DEBRIS BAG FOR A SWIMMING POOL CLEANING APPARATUS

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ABSTRACT
A debris bag for a swimming pool cleaning device includes a body having a debris collection cavity, an upper end and a lower end. The lower end engages the pool cleaner to receive debris from the pool ejected by the cleaner into the bag. The debris bag also includes a float coupled to the body. The float is positioned outside of and adjacent to the debris collection region of the bag so as to be separate from the lower end.
FIG. 3
FIG. 10C
FIG. 19A
FIG. 20
<table>
<thead>
<tr>
<th>MODE</th>
<th>TOP MODE</th>
<th>SPIN-OUT MODE</th>
</tr>
</thead>
<tbody>
<tr>
<td>PISTON 2200</td>
<td>RETRACTED</td>
<td>EXTENDED</td>
</tr>
<tr>
<td>PISTON 2254b</td>
<td>EXTENDED</td>
<td>EXTENDED</td>
</tr>
<tr>
<td>RELIEF VALVE 2240a</td>
<td>CLOSED</td>
<td>OPEN</td>
</tr>
<tr>
<td>RELIEF VALVE 2254b</td>
<td>CLOSED</td>
<td>CLOSED</td>
</tr>
</tbody>
</table>

**FIG. 24**
DEBRIS BAG FOR A SWIMMING POOL CLEANING APPARATUS

CROSS-REFERENCE TO RELATED APPLICATIONS


FIELD OF THE INVENTION

[0002] The present invention relates to swimming pool cleaning apparatus and a debris bag used in connection therewith.

BACKGROUND OF THE INVENTION

[0003] U.S. Pat. Nos. 6,090,219 and 6,365,039 and International Patent Publication No. WO 99/33582 disclose swimming pool cleaners adapted to rise proximate to a water surface of a pool for removing floating debris therefrom and to descend proximate to a wall surface of the pool for removing debris therefrom (see also U.S. Pat. Nos. 6,039,886 and 6,387,250 and International Patent Publication No. WO 99/34077). These cleaners utilize fairly complicated and/or complex mechanisms for controlling their water surface cleaning and wall surface cleaning operations. Accordingly, there is a need for a pool cleaner equipped with an enhanced control mechanism for controlling the operation of the cleaner. There is also a need for other improvements for enhancing the operation of the pool cleaner.

SUMMARY OF THE INVENTION

[0004] The present invention overcomes the disadvantages and shortcomings mentioned above by providing an improved debris bag for a swimming pool cleaning device. More particularly, the debris bag includes a body having a debris collection cavity, an upper end and a lower end. The lower end engages the pool cleaner to receive debris from the pool ejected by the cleaner into the bag. The debris bag also includes a float coupled to the body. The float is positioned outside of and adjacent to the debris collection region of the bag so as to be separate from the lower end. The float has a buoyancy that is sufficient to support the weight of the bag in water. The float may be made of a foam or of a buoyant solid material. The float may also be made as a molded single cell float. The float is coupled to the debris bag via an attachment sack sewn to the outside of the bag. The bag may also include a second float positioned outside of the debris collection region.

[0005] The present invention also provides a pool cleaner debris bag having top and second ends and a body having a debris inlet opening to a collection cavity. The body of the bag is coupled to the cleaner at the debris inlet. The bag also includes a float coupled to the body at a position outside of and adjacent to the collection cavity and separate from the inlet opening. The body has top and bottom ends, left and right ends and a top seam at which the float is positioned. The float is secured to the bag by an external connector such as an external porous material housing which is sewn to the bag. The float may be made of a water-tight material sewn to the bag. The float may have either a triangular cross section or a circular cross section. The bag may also include a second float attached outside of the collection cavity. In addition, the bag may include a weight positioned at a lower portion of the bag relative to the float.

[0006] The present invention is also directed to a pool cleaner debris bag comprising a porous material that defines an interior cavity having a closable top end and an open bottom end. A coupling connects the bottom end of the cavity to the pool cleaner to receive debris from the pool ejected by the cleaner into the bag. A float is disposed outside the cavity, proximate to the closable top end. The float is secured to the closable top end.

[0007] The present invention is also directed to a pool cleaner debris bag including an enhanced means for opening and closing a bag access opening and for orienting the bag to avoid impeding the movement of a cleaner body. More particularly, a debris bag in accordance with the invention is formed of flexible water permeable material, e.g., mesh, enveloping an interior volume or cavity. A bag entrance opening is formed in the material and configured for removable attachment to an outlet port on the cleaner body. Debris from the outlet port passes through the bag entrance opening into a bag interior cavity. A bag access opening is also provided which is closed during normal cleaning operation but which can be opened by the user to access and discard debris from the interior cavity. Thereafter, the access opening can be closed and the bag entrance opening reinstalled on the cleaner body to resume normal cleaning operation.

[0008] In accordance with a significant feature of the invention, a bag closure means for selectively opening and closing the bag access opening comprises a clamp member having first and second opposed edges adapted to clamp against opposed layers of bag material to seal the bag access opening. The opposed bag layers are preferably beaded along their edges to assist in retaining the clamp member against the bag material. The closure means is configured to be sufficiently buoyant so that when immersed in water, the bag access opening is elevated above the bag entrance opening. The desired buoyancy can be readily achieved by proper selection of the structure and materials of the clamp member and/or beaded bag edges.

[0009] In a preferred embodiment, the bag clamp member comprises an integral part, preferably of plastic, defining opposed elongate first and second clamping edges. The clamp member is configured to permit its opposed clamping edges to resiliently move apart to open a slot therebetween for accepting the insertion, e.g., sliding insertion, of opposed layers of bag material proximate to the bag access opening. The resiliency between the clamping edges functions to urge them against the bag material to squeeze closed the access opening. In normal use, the outflow (water and debris) from the cleaner body flows into the bag entrance opening toward the bag access opening. The water component of the outflow will pass through the bag material while the debris component will collect in the bag as a consequence of the access opening being sealed.

[0010] In accordance with a further significant feature of one preferred embodiment of the invention, the bag is configured to permit relatively heavy debris to fall from the outflow path between the bag’s entrance and access open-
ings into a lower pouch portion of the bag. More particularly, one preferred bag embodiment in accordance with the invention includes a pouch for collecting heavy debris such as sand and pebbles. The pouch lower end is preferably configured to be retained close to the cleaner body near or below the cleaner’s center of gravity, to constrain the pouch from swinging relative to the body which could otherwise compromise the stability of the body as it travels through the pool.

[0011] In accordance with a further significant feature of a preferred embodiment, the pouch is also provided with an access opening which is useful for emptying pouch debris. The pouch access opening is preferably closed by a pouch closure means which can be structurally similar to the aforementioned bag closure means to the extent that it includes a clamp member having opposed clamping edges for squeezing against opposed layers of bag pouch material. A preferred pouch closure means further includes means for manually attaching and detaching the pouch clamp member to the cleaner body, preferably close to or below the body’s center of gravity.

[0012] Debris bag embodiments in accordance with the invention can be configured to operate with top/bottom pool cleaners, of the type exemplified by aforementioned U.S. Pat. No. 6,090,219, as well as with more traditional bottom only cleaners.

BRIEF DESCRIPTION OF THE DRAWINGS

[0013] For a more complete understanding of the present invention, reference is made to the following detailed description of exemplary embodiments considered in conjunction with the accompanying drawings, in which:

[0014] FIG. 1 is a schematic representation depicting the overall operation of a positive pressure pool cleaner constructed in accordance with a first exemplary embodiment of the present invention;

[0015] FIG. 2 is a side elevational view of the pool cleaner shown in FIG. 1;

[0016] FIG. 2A is a rear elevational view of the pool cleaner shown in Figs. 1 and 2;

[0017] FIG. 3 is a functional block diagram depicting a water flow distribution of the pool cleaner shown in FIGS. 1-2A;

[0018] FIG. 4 is a rear perspective view of the pool cleaner shown in FIGS. 1-2A;

[0019] FIG. 5 is an exploded perspective view of the pool cleaner shown in FIGS. 1-2A;

[0020] FIG. 5A is a front perspective view of the pool cleaner shown in FIGS. 1-2A;

[0021] FIG. 6 is a top plan view of the pool cleaner shown in FIGS. 1-2A without its cover;

[0022] FIG. 7A is a top perspective view of a water distribution system of the pool cleaner shown in FIGS. 1-2A and 6;

[0023] FIG. 7B is an exploded perspective view of the water distribution system shown in FIG. 7A;

[0024] FIG. 7C is a perspective view of a portion of the water distribution system shown in FIG. 7A;

[0025] FIG. 8A is a top perspective view of a valve assembly of the water distribution system shown in FIGS. 7A and 7B;

[0026] FIG. 8B is an exploded perspective view of the valve assembly shown in FIG. 8A;

[0027] FIG. 9A is a perspective view of a timer control assembly of the water distribution system shown in FIGS. 7A and 7B;

[0028] FIG. 9B is an exploded perspective view of the timer assembly shown in FIG. 9A;

[0029] FIG. 9C is an exploded perspective view of a relief valve of the timer assembly shown in FIGS. 9A and 9B;

[0030] FIG. 9D is an exploded perspective view of another relief valve of the timer assembly shown in FIGS. 9A and 9B;

[0031] FIG. 10 is a schematic cross-sectional view of the valve assembly shown in FIGS. 8A and 8B;

[0032] FIGS. 10A-10D are schematic cross-sectional views of the valve assembly shown in FIGS. 8A and 8B, illustrating its operation;

[0033] FIGS. 11A and 11B are schematic views of a top/bottom mode cam of the timer assembly shown in FIGS. 9A and 9B, illustrating its range of reciprocating motion;

[0034] FIG. 12A is a perspective view of a replacement for a spin-out mode cam of the timer assembly shown in FIGS. 9A and 9B;

[0035] FIG. 12B is a perspective view of another replacement for the spin-out mode cam shown in FIGS. 9A and 9B;

[0036] FIG. 13 is a perspective view of a hose assembly of the pool cleaner shown in FIG. 1;

[0037] FIG. 14A is a perspective view of a swivel jet assembly of the hose assembly shown in FIG. 13;

[0038] FIG. 14B is a bottom plan view of the swivel jet assembly shown in FIG. 14A;

[0039] FIG. 14C is a cross-sectional view, taken along section line 14C-14C and looking in the direction of the arrows, of the swivel jet assembly shown in FIG. 14B;

[0040] FIG. 15 is a partially exploded, cross-sectional view, taken along section line 15-15 and looking in the direction of the arrows, of the hose assembly shown in FIG. 13;

[0041] FIG. 16A is a schematic view of the pool cleaner shown in FIGS. 1-2A, illustrating the interaction between the pool cleaner and the swivel jet assembly during the operation of the pool cleaner;

[0042] FIG. 16B is a schematic view of the pool cleaner shown in FIGS. 1-2A, illustrating its spin-out operation;

[0043] FIG. 17 is a perspective view of a pool cleaner constructed in accordance with a second exemplary embodiment of the present invention;

