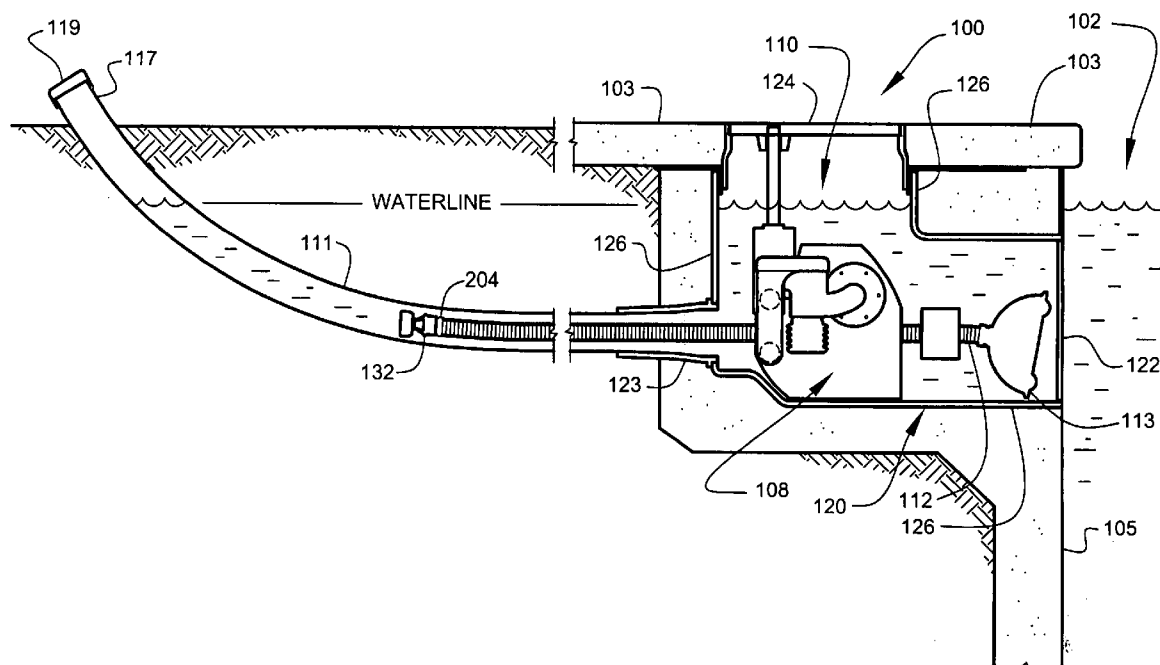




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(19) **United States**(12) **Patent Application Publication**
Torkelson(10) **Pub. No.: US 2006/0169322 A1**(43) **Pub. Date: Aug. 3, 2006**(54) **CONCEALED AUTOMATIC POOL VACUUM
SYSTEMS****Publication Classification**(76) Inventor: **John E. Torkelson**, Mesa, AZ (US)(51) **Int. Cl.****B65H 75/34** (2006.01)(52) **U.S. Cl.** **137/355.2**Correspondence Address:
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PHOENIX, AZ 85012 (US)(57) **ABSTRACT**(21) Appl. No.: **11/324,829**(22) Filed: **Jan. 3, 2006****Related U.S. Application Data**(63) Continuation-in-part of application No. 11/001,557,
filed on Nov. 30, 2004.(60) Provisional application No. 60/528,771, filed on Dec.
12, 2003. Provisional application No. 60/641,607,
filed on Jan. 6, 2005.

A vacuum pool-cleaning storage system that is housed in the side of a swimming pool substantially below the waterline. The pool vacuum cleaner automatically deploys to clean the pool when the central pool vacuum pump is activated, and automatically retracts to a stored position when the central pool vacuum pump is turned off. The system is adapted to store the vacuum hose in a substantially linear tube located substantially underground. A reel-type hose storage embodiment is also disclosed. The system is preferably powered by vacuum pressure generated by a water circulation pump of the pool plumbing system.



