entering the outlet tube 1310 and then the vacuum motor if it is torn or otherwise disintegrates. Of course, this feature may be provided with any of the other embodiments of the invention as well.

A particular advantage of two-part construction of the present invention is that this embodiment may be manufactured from any of the foregoing embodiments by molding the sidewall 1302 with an opening to receive the outlet tube 1310, and covering the original opening through the bottom wall 1304 with an airtight cover (or vice versa for making any of the foregoing embodiments from the present embodiment). This facilitates the manufacture of a variety of products using a single sidewall as a platform.
The installation of the embodiment of Figure 13 into an exemplary vacuum cleaner is shown in Figure 13B. Here, the vacuum cleaner comprises an upright vacuum having a nozzle base 1314 to which a rear housing 1316 is pivotally attached— the rear housing includes a dustcup assembly receiving portion 1318 having an air inlet connection 1320 and an air outlet connection 1322. The inlet connection 1320 mates with the dustcup assembly inlet 1308, and the outlet connection mates with the outlet tube 1310 when the dustcup assembly 1310 is installed. A suitable latch, as are known in the art, holds the dustcup assembly 1300 in place.

While the foregoing embodiments have depicted the sidewall being cylindrical, this shape is not required, and conical, frusto-conical, and other shapes may be used. In addition the outlet tube may have any number of non-circular profiles. The use of the two-part assembly of the present invention also facilitates the manufacture of outlet tubes having relatively complex shapes. Referring to Figures 14A to 14G, a number of exemplary variations are shown. These shapes may be used with any embodiment of the present invention.

Figure 14A illustrates an alternative outlet tube 1410a having a rectangular profile. Figure 14B illustrates an alternative outlet tube 1410b having a square profile. Figure 14C illustrates an alternative outlet tube 1410c having a triangular profile. Such rectilinear profiles may, by virtue of not being circular, initiate the creation of sub-cyclones within the dustcup assembly that help separate particles from the air.

The embodiments of Figures 14D to 14F illustrate multi-part conduits, which have upper and lower portions having different shapes and/ or sizes. In the embodiment of Figure 14D, both outlet tube sections 1410d' and 1410d" are rectangular, but the lower section 1410d' is larger than the upper section 1410d". Of course, the opposite arrangement, that is, having the lower section 1410d' smaller than the upper section 1410d", may also be used, in the embodiment of Figure 14E, both outlet tube sections 1410e' and 1410e" are square, but the lower section 1410e'
is rotated relative to the upper section 1410e". In the embodiment of Figure 14F, the lower outlet tube section 1410f is triangular, and the upper outlet tube section 1410f" is cylindrical. These embodiments are provided only by way of example, and many other embodiments will be apparent to those of ordinary skill in the art in view of the present disclosure and with routine experimentation with the present invention. Additional examples of outlet tube geometries and airflow enhancing contours that may be produced on the outlet tube are provided in U.S. Pat. No. 6,419,719, which is incorporated herein by reference.

Figure 14G illustrates still another embodiment of an alternative outlet tube geometry of the present invention. In this embodiment, the outlet tube 1410g comprises an airfoil-like shape. While this airfoil shape may be located in the center of the dustcup assembly 1400, it may alternatively be located closer to the sidewall 1402. As the air in the dustcup assembly 1400 circles around the sidewall 1402 and past the airflow shaped outlet tube 1410, a lower pressure develops between the outlet tube 1410 and the sidewall 1402, which is expected to increase the efficiency of the cyclonic separating action. In this embodiment, an airfoil-shaped filter 1412 may be used to further assist with cyclone separation and enhance the aesthetic quality of the device.

The present invention also allows the use of multiple outlet tubes having relatively complex geometry. Referring now to Figures 15A to 15C, in another embodiment of the invention the dustcup assembly 1500 comprises a sidewall 1502, bottom wall 1504, and lid 1506. The single outlet tube of the previous embodiments is replaced by a pair of curved outlet tubes 1510 that extend downwardly in a spiral pattern that may enhance the cyclonic airflow within the dustcup assembly 1500. The outlet tubes 1510 may be formed separately from one another, and separately assembled to the bottom wall 1504, as described previously herein, or both outlet tubes 1510 may be formed as a single piece with the bottom wall 1504 attaching them, and this assembly installed to the sidewall 1502. Other variations will be understood by those of ordinary skill in the art with consideration of the present disclosure.
In one embodiment, the filter 1512 is located at the top of the tubes 1510, but this is not required. If such a filter 1512 is provided, the outlet tubes 1510 may be attached to the bottom of the filter 1512 to draw air from the filter 1512 in a tangential manner, which may enhance the post-filter airflow through the device.