[0044] FIG. 18 is an exploded perspective view of the pool cleaner shown in FIG. 17;
FIG. 19 is a perspective view of a debris bag assembly of the pool cleaner shown in FIGS. 17 and 18;
FIG. 19A is an exploded perspective view of the debris bag assembly shown in FIG. 19;
FIG. 20 is a functional block diagram depicting a water flow distribution system of the pool cleaner shown in FIGS. 17 and 18;
FIGS. 20A and 20B are schematic views illustrating the operation of the water distribution system shown in FIG. 20;
FIGS. 21A-21C are schematic views illustrating the process for mounting the debris bag assembly shown in FIGS. 19 and 19A to the pool cleaner;
FIG. 22 is a schematic view of a modified version of a securing mechanism utilized in the debris bag assembly shown in FIG. 21C;
FIG. 23A is a schematic cross-sectional view of a modified version of the water distribution system shown in FIGS. 7A and 7B;
FIG. 23B is a schematic elevational view of the modified water distribution system shown in FIG. 23A;
FIG. 24 is a table summarizing the operation of the modified water distribution system shown in FIGS. 23A and 23B;
FIG. 25 is a partially exploded view of a portion of a swimming pool cleaner, illustrating modified versions of various components of the pool cleaner shown in FIGS. 1-16B;
FIG. 26 is a cross-sectional view of the portion of the pool cleaner shown in FIG. 25;
FIG. 27 is a perspective view of a cam member of a spin-out cam utilized in the pool cleaner shown in FIGS. 25 and 26;
FIG. 28 is substantially identical to FIG. 1 of U.S. Pat. No. 6,090,219 and schematically depicts a positive pressure pool cleaning system including a cleaner body able to selectively operate in a top mode to capture debris from the pool water surface and a bottom mode to capture debris from the pool containment wall surface;
FIG. 29 is a side view partially broken away depicting an exemplary cleaner body operating at the pool water surface and having a debris bag in accordance with the invention for collecting debris captured from the water surface by the cleaner body;
FIG. 30 is a side view depicting the cleaner body of FIG. 29 operating at the pool wall surface and showing how a buoyant bag closure means in accordance with the invention orients the debris bag;
FIG. 31 is a perspective view showing a debris bag access opening and a buoyant clamp member for sliding across the opposed bag layers to close the access opening;
FIG. 32 is a perspective view showing how opposed edges of the clamp member clamp against the bag layers to close the access opening;
FIG. 33 is similar to FIG. 32 but shows larger beaded edges adjacent the access opening for enhancing buoyancy;
FIG. 34 is similar to FIGS. 32 and 33 but shows an alternative clamp member structure;
FIG. 35 is similar to FIG. 34 but shows a further alternative clamp member;
FIGS. 36A-36E show a modification of the clamp member of FIG. 32 comprising a depending stop member for preventing the clamp member from fully sliding off the bag;
FIG. 36F is a sectional view taken substantially along the plane 36f of FIG. 36E;
FIG. 37 is a side view of another exemplary cleaner body having a debris bag in accordance with the invention including a depending pouch for collecting heavy debris;
FIG. 38 is a rear view of the cleaner body and debris bag of FIG. 37;
FIG. 39 is an enlarged fragmentary view showing a pouch access opening and a clamp member for closing the access opening; and
FIG. 40 is a plan view of the clamp member of FIG. 39.

DETAILED DESCRIPTION OF THE EXEMPLARY EMBODIMENTS

Although the present invention can be used in conjunction with any type of pool cleaner, it is particularly suitable for use in connection with a pressure-type or postfed by a supply of pressurized fluid). Accordingly, the present invention will be described hereinafter in connection with such a pool cleaner. It should be understood, however, that the following description is only meant to be illustrative of the present invention and is not meant to limit the scope of the present invention, which has applicability to other types of pool cleaners.

Referring initially to FIGS. 1, 2 and 2A, there is shown a positive pressure swimming pool cleaner 10 constructed in accordance with a first embodiment of the present invention. Briefly, the cleaner 10 is adapted to operate in a manner similar to that of the cleaners disclosed in U.S. Pat. Nos. 6,090,219 and 6,365,039 and International Patent Publication No. WO 99/33582 (i.e., International Patent Application No. PCT/US98/27623), the disclosures of which are incorporated herein by reference. To facilitate consideration and discussion, the basic operation of the cleaner 10 will be discussed first, followed by a detailed discussion of its components.

With reference to FIG. 1, the cleaner 10 is adapted to clean an interior wall 12 of a swimming pool 14 and an upper surface 16 of a body of water contained therein. As a result, the cleaner 10, in typical operation, alternates between (1) a water surface cleaning mode (also referred to hereinafter as the "top mode"), in which it rises proximate to the water surface 16 for removing floating debris therefrom, and (2) a wall surface cleaning mode (also referred to hereinafter as the "bottom mode"), in which it descends proximate to the interior wall 12 of the swimming pool 14.
to remove debris therefrom. The cleaner 10 is also adapted to periodically alternate to a spin-out mode or state from the bottom or top mode, in which the cleaner 10 spins away from the direction of its generally forward motion in an arcuate sideward path (see FIG. 16B) so as to prevent the cleaner 10 from being trapped by an obstruction (e.g., a corner of a swimming pool).

[0074] With reference to FIGS. 2, 2A, 4, 5 and 5A, the cleaner 10 is equipped with a housing or body 18 having a chassis 20 and a cover 22 removable or fixedly attached to the chassis 20. The chassis 20 includes a generally concave wall 24 having an inclined rear wall section 26, a pair of substantially vertical side wall sections 28, 30, and an inclined front wall section 32. A chamber 34 is defined by the concave wall 24 and the cover 22. A funnel-shaped vacuum inlet 36 (see FIG. 2) is provided on the underside of the chassis 20, while a suction tube 38 extends from the vacuum inlet 36 in an upward and rearward direction, terminating at an upper end 40 (see FIG. 5). A vacuum jet nozzle 42 (see FIGS. 2 and 7B) is mounted adjacent to the vacuum inlet 36 and oriented to discharge a high velocity stream of water through the suction tube 38 for removing debris from the interior wall 12 of the swimming pool 14 when the cleaner 10 is in its wall surface cleaning or bottom mode. The vacuum nozzle 42 is provided with one or more jets (e.g., jets 44, 46, 48 (see FIG. 7B) arranged in a triangular orientation).

[0075] Now referring to FIGS. 2, 2A, 4, 5, 5A, 6 and 7A, the chassis 20 is also equipped with a nose gear 50 located at the front wall section 32 and projecting upwardly therefrom. The nose gear 50 is equipped with a plurality of skimmer jets 52 and a plurality of debris retention jets 54, as well as a skimmer jet port 56 communicating with the skimmer jets 52 and a debris retention jet port 58 communicating with the debris retention jets 54. A forward thrust jet nozzle 60 extends through an opening formed in the rear wall section 26 of the chassis 20 for discharging a high velocity stream of water so as to cause the cleaner 10 to move in a generally forward path when the cleaner 10 is in its wall cleaning mode. Likewise, a lift/thrust jet nozzle 62 extends through the rear wall section 26 for discharging a high velocity stream of water so as to place the cleaner 10 proximate to the pool water surface 16 and move the cleaner 10 along same when the cleaner 10 is in its water cleaning mode.

[0076] A front spin-out jet nozzle 64 is also mounted to the front wall section 32 of the chassis 20, while a rear spin-out jet nozzle 66 is mounted to the rear wall section 26 of the chassis 20 (see FIGS. 2, 2A and 6-7B). More particularly, the front and rear spin-out jet nozzles 64, 66 are angled generally downwardly and are oriented at an angle relative to the longitudinal axis of the cleaner 10 (see the arrows in FIG. 6 indicating the direction in which the front and rear spin-out jet nozzles 64, 66 are oriented relative to the longitudinal axis of the cleaner 10) so as to cause the cleaner 10 to spin in a predetermined direction (e.g., in a clockwise direction) and to thereby move away from its forward path in an arcuate sideward path (as illustrated in broken line representation in FIG. 16B), when the cleaner 10 is in its spin-out mode. Because both of the front and rear spin-out jet nozzles 64, 66 are directed downwardly, when the cleaner 10 is in the spin-out mode, it is lifted vertically, facilitating the spinning or rotating motion of the cleaner 10. Alternately, the front and rear spin-out jet nozzles 64, 66 can have different orientations and can be positioned at different locations on the cleaner 10. For instance, the rear spin-out jet nozzle 66 can be positioned on the central axis of the rear wall section 26 and can be oriented substantially horizontally so as to produce a horizontally discharged spin-out jet directed toward the vertical side wall section 30, thereby further facilitating the rotation of the cleaner 10.

[0077] With reference to FIGS. 2, 2A, 4, 5 and 5A, the cover 22 includes a deck 68 and a pair of side walls 70, 72 projecting from the deck 68. The deck 68 includes an access opening 74 formed therein and an enclosure wall 76 (see FIG. 5A) depending from the deck 68 around the access opening 74. A door (i.e., a cap) 78 is pivotally mounted to the deck 68 for closing the access opening 74. The cover 22 also includes a cross member 80 spanning between the side walls 70, 72. A hole 82 is also formed in the deck 68 adjacent a rear end thereof. More particularly, the hole 82 is sized and shaped so as to receive the upper end 40 of the suction tube 38. The upper end 40 of the suction tube 38 is positioned flush with the deck 68 of the cover 22. A rear debris opening 84 is defined by the deck 68, the side walls 70, 72 and the cross member 80. A slot 86 (see FIGS. 2A and 4) is formed around the rear debris opening 84. The cover 22 also includes a nose cap 88 for partially covering the nose gear 50. Diverter wheels 90 are rotatably mounted between the cover 22 and the chassis 20 along the periphery of the chassis 20 for deflecting the cleaner 10 away from an obstruction or a wall of a swimming pool.

[0078] Turning attention to FIGS. 2A, 4 and 5, a filter bag 92 is removably attached to the cleaner 10 for receiving debris through the rear debris opening 84. More particularly, the filter bag 92, which has a construction similar to the filter bags disclosed in International Patent Publication No. WO 99/35852 and its corresponding U.S. Pat. No. 6,365,039, includes a ring 94 defining a mouth 96 of the filter bag 92. The ring 94 is removably received in the slot 86 and retained therein by a retainer member for attaching the filter bag 92 to the cleaner 10.

[0079] A front center wheel 98 (see FIG. 2) is mounted to the front wall section 32 of the chassis 20, while rear wheels 100, 102 (see FIG. 2A) are mounted to the side wall sections 28, 30, respectively, of the chassis 20. The front and rear wheels 98, 100, 102, which are freely rotatable, are adapted to support the chassis 20 and hence the cleaner 10 on the wall 12 of the swimming pool 14.

[0080] Now referring to FIGS. 3, 5 and 6, a water distribution system 104 is mounted in the chamber 34 of the cleaner 10 for controlling the operation of the cleaner 10. Briefly, the water distribution system 104 includes a water supply inlet 106 for receiving a supply of pressurized water from a pressurized water source 108 (e.g., a pump), a valve assembly 110 for directing a supply of pressurized water received from the water supply inlet 106 to one or more of the jets and nozzles discussed above and a timer assembly 112 for controlling the operation of the valve assembly 110. Each of these components of the water distribution system 104 will be discussed in greater detail hereinbelow.