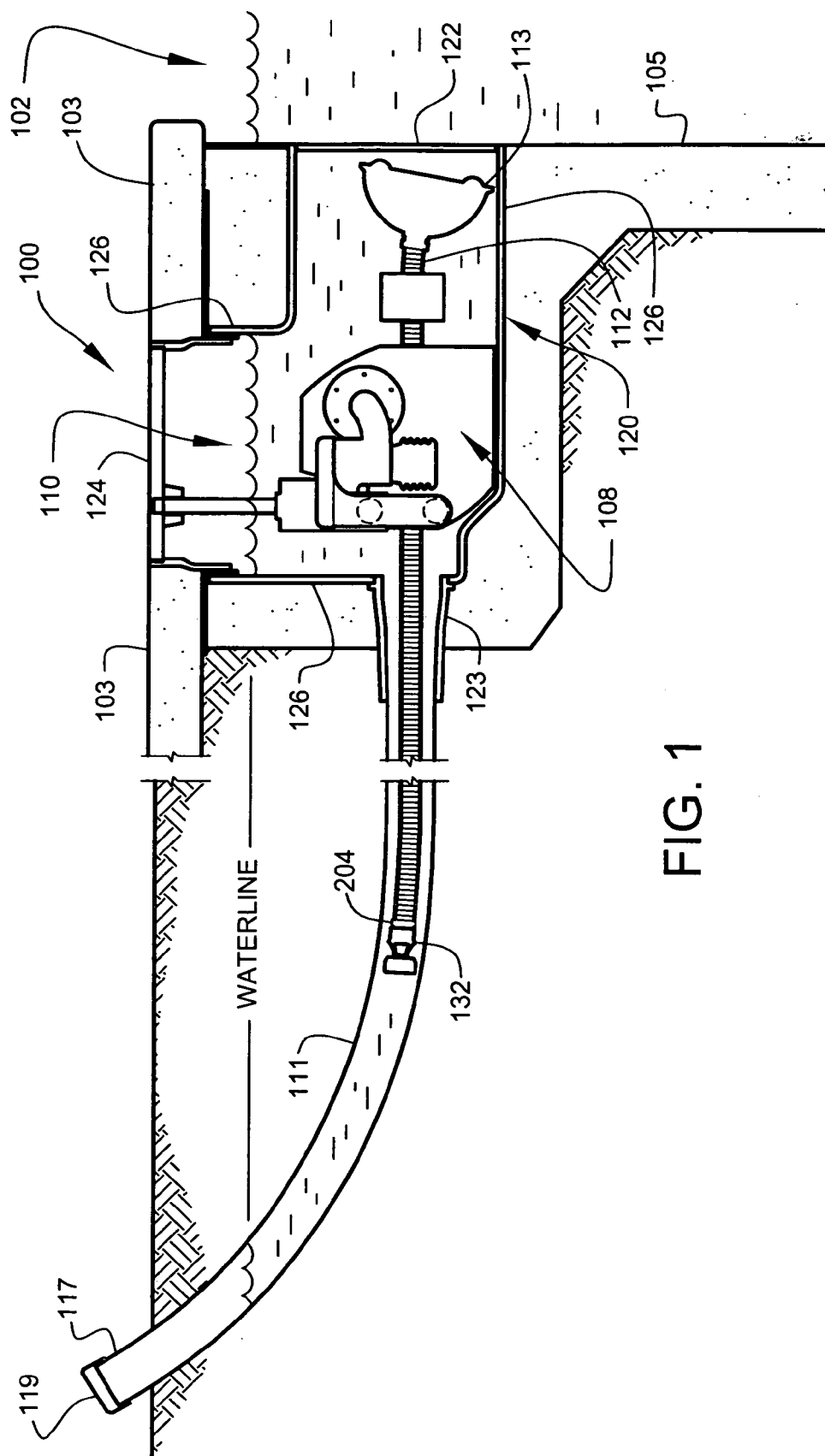