While the embodiments of the invention described above are preferred, it will be recognized and understood that these embodiments are not intended to limit the invention, which is limited only by the appended claims. Various modifications may be made to these embodiments without departing from the spirit of the invention and the scope of the claims.
We claim:

1. An upright vacuum cleaner comprising:
   a housing having an upper housing end and a lower housing end;
   a handle associated with the upper housing end;
   a base pivotally attached to the lower housing end, the base comprising a floor
      inlet nozzle facing generally downwardly therefrom;
   a dustcup assembly associated with at least one of the housing and the base, the
dustcup assembly comprising:
      a sidewall defining an interior space having an open top end and a
      bottom end,
      a bottom wall extending across the bottom end and having a dustcup
      outlet therethrough,
      a dustcup inlet,
      a dustcup lid adapted to selectively cover the open top, and
      a fluid conduit formed separately from the bottom wall and attached to
      the bottom wall at the dustcup outlet, the fluid conduit extending
      into the interior space defined by the sidewall; and
   a vacuum source associated with at least one of the housing and the base, the
vacuum source being adapted to create a working air flow that enters the
floor inlet nozzle, passes into the dustcup assembly through the dustcup inlet,
and exits the dustcup assembly through the dustcup outlet.

2. The vacuum cleaner of claim 1, wherein the fluid conduit is attached to the
   bottom wall by one or more screws.

3. The vacuum cleaner of claim 1, wherein the fluid conduit is attached to the
   bottom wall by a rotating cam lock arrangement.

4. The vacuum cleaner of claim 1, wherein the fluid conduit is attached to the
   bottom wall by one or more flexible latching tabs.
5. The vacuum cleaner of claim 1, wherein the fluid conduit is attached to the bottom wall by snap-fit engagement.

6. The vacuum cleaner of claim 1, wherein the fluid conduit is attached to the bottom wall by an interference fit.

7. The vacuum cleaner of claim 1, wherein the fluid conduit is attached to the bottom wall by bayonet fittings.

8. The vacuum cleaner of claim 1, wherein the fluid conduit is attached to the bottom wall by a fastening ring.

9. The vacuum cleaner of claim 1, further comprising a gasket interposed between the fluid conduit and the bottom wall.

10. The vacuum cleaner of claim 1, wherein the fluid conduit comprises an airfoil cross-section.

11. The vacuum cleaner of claim 1, wherein the fluid conduit comprises one or more integrally formed contours to assist with dust separation.

12. The vacuum cleaner of claim 1, wherein the fluid conduit comprises one or more integrally formed airflow deflectors.

13. The vacuum cleaner of claim 1, wherein the bottom wall comprises at least one additional dustcup outlet, and the dustcup assembly comprises at least one additional fluid conduit attached to the bottom wall at the additional dustcup outlet and extending into the interior space defined by the sidewall.

14. The vacuum cleaner of claim 1, wherein the fluid conduit comprises a first section having a first geometric profile, and a second section having a second geometric profile, the second geometric profile being different from the first geometric profile.
15. The vacuum cleaner of claim 1, wherein the dustcup assembly is adapted to be releasably attached to the housing, and the dustcup lid is formed by the housing.

16. The vacuum cleaner of claim 1, wherein the dustcup assembly is adapted to be releasably attached to the housing, and the dustcup lid is a separate part that is removable with the dustcup assembly from the housing.

17. The vacuum cleaner of claim 1, wherein the dustcup inlet enters the interior space defined by the sidewall through the lid.

18. The vacuum cleaner of claim 1, wherein the dustcup inlet enters the interior space defined by the sidewall through the sidewall.

19. The vacuum cleaner of claim 1, wherein the fluid conduit is releasably attached to the bottom wall.

20. The vacuum cleaner of claim 1, wherein the fluid conduit is not releasably attached to the bottom wall.

21. A vacuum cleaner comprising:
   a housing;
   one or more air inlet nozzles associated with the housing;
   a dustcup assembly associated with the housing, the dustcup assembly comprising:
      a sidewall defining an interior space having an open top end and a bottom end,
      a bottom wall extending across the bottom end and having a dustcup outlet therethrough,
      a dustcup inlet,
      a dustcup lid adapted to selectively cover the open top, and
      a fluid conduit formed separately from the bottom wall and releasably attached to the bottom wall at the dustcup outlet, the fluid conduit extending into the interior space defined by the sidewall; and
a vacuum source associated with the housing, the vacuum source being adapted to create a working air flow that enters the one or more inlet nozzles, passes into the dustcup assembly through the dustcup inlet, and exits the dustcup assembly through the dustcup outlet.