[0081] With reference to FIGS. 6-8B, the supply inlet 106 is adapted to be coupled to a connecting end 114 (see FIGS. 1 and 13) of a supply hose 116 connected to the pressurized water source 108. In this regard, the connecting end 114 of
the supply hose 116 and the supply inlet 106 are provided with a quick connect/disconnect mechanism, such as twist-lock connectors, for facilitating quick and easy connection of the supply hose 116 to the supply inlet 106. The supply inlet 106 has a port 118 connected to the timer assembly 112 via a connecting hose 120 for supplying the timer assembly 112 with a continuous supply of pressurized water so as to activate or energize same.

[0082] Referring to FIGS. 6-8B and 10, the valve assembly 110 includes a valve housing 122 having a valve chamber 124 (see FIG. 10) and a pair of housing sections 126, 128 (see FIG. 8B) attached to one another and defining the valve chamber 124 therebetween. The housing section 126 includes an inlet 130 connected to the supply inlet 106 for receiving a continuous supply of pressurized water therefrom. Cylinders 132, 134 are attached to opposing ends of the housing section 126. The cylinders 132, 134 are provided with small diameter cylinder sections 136, 138 (see FIGS. 6 and 10), respectively, each of which is in fluid communication with the valve chamber 124, and large diameter cylinder sections 140, 142 (see FIGS. 6 and 10), respectively, which extend outwardly from the small diameter cylinder sections 136, 138, respectively. Caps 144, 146 are mounted to the large diameter cylinder sections 140, 142, respectively, so as to close off open ends of the cylinders 132, 134, respectively. The caps 144, 146 include ports 148, 150, respectively, which are in fluid communication with the cylinders 132, 134, respectively, and which are connected to the timer assembly 112 for purposes to be discussed hereinafter.

[0083] Now referring primarily to FIGS. 8A, 8B and 10, the valve housing 122 includes a plurality of outlets formed in the housing section 128 for distributing pressurized water from the valve chamber 124 to one or more of the jets and nozzles discussed above. More particularly, the housing section 128, which is provided with an upper end 152, a lower end 154 and a pair of sides 156, 158, includes a bottom mode outlet 160 (see FIGS. 8B and 10) positioned adjacent to the side 156. The bottom mode outlet 160 communicates with a pair of bottom mode ports 162, 164 (also see FIG. 7C) formed on the upper and lower ends 152, 154, respectively, of the housing section 128. A tube 166 (see FIG. 7A) and a tube 168 (see FIGS. 7B and 7C) connect the bottom mode ports 162, 164, respectively, to the forward thrust jet nozzle 60 and the vacuum jet nozzle 42, respectively, such that when the cleaner 10 is in its bottom mode, pressurized water is supplied from the valve chamber 124 to the forward thrust jet nozzle 60 and the vacuum jet nozzle 42 through the bottom mode outlet 160 of the housing section 128.

[0084] The housing section 128 also includes a top mode outlet 170 (see FIGS. 8B and 10) located adjacent to the side 158 of the housing section 128. The top mode outlet 170 communicates with a pair of top mode ports 172, 174 formed on the upper and lower ends 152, 154, respectively, of the housing section 128. A connecting member 176 (see FIGS. 7A and 7B) is mounted to the upper end 152 of the housing section 128 and includes a pair of channels 178, 180, one of which (i.e., the channel 178) connects the top mode port 172 to the skimmer jet port 56 and hence the skimmer jets 52 of the nose gear 50. Similarly, a tube 182 (see FIGS. 7A and 7B) connects the top mode port 174 to the lift/thrust jet nozzle 62. As a result, when the cleaner 10 is in its top mode, pressurized water is supplied from the valve chamber 124 to the skimmer jets 52 and the lift/thrust jet nozzle 62 through the top mode outlet 170 of the housing section 128.

[0085] The housing section 128 is also equipped with a spin-out mode outlet 184 (see FIGS. 8B and 10) positioned between the bottom mode and top mode outlets 160, 170. A spin-out mode port 186 is formed on the upper end 152 of the housing section 128 and is connected to the debris retention jet port 58 and hence the debris retention jets 54 of the nose gear 50 through the channel 180 of the connecting member 176 (see FIG. 7A). A second spin-out mode port 188 (see FIG. 7C) is formed on the housing section 128, while a T-connector 190 is attached to the spin-out mode port 188. The T-connector 190 is connected to the front and rear spin-out jet nozzles 64, 66 via hoses 192, 194 (see FIGS. 6-7B), respectively. In this manner, when cleaner 10 is in its spin-out mode, pressurized water is supplied to the front and rear spin-out jet nozzles 64, 66 and the debris retention jets 54 from the valve chamber 124 through the spin-out mode outlet 184 of the housing section 128.

[0086] With reference to FIGS. 8B and 10, the valve assembly 110 also includes a pair of valve members 196, 198 mounted in the valve chamber 124 for directing pressurized water from the valve chamber 124 to one of the bottom mode, top mode and spin-out mode outlets 160, 170, 184. The valve member 196 is sized and shaped so as to cover and hence close the bottom mode outlet 160 or the spin-out mode outlet 184, while the valve member 198 is sized and shaped so as to cover and hence close the top mode outlet 170 or the spin-out mode outlet 184.

[0087] Still referring to FIGS. 8B and 10, in order to reciprocate the valve members between their operating positions, pistons 200, 202 are mounted in the cylinders 132, 134, respectively. More particularly, the piston 200, which has a rod 204 coupled to the valve member 196, is movable between an extended position, in which the piston 200 is positioned outwardly from the valve chamber 124 (see FIG. 10), and a retracted position, in which the piston 200 is positioned adjacent to the valve chamber 124 (see FIG. 10C). When the piston 200 is in its extended position, the valve member 196 is positioned over, and thereby closes, the bottom mode outlet 160. Conversely, when the piston 200 is in its retracted position, the valve member 196 is positioned over, and thereby closes, the spin-out mode outlet 184.

[0088] Like the piston 200, the piston 202 has a connecting rod 206 coupled to the valve member 198. The piston 202 is movable between an extended position, in which the piston 202 is positioned outwardly from the valve chamber 124 (see FIG. 10B), and a retracted position, in which the piston 202 is positioned adjacent to the valve chamber 124 (see FIG. 10). When the piston 202 is in its extended position, the valve member 198 is positioned over, and hence closes, the top mode outlet 170. Conversely, when the piston 202 is in its retracted position, the valve member 198 is positioned over, and hence closes, the spin-out mode outlet 184.

[0089] In order to be movable between their retracted and extended positions, the pistons 200, 202 are provided with a “stepped” construction. That is, the pistons 200, 202 include large diameter areas 208, 210, respectively, and small diameter areas 212, 214, respectively, projecting from the large diameter areas 208, 210, respectively. The large diameter
areas 208, 210 are sized and shaped so as to be movably received in the large diameter cylinder sections 140, 142, respectively, of the cylinders 132, 134, respectively. Likewise, the small diameter areas 212, 214 are sized and shaped so as to be movably received in the small diameter cylinder sections 136, 138, respectively. Sealing members 216, 218 (see FIG. 10) are mounted on the large and small diameter areas 208, 212, respectively, of the piston 200 so as to prevent or inhibit flow of pressurized water between the valve chamber 124 and the large diameter cylinder section 140 through a space 220 formed between the cylinder 132 and the piston 200. Similarly, sealing members 222, 224 (see FIG. 10) are mounted on the large and small diameter areas 210, 214, respectively, of the piston 202 so as to prevent or inhibit flow of pressurized water between the valve chamber 124 and the large diameter cylinder section 142 through a space 226 formed between the cylinder 134 and the piston 202. A discharge opening 228 (see FIG. 10) is formed in the cylinder 132 for discharging water present in the space 220 during the movement of the piston 200, while a discharge opening 230 is formed in the cylinder 134 for discharging water present in the space 226 during the movement of the piston 202.

[00090] Now referring to FIGS. 8B and 10, the pistons 200, 202 are provided with openings 232, 234, respectively, extending from the large diameter areas 208, 210, respectively, and terminating in the small diameter areas 212, 214, respectively. Holes 236, 238 are also formed in the small diameter areas 212, 214, respectively. More particularly, the hole 236 communicates with the opening 232 and the valve chamber 124 such that a continuous supply of pressurized water can be provided to the port 148 of the cap 144 from the valve chamber 124 through the hole 236 and the opening 232. Likewise, the hole 238 communicates with the opening 234 and the valve chamber 124 such that a continuous supply of pressurized water can be provided to the port 150 of the cap 146 from the valve chamber 124 through the hole 238 and the opening 234.

[00091] Referring primarily to FIGS. 7A, 7B, 9A-9C and 10A, a relief valve 240 is connected to the port 148 of the cylinder 132 of the valve assembly 110 via a connecting tube 242 for causing movement of the piston 200 between its retracted and extended positions. More particularly, the relief valve 240 is provided with a housing 244, which has an inlet 246, and a cap 247, which has an outlet opening 248. The inlet 246 is interconnected to the port 148 of the cylinder 132 by the tube 242 such that pressurized water can be supplied from the valve chamber 124 to the relief valve 240 through the hole 236 and opening 232 of the piston 200 (as indicated by arrows A in FIG. 10A) and the tube 242 (as indicated by arrow B in FIG. 10A). A ball or valve member 250 is mounted within the housing 244 and retained therein by the cap 247 attached to the housing 244 (see FIG. 10A). The ball 250 is movable between an open position, in which the ball 250 is spaced from the outlet opening 248, and a closed position, in which the ball 250 is urged against the outlet opening 248. An urging member 252 (e.g., a spring) is mounted in the housing 244 for constantly urging the ball 250 toward its closed position.

[00092] When the relief valve 240 is in its closed position (see FIG. 10C), pressurized water is inhibited from being released from the tube 242. As a result, the downstream side of the piston 200 (i.e., the tube 242) is pressurized by the pressurized water present therein or supplied thereto from the valve chamber 124. As a result, the pressure in the downstream side of the piston 200 (referred to hereinafter as "the downstream pressure P_s") is substantially equal to the pressure in the upstream side (e.g., the valve chamber 124) of the piston 200 (referred to hereinafter as "the upstream pressure P_u"). While the downstream pressure P_s is substantially equal to the upstream pressure P_u, because of the stepped construction of the piston 200 (i.e., the surface of the piston 200 adjacent the downstream side has an area greater than the surface of the piston 200 adjacent the upstream side), a larger force is applied to the piston 200 from the downstream side thereof. As a result, the piston 200 is caused to move to its retracted position (see FIG. 10C), when the relief valve 240 is in the closed position.

[00093] Conversely, when the relief valve 240 is in its open position (see FIG. 10A), pressurized water is vented or released from the tube 242 through the relief valve 240, thereby depressurizing the downstream side of the piston 200. The upstream pressure P_u is hence substantially greater than the downstream pressure P_s. As a result, the piston 200 is caused to move to its extended position, when the relief valve 240 is in the open position.