FIG. 1

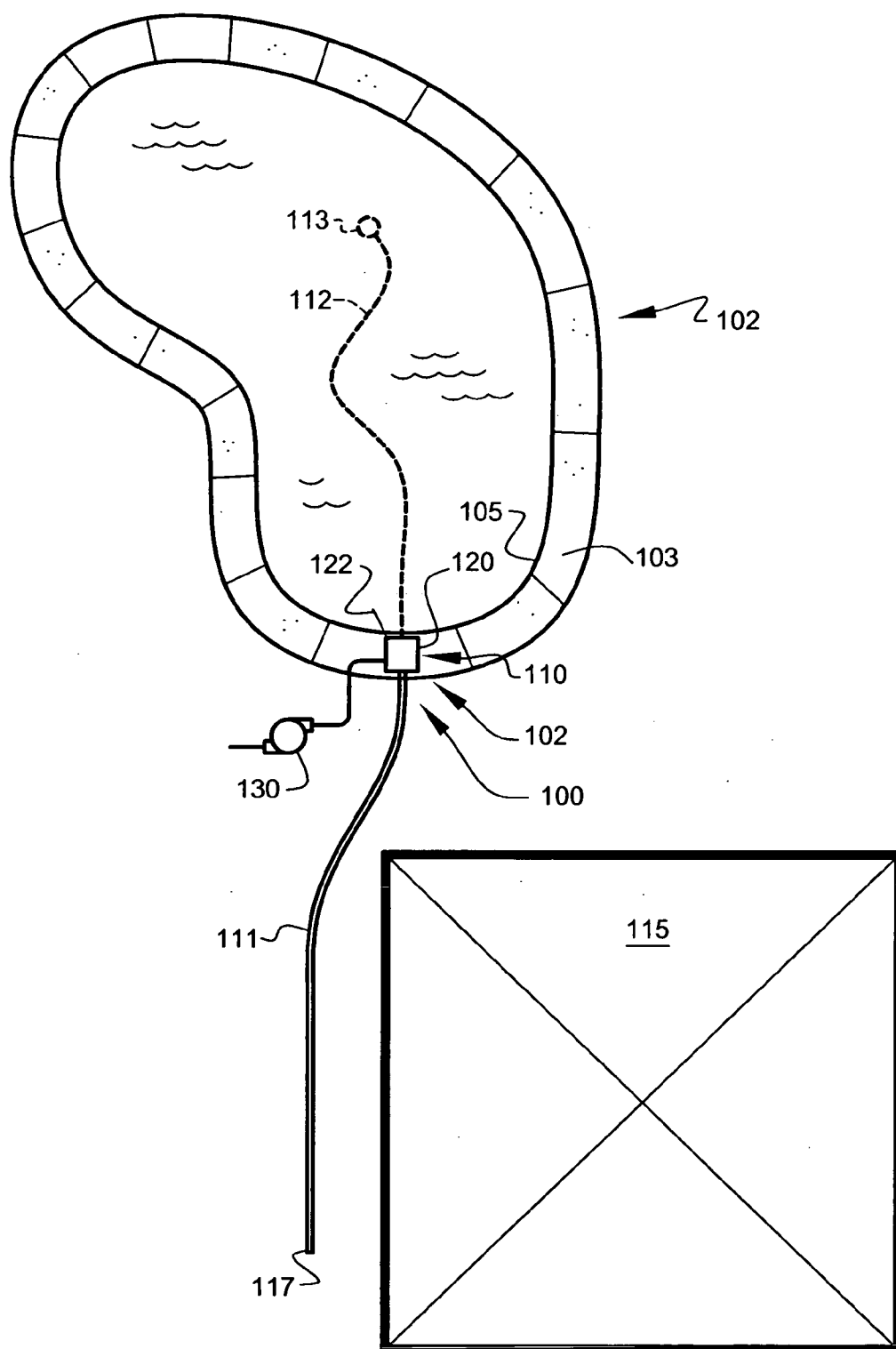