22. The vacuum cleaner of claim 21, wherein the fluid conduit is attached to the bottom wall by one or more of the following devices: one or more screws, a rotating cam lock arrangement, one or more flexible latching tabs, snap-fitting members, interference fitting members, bayonet fittings, a fastening ring.

23. The vacuum cleaner of claim 21, further comprising a gasket interposed between the fluid conduit and the bottom wall.

24. The vacuum cleaner of claim 21, wherein the fluid conduit comprises an airfoil cross-section.

25. The vacuum cleaner of claim 21, wherein the fluid conduit comprises one or more integrally formed contours to assist with dust separation.

26. The vacuum cleaner of claim 21, wherein the fluid conduit comprises one or more integrally formed airflow deflectors.

27. The vacuum cleaner of claim 21, wherein the bottom wall comprises at least one additional dustcup outlet, and the dustcup assembly comprises at least one additional fluid conduit attached to the bottom wall at the at additional dustcup outlet and extending into the interior space defined by the sidewall.

28. The vacuum cleaner of claim 21, wherein the fluid conduit comprises a first section having a first geometric profile, and a second section having a second geometric profile, the second geometric profile being different from the first geometric profile.

29. The vacuum cleaner of claim 21, wherein the dustcup assembly is adapted to be releasably attached to the housing, and the dustcup lid is formed by the housing.
30. The vacuum cleaner of claim 21, wherein the dustcup assembly is adapted to be releasably attached to the housing, and the dustcup lid is a separate part that is removable with the dustcup assembly from the housing.

31. The vacuum cleaner of claim 21, wherein the dustcup inlet enters the interior space defined by the sidewall through the lid.

32. The vacuum cleaner of claim 21, wherein the dustcup inlet enters the interior space defined by the sidewall through the sidewall.

33. A vacuum cleaner comprising:

   a housing;
   one or more air inlet nozzles associated with the housing;
   a dustcup assembly associated with the housing, the dustcup assembly comprising:
   a sidewall defining an interior space having an open top end and a bottom end,
   a bottom wall extending across the bottom end and having a dustcup outlet therethrough,
   a dustcup inlet,
   a dustcup lid adapted to selectively cover the open top, and
   a fluid conduit attached to the bottom wall at the dustcup outlet, the fluid conduit extending into the interior space defined by the sidewall,
   wherein the fluid conduit and at least a portion of the bottom wall form a combined conduit/ bottom wall part that is formed separately from the sidewall and attached thereto; and
   a vacuum source associated with the housing, the vacuum source being adapted to create a working air flow that enters the one or more inlet nozzles, passes into the dustcup assembly through the dustcup inlet, and exits the dustcup assembly through the dustcup outlet.
34. The vacuum cleaner of claim 33, wherein the combined conduit/ bottom wall part is removably attached to the sidewall by a fastener that does not comprise threads formed on the combined conduit/ bottom wall part itself.

35. The vacuum cleaner of claim 33, wherein the combined conduit/ bottom wall part is attached to the sidewall by one or more screws.

36. The vacuum cleaner of claim 33, wherein the combined conduit/ bottom wall part is attached to the sidewall by a rotating cam lock arrangement.

37. The vacuum cleaner of claim 33, wherein the combined conduit/ bottom wall part is attached to the sidewall by one or more flexible latching tabs.

38. The vacuum cleaner of claim 33, wherein the combined conduit/ bottom wall part is attached to the sidewall by snap-fit engagement.

39. The vacuum cleaner of claim 33, wherein the combined conduit/ bottom wall part is attached to the sidewall by an interference fit.

40. The vacuum cleaner of claim 33, wherein the combined conduit/ bottom wall part is attached to the sidewall by bayonet fittings.

41. The vacuum cleaner of claim 33, wherein the combined conduit/ bottom wall part is attached to the sidewall by a fastening ring.

42. The vacuum cleaner of claim 33, further comprising a gasket interposed between the combined conduit/ bottom wall part and the sidewall.

43. The vacuum cleaner of claim 33, wherein the combined conduit/ bottom wall part is releasably attached to the sidewall.

44. The vacuum cleaner of claim 33, wherein the combined conduit/bottom wall part is not releasably attached to the sidewall.
Fig. 2
(Prior Art)
Fig. 4A
Fig. 8A
Fig. 8B
Fig. 8C