[00094] Now referring primarily to FIGS. 7A, 7B, 9A, 9D and 10A, a relief valve 254 is connected to the port 150 of the cylinder 134 of the valve assembly 110 via a connecting tube 256 for causing the piston 202 to move between its retracted and extended positions. More particularly, the relief valve 254 is provided with a housing 258, which has an inlet 260, and a cap 261, which has an outlet opening 262. The inlet 260 is interconnected to the port 150 of the cylinder 134 by the tube 256 such that pressurized water can be supplied from the valve chamber 124 to the relief valve 254 through the hole 238 and opening 234 of the piston 202 and the tube 256. A ball or valve member 264 is mounted within the housing 258 and is retained therein by the cap 261 attached to the housing 258 (see FIG. 10A). The ball 264 is movable between an open position, in which the ball 264 is spaced from the outlet opening 262, and a closed position, in which the ball 264 is urged against the outlet opening 262. An urging member 266 (e.g., a spring) is mounted in the housing 258 for constantly urging the ball 264 toward its closed position.

[00095] The relief valve 254 interacts with the piston 202 of the valve assembly 110 in a manner basically identical to the manner discussed above in connection with the relief valve 240 and the piston 200. The operation of the piston 202 in relation to the relief valve 254 will be discussed in greater detail hereinafter.

[00096] With reference to FIGS. 9A and 9B, the timer assembly 112, which is adapted to periodically actuate the relief valves 240, 254, includes a timer housing 268 and an end cap 270 attached to the timer housing 268. A control area 272 is provided on the housing 268 opposite the end cap 270. More particularly, the control area 272 is defined by a bottom 274, which includes a pair of openings 276, 278 and an acute slot 280, and an enclosure wall 282, which extends from the periphery of the bottom 274. The enclosure wall 282 includes a pair of diametrically opposed mounting slots 284, each of which is sized and shaped so as to receive a corresponding one of the relief valves 240, 254.

[00097] Now referring to FIG. 9B, the timer assembly 112 includes a turbine 286 and a gear train 288 coupled to the
turbine 286. The turbine 286 and the gear train 288 are housed in the timer housing 268, enclosed by the end cap 270, which includes an inlet 290 for receiving pressurized water from the supply inlet 106 through the hose 120 so as to rotate the turbine 286, as well as a vent 291. The gear train 288 includes drive gears 292, 294, each of which is adapted to rotate at a predetermined speed (e.g., 0.05 rpm for the drive gear 292 and 0.4 rpm for the drive gear 294). The drive gear 294 is provided with a rectangularly shaped aperture 296, while the drive gear 292 has a circular cam driver 298 projecting therefrom for conjoint rotation therewith. The cam driver 298, which is received in the opening 276 of the control area 272, includes a hole 300 which is offset from the center of the drive gear 292 such that it moves in a circular path in response to the rotation of the drive gear 292.

[0098] Still referring to FIGS. 9A and 9B, a drive shaft 302 is connected to the drive gear 294 for conjoint rotation therewith. The timer assembly 112 is also provided with a top/bottom mode cam 304 and a spin-out mode cam 306 removably mounted on the drive shaft 302 in a stacked fashion. Each of the top/bottom mode cam 304 and the spin-out mode cam 306 is movable so as to periodically engage the relief valves 240, 254 for orienting them into their open positions from their normally closed positions as will be discussed in greater detail hereinafter. The top/bottom mode cam 304, which is located beneath the spin-out mode cam 306, has a circularly shaped aperture 308 for receiving the drive shaft 302 such that it is freely rotatable about the drive shaft 302 and is not driven by the drive shaft 302. The top/bottom mode cam 304 includes an arc-shaped cam portion 310 extending about 180° along the periphery of the top/bottom mode cam 304. Mode selection holes 312a, 312b are formed in the top/bottom mode cam 304 and are arranged around the aperture 308 in an arcurate arrangement for purposes to be discussed hereinafter.

[0099] An arcuate link 314 (see FIG. 9B) connects the top/bottom mode cam 304 to the drive gear 292. More particularly, the link 314 includes a pin 316 at one end thereof and upper and lower pins 318, 320 at an opposite end thereof. The pin 316 is received in the hole 300 of the cam driver 298 of the drive gear 292. Similarly, the upper pin 318 is removably inserted into a selected one of the mode selection holes 312a, 312b of the top/bottom mode cam 304, while the lower pin 320 is placed in the arcuate slot 280 of the control area 272 such that it is movable along the path defined by the arcuate slot 280. In this manner, the top/bottom mode cam 304 is linked to the drive gear 292 through the link 314 such that it is rotatable in reciprocating fashion (i.e. clockwise and counterclockwise) in response to the rotation of the drive gear 292. For instance, when the lower pin 320 of the link 314 is in the mode selection hole 312a of the top/bottom mode cam 304, the top/bottom mode cam 304 has a predetermined range of motion relative to the relief valves 240, 254, the range of motion being delimited by a clockwise end point (see FIG. 11A) and a counter-clockwise end point (see FIG. 11B). In other words, the top/bottom mode cam 304 is adapted to reciprocate between these end points in response to the rotation of the drive gear 292. The remaining mode selection holes 312a, 312b, 312c, 312d have different ranges of motion associated therewith.

[0100] Unlike the top/bottom mode cam 304, the spin-out mode cam 306 is coupled to the drive shaft 302 such that it is rotatable conjointly with same. The spin-out mode cam 306 includes a plurality of radially projecting cam members 322. Each of the cam members 322 has a width different from one another for purposes to be discussed hereinafter.

[0101] Now referring to FIGS. 5 and 5A, the timer assembly 112 is mounted in the chamber 34 of the cleaner 10 such that the top/bottom mode cam 304 and the spin-out mode cam 306 are accessible through the access opening 74 of the cover 22 when the door 78 is in its open position. A spring (not shown) is provided for retaining the top/bottom mode cam 304 and the spin-out mode cam 306 in place. More particularly, when the door 78 is pivoted to close the access opening 74, the spring is positioned between the door 78 and the spin-out mode cam 306. Alternatively, the spring can be replaced by other retaining mechanisms (e.g., a rod or retainer attached to the door 78).

[0102] The operation of the cleaner 10 will be discussed hereinafter. During the operation of the cleaner 10, a constant supply of pressurized water is supplied to the supply inlet 106 of the cleaner 10 from the pressurized water source 108 through the supply hose 116. As a result, pressurized water is supplied to the valve chamber 124 of the valve assembly 110, pressurizing the valve chamber 124 and hence urging the pistons 200, 202 toward their extended positions. Pressurized water is continuously supplied from the valve chamber 124 to the tube 242 (i.e., the downstream side of the piston 200) and the tube 256 (i.e., the downstream side of the piston 202) through the hole 238 and opening 234 of the piston 200 and through the hole 238 and opening 234 of the piston 202, respectively (see FIG. 10). With reference to FIG. 10A, the relief valve 240 is engaged by the top/bottom mode cam 304, and is hence in its open position. When this happens, pressurized water supplied to the tube 242 is released through the relief valve 240 (i.e., the downstream side of the piston 200 is not pressurized). As a result, the pressure in the valve chamber 124 (i.e., the upstream side of the piston 200) is greater than the pressure in the tube 242 (i.e., the downstream side of the piston 200), causing the piston 200 to move into its extended position. In response, the valve member 196 is placed over, and hence closes, the bottom mode outlet 160.

[0103] The relief valve 254 illustrated in FIG. 10A is engaged by neither the top/bottom mode cam 304 nor the spin-out mode cam 306, and is hence in its closed position. In such circumstances, pressurized water supplied to the tube 256 is prevented from being released through the relief valve 254, and the tube 256 becomes pressurized to a level that is substantially identical to the pressure level of the valve chamber 124. As discussed above, due to the stepped construction of the piston 202 (i.e., the surface adjacent to the upstream side has an area smaller than that of the surface adjacent to the downstream side), a greater force is exerted on the piston 202 from the downstream side thereof, hence positioning the piston 202 in its retracted position (see FIG. 10A). As a result, the valve member 198 is positioned over the spin-out mode outlet 184, leaving only the top mode outlet 170 open. Accordingly, pressurized water is supplied from the valve chamber 124 to the lift/thrust jet nozzle 62 and the skimmer jets 52 through the top mode outlet 170 (i.e., the cleaner 10 in the top mode, removing floating debris from the water surface 16 of the pool 14).

[0104] Throughout the operation of the cleaner 10, pressurized water is continuously supplied to the turbine 286
from the supply inlet 106 through the hose 120, thereby energizing the gear train 288 and causing the drive gears 292, 294 to rotate at predetermined speeds. As a result, the spin-out mode cam 306 rotates conjointly with the drive gear 294. As the spin-out mode cam 306 rotates, one of the cam members 322 comes in contact with the ball 264 of the relief valve 254, causing the ball 264 to move into its open position (see FIG. 10B). In response, pressurized water is vented or released from the tube 256 through the relief valve 254, depressurizing the downstream side of the piston 202 (i.e., the tube 256). As a result, the piston 202 moves into its extended position, causing the valve member 198 to close the top mode outlet 170 and thereby leaving only the spin-out mode outlet 184 open (see FIG. 10B). Pressurized water is then supplied from the valve chamber 124 to the front and rear spin-out jet nozzles 64, 66 and the debris retention jets 54 and hence causes the cleaner 10 to go into its spin-out mode.

[0105] As the spin-out mode cam 306 continues to rotate, the cam member 322 disengages the ball 264 of the relief valve 254, causing the ball 264 to move into its closed position and hence re-pressurizing the tube 256 (i.e., the downstream side of the piston 202) to a level substantially identical to that of the valve chamber 124 (i.e., the upstream side of the piston 202). In response, the piston 202 moves into its retracted position and causes the spin-out mode outlet 184 to be closed by the valve member 198, leaving only the top mode outlet 184 open and thereby causing the cleaner 10 to resume its top mode operation.

[0106] Throughout the operation of the cleaner 10, the top/bottom mode cam 304 continuously reciprocates between its two end points of motion in response to the rotation of the cam driver 298 of the drive gear 292. As the top/bottom mode cam 304 moves in reciprocating motion, the cam portion 310 of the top/bottom mode cam 304 disengages the relief valve 240 and engages the relief valve 254 (see FIG. 10C). In response, the relief valve 240 moves into its closed position, while the relief valve 254 moves into its open position. As a result, the piston 200 moves into its retracted position so as to close the spin-out mode outlet 184, while the piston 202 moves into its extended position so as to close the top mode outlet 170, leaving only the bottom mode outlet 160 open (see FIG. 10C). Pressurized water is then diverted from the valve chamber 124 to the forward thrust jet nozzle 60 and the vacuum jet nozzle 42, hence causing the cleaner 10 to initiate its bottom mode operation.

[0107] With reference to FIG. 10D, as the spin-out mode cam 306 rotates, one of the cam members 322 comes in contact with the relief valve 240, orienting same in its open position. In response, the piston 200 moves to its extended position and causes the closure of the bottom mode outlet 160, leaving only the spin-out mode outlet 184 open. As a result, the spin-out mode is initiated. After a lapse of a predetermined time, the spin-out mode cam member 322 disengages the relief valve 240, causing the cleaner 10 to resume its bottom mode operation.