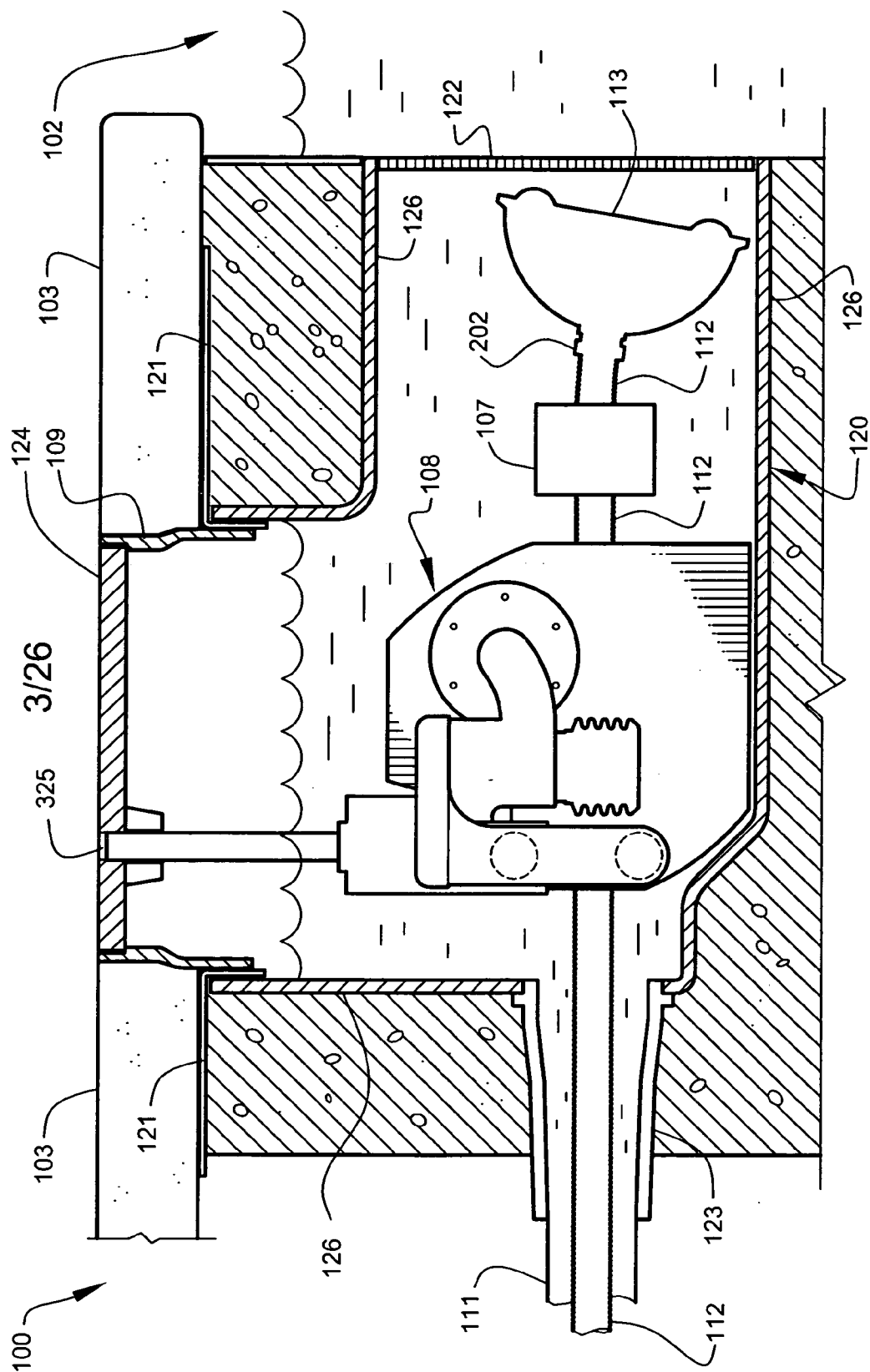