[0108] The following table summarizes the relationship between the positions of the relief valves 240, 254 and the condition of the top mode, bottom mode and spin-out mode outlets 160, 170, 184 of the valve assembly 110 (i.e., the top, bottom mode operations of the cleaner 10).

```
<table>
<thead>
<tr>
<th>Relief Valve 240</th>
<th>Relief Valve 254</th>
<th>Valve Assembly Outlets</th>
</tr>
</thead>
<tbody>
<tr>
<td>Open</td>
<td>Closed</td>
<td>Top Mode Outlet Open</td>
</tr>
<tr>
<td>Open</td>
<td>Open</td>
<td>Spin-Out Mode Outlet Open</td>
</tr>
<tr>
<td>Closed</td>
<td>Open</td>
<td>Bottom Mode Outlet Open</td>
</tr>
</tbody>
</table>
```

For the proper operation of the cleaner 10, the top/bottom mode cam 304 is sized and shaped such that only one of the relief valves 240, 254 is engaged by same at any one time. For instance, if the relief valve 240 is engaged by the cam portion 310 of the top/bottom mode cam 304, the relief valve 254 is disengaged from same and vice versa.

[0110] As indicated above, each of the mode selection holes 312a-312e (see FIG. 9B) of the top/bottom mode cam 304 has a different top mode/bottom mode ratio (i.e., the ratio between the amount of time during which the cleaner 10 is in the top mode and the amount of time during which the cleaner 10 is in the bottom mode) associated therewith. For instance, the mode selection hole 312e is positioned and arranged on the top/bottom mode cam 304 such that it engages the relief valves 240, 254 for a predetermined time while reciprocating between its preselected end points of motion (see FIGS. 11A and 11B) so as to achieve a 1:1 top mode/bottom mode ratio (i.e., the amount of time during which the cleaner 10 is in the top mode is roughly 12 equal to the amount of time during which the cleaner 10 is in the bottom mode). More particularly, when the mode selection hole 312e is selected, the top/bottom mode cam 304 engages the relief valves 240, 254 for a substantially equal amount of time, thereby achieving a 1:1 top mode/bottom mode ratio. In contrast, the mode selection hole 312e has a 0:1 top mode/bottom mode ratio (i.e., the cleaner 10 is always in the top mode), while the mode selection hole 312d has a 0:1 top mode/bottom mode ratio (i.e., the cleaner 10 is always in the bottom mode). The mode selection hole 312b has a top mode/bottom mode ratio ranging between 1:1 and 1:0 (e.g., 1:2), while the mode selection hole 312d has a top mode/bottom mode ratio ranging between 1:1 and 1:0 (e.g., 2:1). Because of the mode section holes 312a-312e, the top mode/bottom mode ratio can be easily adjusted by coupling the link 314 to a desired one of the mode selection holes 312a-312e. The top mode/bottom mode ratios associated with the mode section holes 312a-312e are summarized hereinbelow.

```
<table>
<thead>
<tr>
<th>Holes</th>
<th>Top Mode</th>
<th>Bottom Mode</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hole 312e</td>
<td>100%</td>
<td>0%</td>
</tr>
<tr>
<td>Hole 312d</td>
<td>About 67%</td>
<td>about 33%</td>
</tr>
<tr>
<td>Hole 312c</td>
<td>about 50%</td>
<td>about 50%</td>
</tr>
<tr>
<td>Hole 312b</td>
<td>about 33%</td>
<td>about 67%</td>
</tr>
<tr>
<td>Hole 312a</td>
<td>0%</td>
<td>100%</td>
</tr>
</tbody>
</table>
```

[0111] It should also be appreciated that because the cam members 322 of the spin-out mode cam 306 have different widths, each of them is adapted to engage the relief valve 240 or the relief valve 254 for a different duration. As a result, the cleaner 10 is adapted to perform its spin-out mode operation for a different time period during each spin-out cycle, making its movement more random.
[0112] Because the spin-out mode cam 306 is removably mounted on the drive shaft 302, it can be removed and replaced with different spin-out mode cams. For instance, FIGS. 12A and 12B illustrate two replacement spin-out mode cams 306, 306' having multiple cam members 322, 322', respectively. Due to the smaller number of cam members, the spin-out mode cam 306 is adapted for less frequent spin-out mode operations, and is hence useful, for instance, in connection with large pools or pools having minimum obstruction. On the other hand, due to the large number of cam members, the spin-out mode cam 306' is adapted for more frequent spin-out mode operations and is hence useful, for instance, in connection with small pools or pools having many obstructions or obstacles.

[0113] The spin-out mode cam 306 can be replaced with a replacement cam by accessing the control area 272 of the timer assembly 112 through the access opening 74 of the cover 22. More particularly, when the door 78 of the cover 22 is in its open position (see FIG. 5A), the spin-out mode cam 306 is accessible by a user. The spin-out mode cam 306 can be modified so that it is replaced together with the drive shaft 302 (i.e., the spin-out mode cam 306 can be formed integrally with the drive shaft 302). The top/bottom mode cam 304 is also accessible through the access opening 74. As a result, the selection or adjustment of the mode selection holes 312a-312c of the top/bottom mode cam 304 can be made through the access opening 74 without detaching the cover 22 from the chassis 20. In this manner, the cleaner 10 is adapted for easy and efficient adjustability, accommodating user preferences and/or needs.

[0114] Now referring to FIGS. 13-14C, the supply hose 116 is provided with a swivel jet assembly 326 mounted therein. More particularly, the supply hose 116 is divided into sections 116a, 116b by the swivel jet assembly 326. The section 116a, which is coupled to the cleaner 10, has a predetermined length such that the swivel jet assembly 326 trails the cleaner 10 at that predetermined length. The swivel jet assembly 326, which has a flow channel 328 therethrough, is provided with a pair of bodies 330, 332 rotatably connected to one another. The body 330 is connected to the section 116a of the supply hose 116, while the body 332 is connected to the section 116b of the supply hose 116. A nozzle 334 extends from the body 330 and communicates with the flow channel 328 so as to continuously discharge a high velocity stream of water during the operation of the cleaner 10. The nozzle 334 is oriented in a rearward direction (i.e., away from the cleaner 10) and is slanted relative to the longitudinal axis of the swivel jet assembly 326. The nozzle 334 is positioned such that when the hose 116 is properly attached to the cleaner 10, it is located at the bottom of the swivel jet assembly 326. Alternatively, the nozzle 334 can be position on the top of the swivel jet assembly 326.

[0115] In operation, the swivel jet assembly 326 functions to enhance the maneuverability of the cleaner 10 around obstructions and inhibit hose entanglement. For instance, when the cleaner 10 comes in contact with an obstruction (e.g., a wall of a swimming pool), its forward motion becomes restricted or inhibited (as represented by the solid line representation of the cleaner 10 in FIG. 16A). In response, the high velocity stream of water discharged from the nozzle 334 of the swivel jet assembly 326 causes the hose section 116a to bend and/or displaces the swivel jet assembly 326 away from the longitudinal axis of the cleaner 10 (see the broken line representation of the supply hose section 116a in FIG. 16A), causing the cleaner 10 to pivot in a generally counterclockwise direction and thereby dislodging same from the obstruction (as indicated by the broken line representation of the cleaner 10 in FIG. 16A).

[0116] The swivel jet assembly 326 also facilitates the spin-out operation of the cleaner 10. Referring to FIG. 16B, when the cleaner 10 initiates its spin-out operation, due to the slanted orientation of the front and rear spin-out jet nozzles 64, 66, it rotates in a generally clockwise direction (as indicated by arrows C in FIG. 16B) and moves in an arcuate sideways motion (as indicated by arrow C' in FIG. 16B). After the expiration of the spin-out mode cycle, the cleaner 10 tends to continue its clockwise rotation due to the bend created in the hose section 116a (as indicated by arrow D in FIG. 16B). Because of the force applied by the high velocity stream of water from the swivel jet assembly 326 (see arrow E in FIG. 16B), the cleaner 10 moves in a different direction (as indicated by arrow F in FIG. 16B), making the cleaner’s movement more random. In addition, the swivel jet assembly 326 helps to tug the supply hose 116, reducing the amount of load carried by the cleaner 10.

[0117] Referring back to FIG. 13, the supply hose 112 is also provided with a sweep hose 336 having a jet 338 at an end thereof. Beads 340 are mounted on the sweep hose 336 such that they are substantially immovable relative to the sweep hose 336 (see also FIG. 15). Each of the beads 340 includes a metal (e.g., stainless steel) ring 341 in a plastic enclosure 343. The plastic enclosures 343 are adapted for protecting the liner of a vinyl pool. The stainless steel rings 341 provide longer wear in concrete, granite, pebble-tech and similar pools. The stainless steel rings 341 also serve to remove hard deposits (e.g., calcium) from pool surfaces. The beads 340 in general also help to remove algae from pool surfaces.

[0118] It should be noted that the cleaner 10 can have numerous modifications and variations. For instance, the relief valves 240, 254 of the timer assembly 112 can be replaced with other types of valves. With reference to FIG. 1, the cleaner 10 can also be equipped with a pressure regulator 337 (e.g., the “L-Type” flow regulator marketed by Neopor, Waterbury, Conn.) can be mounted in a wall fitting 339 of the supply hose 116 for maintaining a predetermined pressure.

[0119] FIGS. 17-21C depict a second embodiment of the present invention. Elements illustrated in FIGS. 17-21C, which correspond, either identically or substantially, to the elements described above with respect to the embodiment of FIGS. 1-16B, have been designated by corresponding reference numerals increased by one thousand. Unless otherwise stated, the embodiment of FIGS. 17-21C is constructed and assembled and operates in the same basic manner as the embodiment of FIGS. 1-16B.

[0120] FIGS. 17 and 18 show a pressure-type swimming pool cleaner 1010 constructed in accordance with the second embodiment of the present invention. While the cleaner 1010 is adapted for bottom mode and spin-out mode operations, it does not have a top mode (i.e., it remains proximate to an interior wall of a swimming pool throughout its operation). In such circumstances, the cleaner 1010 is devoid of the components of the embodiment of FIGS. 1-16B associated with the top mode operation.
the cleaner 1010 is not provided with a lift/thrust jet nozzle or skimmer jets. Because a different type of filter bag is used in connection with the cleaner 1010 (as will be discussed in greater detail hereinafter), debris retention jets are not included in the cleaner 1010. In such circumstances, the cleaner 1010 is not provided with a nose gear.

[0121] With reference to FIGS. 18, 20A and 20B, the cleaner 1010 is equipped with only one relief valve 1240 for operating a piston 1200 so as to move a valve member 1196 between a bottom mode position, in which the valve member 1196 is positioned over a spin-out mode outlet 1184 of a valve housing 1122 (see FIG. 20A), and a spin-out mode position, in which the valve member 1196 is positioned over a bottom mode outlet 1160 of the valve housing 1122 (see FIG. 20B). While the cleaner 1010 is provided with a piston 1202, it remains in its extended position throughout the operation of the cleaner 1010 so as to constantly position a valve member 1198 over a top mode outlet 1170 (see FIGS. 20A and 20B). More particularly, the valve housing 1122 has a port 1150, which is not sealed, thereby causing the downstream side of the piston 1202 to be constantly vented through the port 1150. As a result, the top outlet 1170 is closed throughout the operation of the cleaner 1010. Alternatively, the top mode outlet 1170 can be permanently plugged or sealed, thereby eliminating the need to provide the piston 1202 and the valve member 1198. In such circumstances, the port 1150 can be closed off.

[0122] Referring to FIGS. 20A and 20B, while the cleaner 1010 is provided with a spin-out mode cam 1306, it is not provided with a top/bottom mode cam. Like the spin-out mode cam 306 of the embodiment of FIGS. 1-16B, during the operation of the cleaner 1010, the spin-out mode cam 1306 rotates and periodically engages and disengages the relief valve 1240. When the relief valve 1240 is disengaged by the spin-out mode cam 1306, the piston 1200 is positioned in its retracted position, and the spin-out mode outlet 1184 is closed by the valve member 1196, leaving only the bottom mode outlet 1160 open (see FIG. 20A). As a result, the cleaner 1010 moves along an interior wall of a pool so as to remove debris therefrom. When the relief valve 1240 is engaged by the spin-out mode cam 1306, the piston 1200 is positioned in its extended position, and the bottom mode outlet 1160 is closed by the valve member 1196 (see FIG. 20B). As a result, the spin-out mode outlet 1184 is left open, thereby causing the cleaner 1010 to initiate its spin-out operation.

[0123] Now referring to FIGS. 18-19A and 21A, the cleaner 1010 has a cover 1022 including a hole 1082 for receiving debris removed from a pool through a suction tube 1038. The cover 1022 has a deck which includes a filter bag mounting area 1350 defined by tracks 1352 formed adjacent an end of the cover 1022. The cover 1022 also has a finger member 1354 provided on the deck of the cover 1022, as well as an opening 1082 formed in the cleaner deck. The suction tube 1038 terminates at an end which is positioned substantially flush with the cleaner deck.

[0124] With reference to FIGS. 19 and 19A, the cleaner 1010 is also equipped with a filter bag assembly 1090. More particularly, the filter bag assembly 1090 includes a filter bag 1356 and a base plate member 1358 attached to the filter bag 1356. More particularly, the base member 1358 includes a base panel 1360 having an opening 1362 formed therein. The base panel 1360 is sized and shaped so as to be received between, and engage, the tracks 1352 of the filter mounting area 1350 for mounting the filter bag assembly 1090 to the deck of the cleaner 1010. More particularly, with reference to FIGS. 21A-21C, the base member 1358 is adapted to be mounted to the filter bag mounting area 1350 by sliding the base member 1358 toward the front of the cleaner 1010 (see arrow G in FIG. 21A) and then sliding same transversely toward the hole 1082 (see arrow H in FIG. 21A). When the base member 1358 is properly attached to the cleaner 1010, the opening 1362 of the base panel 1360 registers with the hole 1082 of the cover 1022. The finger member 1354 is adapted to retain the base member 1358 in place between the tracks 1352. A column 1364 projects from the base panel 1360 at an angle and includes a conduit 1366 extending completely through the column 1364. A mounting hole 1368 is formed in the column 1364, while a pole 1370 having a pair of ends 1372, 1374 is provided. The end 1372 of the pole 1370 is received in the mounting hole 1368.

[0125] Still referring to FIGS. 19 and 19A, the filter bag 1356 has a lower end 1380, an upper end 1382 and left and right sides 1384, 1386. The filter bag 1356 includes a pair of filter layers 1376, 1378 stitched (i.e., sewn) to one another along the left side 1384 and the upper end 1382 and partially along the right side 1386. The filter layers 1376, 1378 are also stitched to one another along a seam 1375 and a seam 1377. More particularly, the seam 1375 is angled and extends between the left side 1384 and the upper end 1382 of the filter bag 1356, while the seam 1377 is angled and extends between the right side 1386 and the upper end 1382. The left and right sides 1384, 1386, the seams 1375, 1377 and the upper end 1382 of the filter bag 1356 cooperate to define an inner cavity 1379 for receiving debris from the cleaner 1010. The seam 1377, the upper end 1382 and the right side 1386 of the filter bag 1356 cooperate to define a compartment 1381 which is permanently separated from the inner cavity 1379 by the seam 1377 and which does not hence form part of the inner cavity 1379.

[0126] The filter bag 1356 also includes a debris inlet 1390 formed adjacent to the lower end 1380 and the left side 1384. The debris inlet 1390 receives an end of the column 1364 and is retained thereto by a retainer ring 1392 for removably attaching the filter bag 1356 to the base member 1358. The filter bag 1356 also has a debris collection area 1394 located adjacent to the right side 1386 and the lower end 1380. More particularly, the filter layers 1376, 1378 are sewn together along a seam 1396 so as to separate the debris inlet 1390 from the debris collection area 1394. The seam 1396 extends generally upwardly from the lower end 1380. Strips of releasable fasteners 1398, 1400 (e.g., hook-and-loop type fasteners) are attached to the filter layers 1376, 1378, respectively, along the lower end 1380 and the right side 1386 of the filter bag 1356. In this manner, debris can be removed from the debris collection area 1394 of the filter bag 1356.

[0127] A float member 1402 is retained in the compartment 1381 which is located adjacent to a corner 1404 of the filter bag 1356 (see FIG. 19). Because of the float member 1402, during the operation of the cleaner 1010, the corner 1404 tends to be positioned above the debris collection area 1394, thereby facilitating the collection of debris in the debris collection area 1394.
Referring to FIG. 19, the seam 1375 is formed adjacent to a corner 1408 defined by the upper end 1382 and the left side 1384 and is oriented so as to deflect flow of water and herbe debris from the inlet 1390 toward the debris collection area 1394 (as indicated by arrows in FIG. 19). In this regard, the seam 1377 functions to deflect flow of water toward the debris collection area 1394 to cause debris to settle in the debris collection chamber 1394. Because the float member 1402 is retained in the compartment 1381 and is not hence positioned in the inner cavity 1379, it does not interfere with flow within the inner cavity 1379, thereby facilitating the settlement of debris in the debris collection area 1394.

Adjacent to the seam 1375, a pouch 1410 is formed for receiving the end 1374 of the pole 1370 (see FIGS. 19 and 19A). When assembled, the pole 1370 is placed within the filter bag 1356 so as to keep same in proper orientation. A mounting strip 1412 (see FIG. 19A) is attached to the filter bag 1356 adjacent the debris collection area 1394, while a slot 1414 is formed in the cover 1022 (see FIGS. 21A and 21C). The mounting strip 1412 has an end 1416 sized and shaped as so as to be inserted through the slot 1414 and looped around for attachment to the mounting strip 1412 (see FIG. 21C). In this manner, the debris collection area 1394 is positioned adjacent to the cleaner 1010 so as to prevent the filter bag 1356 from sagging and creating a drag on the cleaner 1010.

It should be noted that the cleaner 1010 can have numerous modifications and variations. For instance, the mounting strip 1412 can be replaced with other quick release devices to maintain the debris collection area 1394 close to the cleaner 1010. With reference to FIG. 22, a fastener 1383 can be mounted to the filter bag mounting area 1350 of the cleaner 1010, while a mating fastener 1385 can be affixed to the filter bag 1356 adjacent to the debris collection area 1394 for releasable attachment to the fastener 1383. The fastener 1383 can be recessed into the filter bag mounting area 1350 so as not to interfere with the mounting of the base member 1358 to the cleaner 1010. The filter bag 1356 can also be modified to have a second float member positioned outside the inner cavity 1379, as shown in FIG. 4.

FIGS. 23A and 23B illustrate a modified version of the water distribution system 104 of the embodiment shown in FIGS. 1-16B. Elements illustrated in FIGS. 23A and 23B, which correspond, either identically or substantially, to the elements described above with respect to the embodiment of FIGS. 1-16B, have been designated by corresponding reference numerals increased by two thousand. Unless otherwise stated, the modified version of FIGS. 23A and 23B is constructed and assembled and operates in the same basic manner as the water distribution system 104 of the embodiment of FIGS. 1-16B.

With reference to FIGS. 23A and 23B, a water distribution system 2104 has a pair of pistons 2200, 2202. The downstream side of the piston 2200 has a top/bottom mode relief valve 2240a (e.g., a poppet valve) and a spin-out mode valve 2240b (e.g., a poppet valve), while the downstream side of the piston 2202 has a top/bottom mode relief valve 2254a (e.g., a poppet valve) and a spin-out mode valve 2254b (e.g., a poppet valve). The water distribution system 2104 also has a top/bottom mode cam 2304 and a spin-out mode cam 2306 mounted side-by-side on a control area so as to engage the top/bottom mode relief valves 2240a, 2254a and the spin-out mode relief valves 2240b, 2254b, respectively. The top/bottom mode cam 2304 has an arc-shaped cam portion 2310 and is adapted to rotate in a single direction (i.e., it does not reciprocate). Unlike the spin-out mode cam 2306 of the embodiment of FIGS. 1-16B, the spin-out mode cam 2306 has a set of cam members 2322a and a set of cam members 2322b. More particularly, the cam members 2322a and the cam members 2322b are vertically offset such that the cam members 2322a are engageable only with the spin-out mode relief valve 2240b and the cam members 2322b are engageable only with the spin-out mode relief valve 2254b. The top/bottom mode cam 2304 and the spin-out mode cam 2306 are driven by a turbine 2286 and a gear train 2288.

When any of the top/bottom mode relief valve 2240a and the spin-out mode relief valve 2240b is in an open position, the downstream side of the piston 2200 is vented, and, as a result, the piston 2200 is in its extended position. Likewise, when any of the top/bottom mode relief valve 2254a and the spin-out mode relief valve 2254b is in an open position, the downstream side of the piston 2202 is vented, and, as a result, the piston 2202 is in its extended position. Conversely, when both of the top/bottom mode relief valve 2240a and the spin-out mode relief valve 2240b are in their closed positions, the downstream side of the piston 2200 is pressurized, and, as a result, the piston 2200 is in its retracted position. Similarly, when both of the top/bottom mode relief valve 2254a and the spin-out mode relief valve 2254b are in their closed positions, the downstream side of the piston 2202 is pressurized, and, as a result, the piston 2202 is in its retracted position. The positions of the pistons 2200 and 2202 in relation to the condition of the relief valves 2240a, 2240b, 2254a, 2254b are summarized in the table of FIG. 23.

FIGS. 25-27 illustrate modified versions of various components of the embodiment shown in FIGS. 1-16B. Elements illustrated in FIGS. 25-27, which correspond, either identically or substantially, to the elements described above with respect to the embodiment of FIGS. 1-16B, have been designated by corresponding reference numerals increased by three thousand. Unless otherwise stated, the modified versions illustrated in FIGS. 25-27 are constructed and assembled and operate in the same basic manner as their counterparts shown in FIGS. 1-16B. The modified versions shown in FIGS. 25-27 can be utilized in the embodiment illustrated in FIGS. 17-21C.