FIG. 2



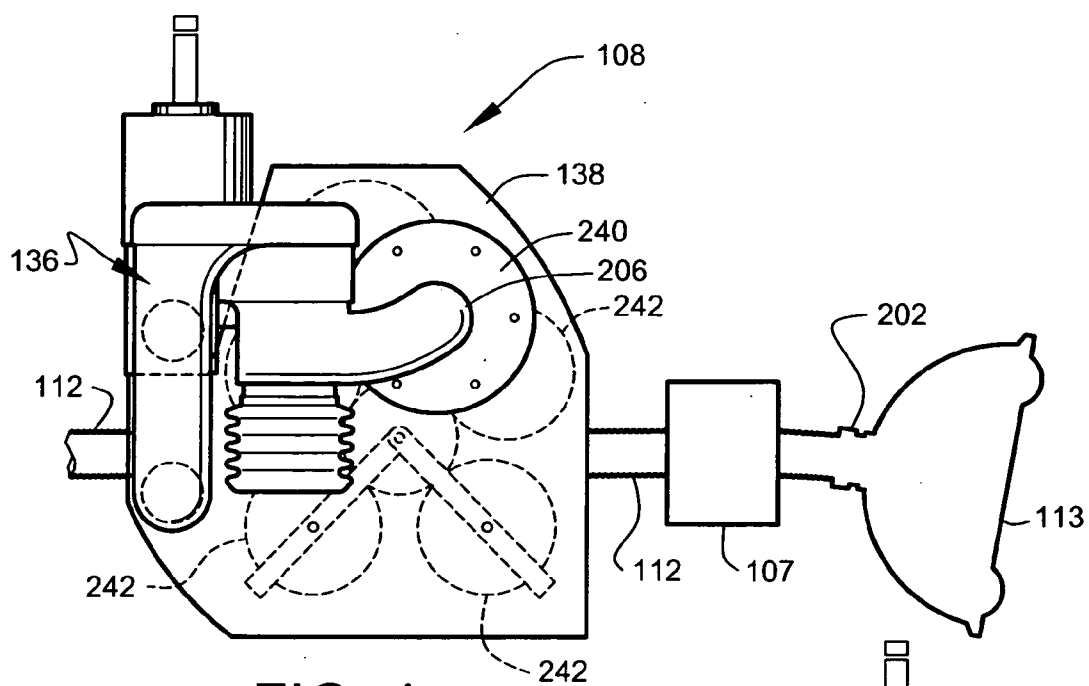


FIG. 4

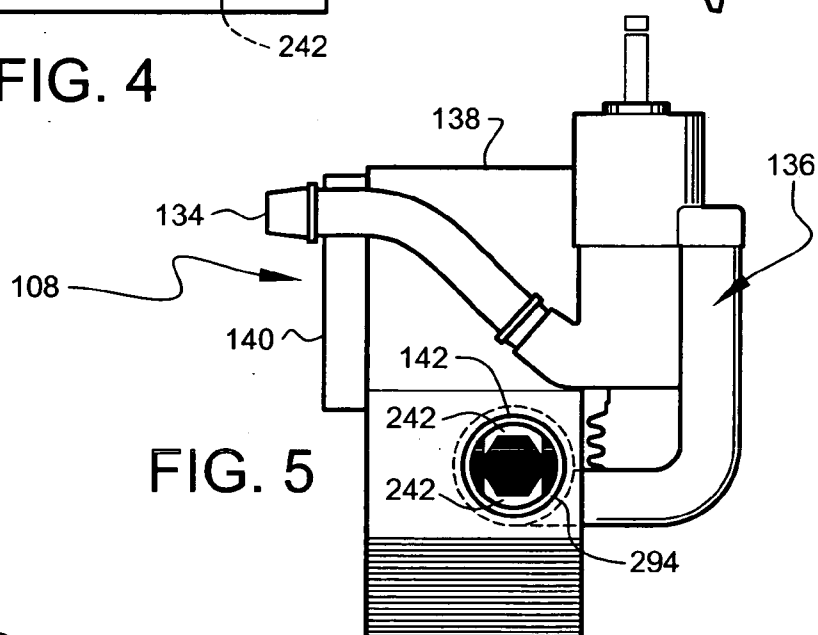


FIG. 5

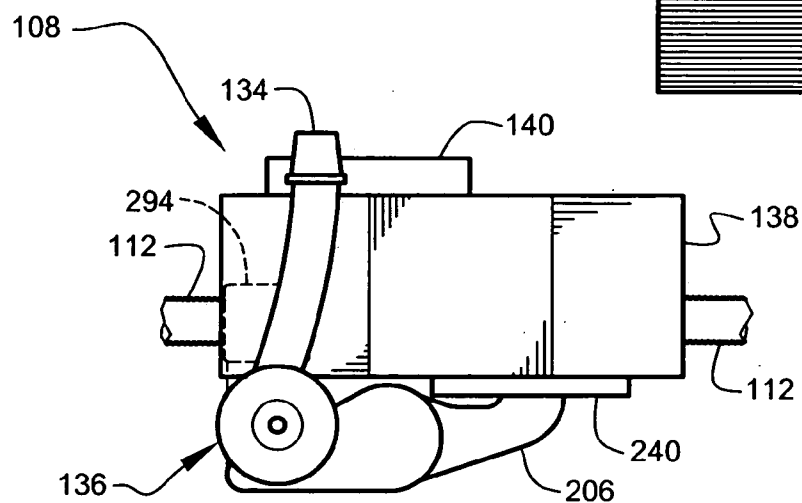
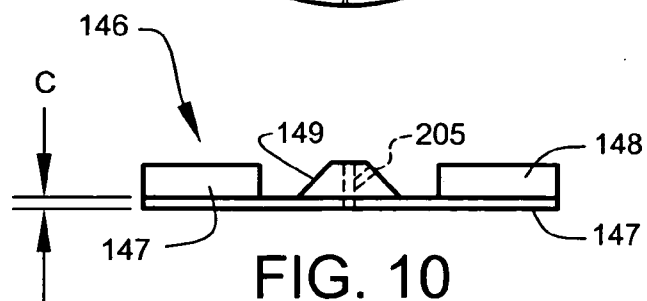