Referring to FIGS. 25-27, a cleaner 3010 has a deck 3068 equipped with an access opening 3074 formed therein. A cap 3078 is removable attached to the deck 3068 for covering the access opening 3074. In this regard, quick-release connectors 3420, 3422 (e.g., bayonet-type connectors) are provided on the cap 3078 and the deck 3068, respectively, for removably attaching the cap 3078 to the deck 3068. Fingers 3424 depend from the cap 3078 for purposes to be discussed hereinafter.

The cleaner 3010 is also equipped with a drive shaft 3302 and a spin-out cam 3306 mounted on the drive shaft 3302 for engaging a relief valve 3240 so as to cause the cleaner 3010 to periodically go into its spin-out mode. A screw 3426 removably secures the spin-out cam 3306 to the drive shaft 3302. The spin-out cam 3306 has a plurality of
cam members 3322, each of which has a cam engaging surface 3428 on one side 3430 of the spin-out cam 3306 and a cam engaging surface 3432 on an opposite side 3434 of the spin-out cam 3306 (see FIGS. 26 and 27). The cam engaging surfaces 3428 are positioned such that when the spin-out cam 3306 is placed on the drive shaft 3302 with the side 3430 facing upward, only the cam engaging surfaces 3428 are engageable with the relief valve 3240. Likewise, the cam engaging surfaces 3432 are positioned such that when the spin-out cam 3306 is placed on the drive shaft 3302 with the side 3434 facing upward, only the cam engaging surfaces 3432 are engageable with the relief valve 3240. Each of the cam engaging surfaces 3428 has a width, and hence a spin-out duration, different from the width and the spin-out duration of the cam engaging surfaces 3432. As a result, the side 3430 of the spin-out cam 3306 (i.e., the cam engaging surfaces 3428) has a spin-out “program” different from the spin-out “program” associated with the side 3434 (i.e., the cam engaging surfaces 3432) of the spin-out cam 3306. For instance, the side 3430 of the spin-out cam 3306, which have a wider width and hence a longer spin-out duration, is suitable for summer use, while the side 3434 of the spin-out cam 3306, which have a shorter width and hence a shorter spin-out duration, is suitable for winter use. In such circumstances, the cleaner 3010 can be equipped for summer or winter use by simply changing the orientation of the spin-out cam 3306.

[0137] Referring to FIGS. 25 and 26, the cleaner 3010 is equipped with replacement spin-out cams 3306, 3306' carried in the access opening 3074 by the cap 3078. More particularly, each of the replacement cams 3306, 3306' has a hole 3436 for receiving the drive shaft 3302, as well as the finger 3224 of the cap 3078. The replacement cams 3306, 3306' are removably mounted to the fingers 3432 of the cap 3078 and are hence readily available for replacing the spin-out cam 3306.

[0138] FIGS. 29-40 illustrate additional modified pool cleaner debris bags constructed in accordance with the present invention. To facilitate discussion and consideration, a positive pressure pool cleaning system described in U.S. Pat. Nos. 6,090,219 and 6,365,039 will be described hereinbelow in conjunction with FIG. 28, followed by a detailed description of such modified pool cleaner debris bags.

[0139] As discussed above, U.S. Pat. Nos. 6,090,219 and 6,365,039 describe positive pressure automatic pool cleaning systems which include a cleaner body able to selectively operate in a top (water surface) mode and a bottom (water surface) mode. When operating in the top mode, the cleaner body captures debris from the pool water surface and collects the debris in a container, e.g., a water permeable bag, carried by the cleaner body. When operating in the bottom mode, the cleaner body captures debris from the pool containment wall surface and the debris can be collected in the same debris bag.

[0140] The present invention is directed to an enhanced debris collection bag for use with a cleaner body which has both water surface and wall surface operational modes, as is generally described in the aforementioned patents, or with a cleaner body which only has a wall surface operational mode.

[0141] FIG. 28 herein duplicates FIG. 1 of U.S. Pat. No. 6,090,219 and shows an apparatus for cleaning a water pool 4001 contained in an open vessel 4002 defined by a containment wall 4003 having bottom 4004 and side 4005 portions. The apparatus of FIG. 28 includes a cleaner body 4006 configured for immersion in and travel through the water pool 4001 for selective cleaning operation proximate to the water surface 4007 (in the top cleaning mode) or proximate to the interior wall surface 4008 (in the bottom cleaning mode).

[0142] The cleaner body 4006 preferably comprises an essentially rigid structure having a hydraulically contoured exterior surface for efficient travel through the water pool. The body 4006 can be variously configured but preferably is compactly formed such that it fits within a two foot cube. The cleaner body 4006 can be heavier than water so that in its quiescent, powered, state it will sink to the containment wall surface 4008 at the bottom of the pool such that a vertical force must be provided to lift the body 4006 to proximate the water surface 4007 for operation in the water surface cleaning mode. As noted in U.S. Pat. No. 6,090,219, the body 4006 can, alternatively, be configured to be lighter than water such that in its quiescent, unpowered, state, it floats proximate to the water surface 4007. When so configured, a vertical force must be provided to cause the lighter than water body to descend to operate in the bottom wall surface cleaning mode.

[0143] In either case, the vertical force required to move the body either up or down is produced as a consequence of a positive pressure water flow supplied via a flexible hose 4009 from, e.g., an electrically driven motor/pump assembly 4010. The assembly 4010 defines a pressure side outlet 4011 preferably coupled via a pressure/flow regulator 4012 and quick disconnect coupling 4012B to the hose 4009. The hose 4009 can be formed of multiple sections coupled in tandem by hose nuts and swivels 4013 and can carry appropriately placed floats 4014 and distributed weight.

[0144] As is explained in the aforementioned U.S. Pat. No. 6,090,219, the positive pressure water flow supplied to the cleaner body 4006 via hose 4009 functions to produce the vertical force for moving the body up or down, functions to propel the cleaner body along a travel path through the pool and functions to produce a water flow relative to the cleaner body for capturing debris from either the water surface (top mode) or the wall surface (bottom mode).

[0145] As represented in FIG. 28, the body 4006 generally comprises a top portion or frame 4006T and a bottom portion or chassis 4006B, spaced in a nominally vertical direction. The body also generally defines a front or nose portion 4006F and a rear or tail portion 4006R spaced in a nominally horizontal direction. The body is supported on a traction means such as wheels 4015 which are mounted for engaging the wall surface 4008 when operating in the wall surface cleaning mode.

[0146] The body 4006 in FIG. 28 typically operates alternately in (1) the water surface cleaning mode to capture floating debris and (2) the wall surface cleaning mode in which it travels along bottom and side wall portions to capture debris from the wall surface 4008. The body 4006 preferably tows a flexible hose 4016 configured to be whipped by a water outflow from a nozzle at its free end to sweep against the wall surface 4008. When operating in either mode, captured debris is collected in a debris container, e.g., bag 4017, which is removably attached to the
rear end of the cleaner body 4006 and towed along as the body is propelled through the pool.

[0147] Attention is now directed to FIGS. 29 and 30, which comprise enlarged side views of a cleaner body 4006 having a debris bag 4018 in accordance with the present invention remotely attached thereto. FIG. 29 shows the cleaner body 4006 operating at the water surface 4007 (top mode) and FIG. 30 shows the cleaner body 4006 operating at the wall surface 4008 (bottom mode). Note that as the cleaner body 4006 is propelled to the right as viewed in FIG. 29, pool surface water (represented by flow arrow 4019) will move rearwardly across the cleaner’s deck 4020 to carry water borne debris to the entrance opening 4022 of the debris bag 4018 and toward an access opening 4024 spaced from the entrance opening 4022. The access opening 4024, during operation, is closed by a closure means 4025 configured in accordance with the present invention.

[0148] As will be discussed in greater detail hereinafter, the bag 4018 is formed by flexible water permeable material 4026, e.g., mesh, configured to envelop an interior cavity 4027. The bag 4018 can be loosely considered as comprising opposed upper and lower material layers 4028, 4029 joined by side panels to surround the cavity 4027, a bottom portion containing entrance opening 4022 and a top portion containing access opening 4024.

[0149] With reference to FIG. 29, as the water flow 4019 moves through the entrance opening 4022 into the bag, the water will exit through the bag material 4026, as represented by flow arrows 4032, while the debris will be retained, or collected, in the bag cavity 4027. Note in FIG. 29 that the closure means 4025 is depicted as floating on the water surface 4007 with the bag 4018 essentially oriented horizontally as the cleaner body 4006 is propelled along the water surface.

[0150] FIG. 30 depicts the cleaner body 4006 being propelled along the containment wall surface 4008 when operating in the wall surface mode. In this mode, water and debris are drawn from the wall surface 4008 into a vacuum inlet 4034 as a consequence of a water jet 4036 discharged from nozzle 4038. The water and debris drawn into vacuum inlet 4034 are directed through passageway 4040 producing an outflow 4041 at vacuum outlet 4042 which is discharged through the entrance opening 4022 into the bag cavity 4027. Note that the water flow entering the cavity 4027 exits through the bag material 4026, represented by arrows 4044, leaving the debris in the bag cavity 4027.

[0151] Note that FIG. 30 depicts the bag 4018 inclined rearwardly from the cleaner body 4006. As will be discussed hereinafter, this orientation is achieved by implementing the closure means 4025 with sufficient buoyancy to elevate the access opening end of the bag above the entrance opening end attached to the cleaner body. By making the closure means 4025 sufficiently buoyant, the bag 4018 will assume an orientation relative to the cleaner body 4006 which avoids its impeding the body’s travel through the pool.

[0152] A preferred closure means 4025 in accordance with the invention is depicted in FIGS. 29 and 30 and in greater detail in FIGS. 31 and 32. The closure means 4025 includes a clamp member 4050 defined by a substantially cylindrical peripheral wall 4052. An elongate gap, or gap, 4054 is formed in the wall 4052 so as to define opposed clamping edges 4056. The slot 4054 is dimensioned to snugly slidingly receive the opposed edges of upper and lower bag layers 4028, 4029 adjacent the access opening 4024. The clamp member 4050 is constructed so that the clamping edges 4056 will resiliently bear against the opposed bag layers to close the access opening 4024 for retaining debris in the bag cavity during cleaner operation. When it is desired to remove and discard debris from the bag 4018, the bag and clamp member 4050 are slid relative to one another to provide access to the opposed edges of the bag layers allowing them to be pulled apart to open to the cavity 4027.

[0153] In a preferred closure means embodiment, as depicted in FIGS. 29-32, beads 4058, 4060 are respectively formed along the opposed edges of bag layers 4028, 4029. For example with reference to FIG. 32, bead 4058 is formed by folding the edge 4028A of layer 4028 upon itself adjacent the access opening 4024 and securing bead material 4061 therebetween. Bead 4060 is similarly formed on layer 4029.

[0154] When the clamp member 4050 is slid onto the bag layers (FIG. 31), the clamping edges 4056 will spread to accommodate the thickness of the bag layers resulting in the edges 4056 resiliently bearing against the layers to close the access opening 4024. As shown in FIGS. 29 and 30, the beads 4058, 4060 will be accommodated within the open elongate recess 4064 within the clamp member wall 4052.

[0155] The clamp member 4050 is preferably constructed of plastic material which can be formed to be sufficiently resilient for the edges 4056 to spread to accommodate the bag layers and to then clamp the opposed layers together to close the access opening 4024 and prevent debris from exiting the cavity 4027. Additionally, the clamp member material is preferably selected to be buoyant in water to elevate the access opening end of the bag above the entrance opening end removably attached to the cleaner body 4006 as depicted in FIG. 30.

[0156] The closure means 4026 can be made buoyant in various ways, e.g., by a proper choice of clamp member material and/or by configuring the clamp member with supplemental buoyancy such as closed air chambers or foam material (not shown), e.g., within the elongate recess 4064. Alternatively, or supplemental, the closure means buoyancy can be enhanced by forming the edge beads 4058, 4060 of buoyant material. For example, beads 4058 and 4060 can be formed by larger diameter tubes, as shown at 4066, 4067 in FIG. 33, having sealed ends.

[0157] Attention is now directed to FIG. 34 which illustrates an alternative clamp member embodiment 4070. The cross section of the clamp member 4070 comprises first and second legs 4072 and 4074 which extend from a U shaped bight or bridge portion 4076. Remote from the bight portion 4076, the legs 4072 and 4074 turn inwardly and terminate at spaced clamping edges 4078 and 4080. The edges 4078 and 4080 are dimensioned to snugly slidingly receive opposed layers of bag material therebetween, as has been previously discussed. In the clamp member embodiment 4070, a partition 4082 separates an internal recess 4084 into first and second recesses, or compartments, 4086 and 4088. As depicted, the recess 4086 accommodates the beaded edges of the bag 4018 adjacent to the compartment opening. The elongate recess 4088 can be used to enhance buoyancy by sealing its ends to enclose an air pocket. Alternatively, the compartment 4088 can be filled with foam or other buoyant material.
FIG. 35 depicts a further alternative clamp member embodiment 4090. In cross section, the clamp member 4090 includes legs 4092 and 4094 coupled by a partition 4096. Below the partition 4096 (as viewed in FIG. 35), the legs 4090 and 4092 turn inwardly to define clamping edges 4098 and 4100. The clamp member 4090 is configured so that these edges 4098 and 4100 are normally resiliently urged toward one another for gripping layers of bag material therebetween. The legs 4090 and 4092 additionally extend above the partition 4096 to form extensions 4102 and 4104 which can be manually squeezed to pivot the legs 4090, 4092 to spread the clamping edges 4098, 4100 to facilitate insertion of the bag beaded edges 4105, 4106 therebetween.

As with the previously discussed clamp members, the clamp member 4090 is constructed to be buoyant in water for the purpose of elevating the access opening end of the bag 4018, as depicted in FIG. 30, when the cleaner is being operated in its wall surface cleaning mode.

The various clamp member embodiments thus far discussed are configured to define opposed clamping edges for bearing against layers of bag material to close the access opening. The clamping edges of the various embodiments can be spread to receive the bag material layers and then released to resiliently clamp against the bag material. For simplicity in construction, the elongate clamping edges can extend substantially the full length of the clamp member shell to allow the clamp member to slide onto the beaded bag edges from either end. This characteristic enables a clamp member to be fully detached from the bag thereby providing unimpeded access to the bag interior cavity 4027 for emptying debris therefrom. The advantage of constructing the clamp member so that it can be fully detached from the bag is that a user can inadvertently misplace the clamp member. If this occurred, it would disable the cleaner body from collecting debris. In order to avoid such a circumstance, a clamp member can be used which is configured to prevent inadvertent detachment from the bag as shown in FIG. 36A.

The clamp member 4120 is comprised of a substantially cylindrical elongate shell 4122 split along its length to define opposed clamping edges 4124 and 4126 separated by a gap. As is best depicted in FIGS. 36A and 36F, the shell 4122 is configured to define a stop 4130 which preferably extends diametrically through the shell 4122 and gap 4127 past clamping edges 4124 and 4126. Note in FIGS. 36A and 36E that the stop 4130 extends only a short axial distance along the elongation of shell 4122.

FIG. 36A shows the beaded edges 4134, 4136 of the bag 4018 threaded through the gap 4127. FIG. 36B shows how the depending stop 4130 extends into the bag beneath the beaded edges 4134 and 4136. FIG. 36C shows how the bag 4018 can be pulled to the left to engage the stop 4130 against the bag side panel to thereby retain the shell 4122 on the bag while still allowing the bag edges 4134 and 4136 to be spread apart to provide access to the bag interior cavity. FIG. 36D shows the bag slid back to the right relative to the shell 4122 to seal the access opening between the beaded edges 4134 and 4136.

The debris bag 4018 and the various clamp member embodiments as discussed thus far are particularly configured to operate with an automatic pool cleaner whose cleaner body is selectively operable at either the pool water surface (top mode) or the containment wall surface (bottom mode). It should be understood, however, that debris bag embodiments and closure means in accordance with the invention can also be used with a cleaner body configured for operation solely at the wall surface. Such a cleaner body 4200 is depicted in FIG. 37 which shows the body supported on wheels 4201 for engaging the wall surface 4008. The cleaner body 4200 includes an internal flow passageway 4204 which at its bottom end has a vacuum inlet 4206 and its top end a vacuum outlet 4208. A jet nozzle 4210 discharges a jet 4212 into the passageway which produces a force to draw debris and water from proximate to wall surface 4008 through the vacuum inlet 4206 for discharge through the vacuum outlet 4208.

FIG. 37 shows a debris bag 4214 in accordance with the invention including an entrance opening 4216 intended to be detachably secured to the upper end of passageway 4204 for collecting the discharge from vacuum outlet 4208. The bag 4214 is formed of water permeable material so that the water component of the flow 4218 entering the entrance opening 4216 will exit through the bag material as represented by flow arrows 4220.

FIG. 37 shows the bag as having an access opening 4224 defined between beaded edges 4226, 4228 of opposed layers of bag material. A buoyant clamp member 4230, for example of the type depicted in FIG. 32, is mounted adjacent to the beaded edges 4226, 4228 for closing the access opening 4224.

As can best be seen in FIGS. 37 and 38, the bag 4214 is configured with a small pouch 4236 which extends below the bag entrance opening 4216, as viewed in FIGS. 37 and 38. The pouch 4236 defines an internal cavity 4238 which functions to collect heavier debris, e.g., sand, pebbles, etc., drawn through the entrance opening 4216 from passageway 4204. More particularly, flow arrow 4218 in FIG. 37 represents the flow of water and debris drawn through vacuum inlet 4206. The water component of the flow 4218 exits through the water permeable bag material, as represented by flow arrows 4220. The debris component of flow 4218 is unable to pass through the bag material and tends to sink downwardly away from the bag access opening, as represented by the flow arrow 4240. This debris 4240 is collected in the pouch 4236.

In accordance with the present invention, the lower end of the pouch 4236 is provided with an access opening 4242 in which operation, is closed by a closure means including a clamp member 4244. The structure of clamp member 4244 can be similar to the various clamp member embodiments discussed in FIGS. 28-36. However, the clamp member 4244 need not be buoyant. Rather, it is desirable that the lower end of the pouch 4236 be attached to the cleaner body to prevent it from swinging relative to the body which could adversely affect the stability of the cleaner body as it moves along its travel path. It is preferable that the pouch lower end be attached immediately adjacent to the cleaner body close to or below the body's center of gravity 4245. A preferred form of attachment is to configure clamp member 4244 to snap into the cleaner body. More particularly, note in FIG. 40 that the clamp member 4244 carries bifurcated plastic snaps 4248, 4250 which extend perpendicular to the elongation of the clamp member shell. The bifurcated snaps 4248 and 4250 are configured to
squeeze into cleaner body openings 4252 for retaining the clamp member 4244 immediately adjacent to the cleaner body.

[0167] In use, the clamp member 4244 is mounted on the beaded edges of the bag 4244 adjacent the pouch access opening 4242 as shown in FIG. 39. The bifurcated snaps 4248 and 4250 are then snapped into corresponding openings 4252 in the cleaner body 4200 for retaining the pouch access end close to and low on the body 4200. Of course when it is desired to remove the bag 4214 for discarding collected debris, the clamp member 4244 can be pulled from the cleaner body to withdraw the snaps 4248, 4250 from openings 4292 to detach the clamp member 4244 from the cleaner body. The clamp member 4244 can then be released from the bag beaded edges to allow them to be pulled apart for providing access to the pouch cavity.

[0168] From the foregoing, it should now be appreciated that a pool cleaner debris bag has been described characterized by a closure means for closing a bag access opening which has sufficient buoyancy in water to orient the bag to avoid impeding cleaner travel. Although a limited number of embodiments have been described, it is recognized that variations and modification may readily occur to those skilled in the art coming within the intended scope of the appended claims.

[0169] It will be understood that the embodiments described herein are merely exemplary and that a person skilled in the art may make many variations and modifications without departing from the spirit and scope of the invention. All such variations and modifications, including those discussed above, are intended to be included within the scope of the invention as defined in the appended claims.

We claim:

1. A pool cleaner debris bag comprising:
   a body including a debris collection cavity, the body having an upper end and a lower end, the lower end coupled to the pool cleaner to receive debris from the pool ejected by the cleaner into the bag; and
   a float coupled to the body positioned outside of and adjacent to the debris collection region of the bag separate from the lower end.

2. The debris bag of claim 1 further including a second float positioned outside the debris collection region.

3. The debris bag of claim 1 wherein said float has a buoyancy sufficient to support the weight of the bag in water.

4. The debris bag of claim 1 wherein the float is comprised of a foam.

5. The debris bag of claim 1 wherein the float is comprised of a molded single cell float.

6. The debris bag of claim 1 wherein the float is comprised of a buoyant solid material.

7. The debris bag of claim 1 wherein the float is coupled to the bag by means of attachment sack sewn to the outside of the bag.

8. A debris bag for a pool cleaner having a top end and a second end, comprising:
   a body having a debris inlet opening to a collection cavity and being coupled to the cleaner at the inlet; and
   a float coupled to the body at a position outside of and adjacent to the collection cavity and separate from the inlet opening.

9. The debris bag of claim 8 wherein the body has a top end and a bottom end, a left end and a right end, a top seam, and the float is positioned at the top seam.

10. The debris bag of claim 8 wherein the float is secured to the bag by an external connector.

11. The debris bag of claim 8 wherein the float is contained in an external porous material housing.

12. The debris bag of claim 11 wherein the porous material housing is sewn to the bag.

13. The debris bag of claim 8 wherein the float comprises a water-tight material sewn to the bag.

14. The debris bag of claim 8 wherein the float has a triangular cross-section.

15. The debris bag of claim 8 wherein the float has a circular cross-section.

16. The debris bag of claim 8 further including a second float attached outside the cavity.

17. The debris bag of claim 8 further including a weight positioned at a lower portion of the bag relative to the float.

18. A pool cleaner debris bag comprising:
   a porous material defining an interior cavity having a closable top end and an open bottom end, the bottom end coupled to the pool cleaner to receive debris from the pool ejected by the cleaner into the bag;
   a coupling connecting the bottom end to the cleaner;
   a float disposed outside the interior cavity of the bag proximate the closable top end; and
   means joined to the top end for securing the float to the closable top end.

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