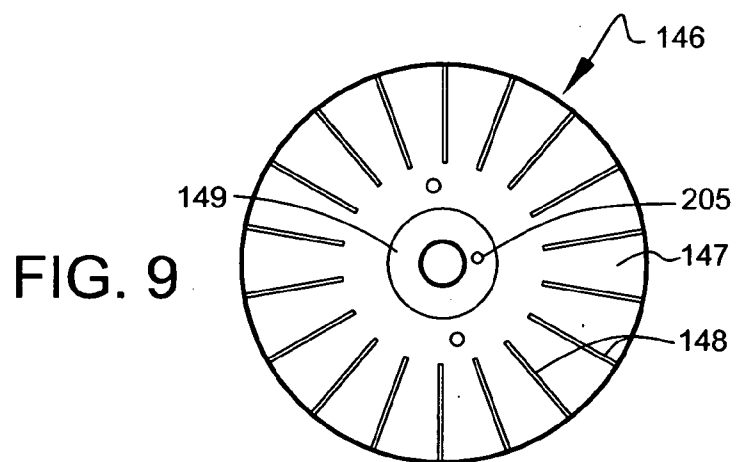
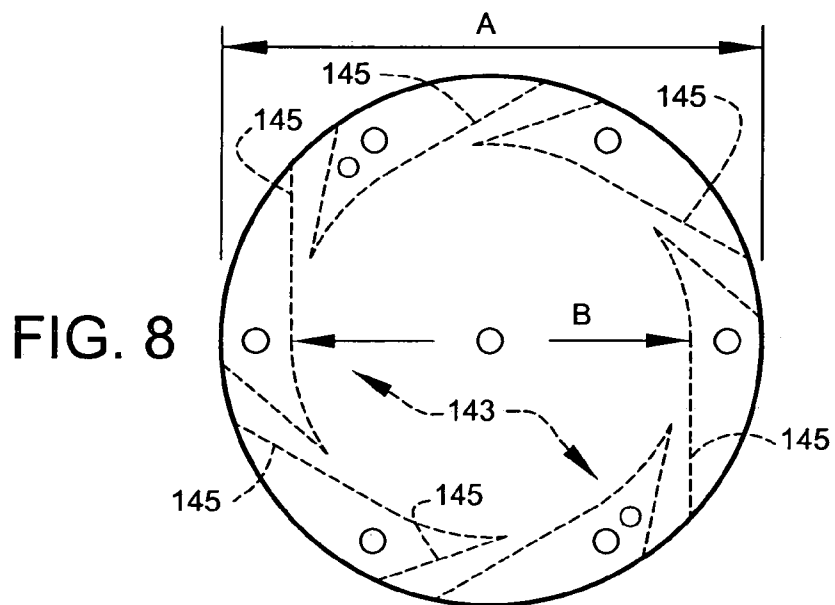
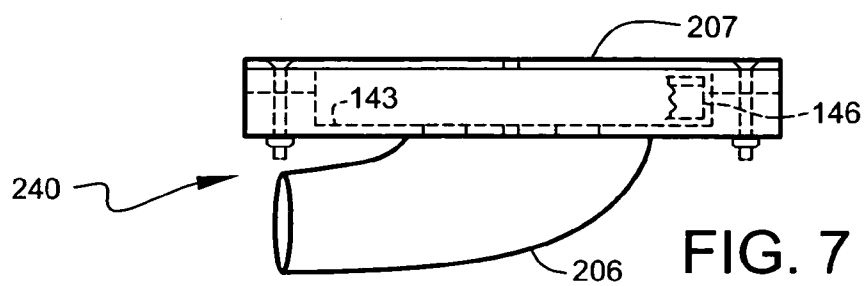
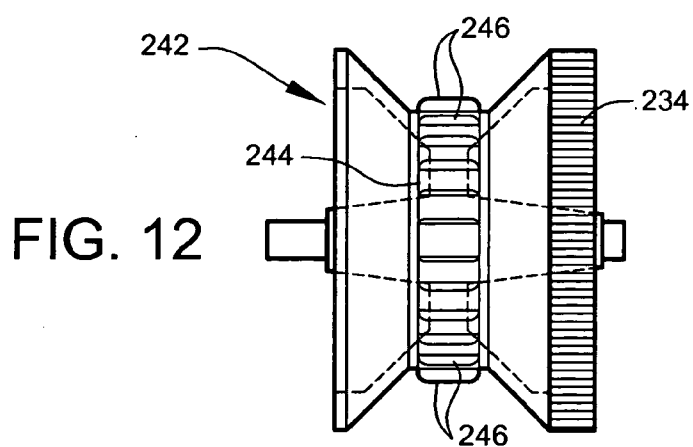
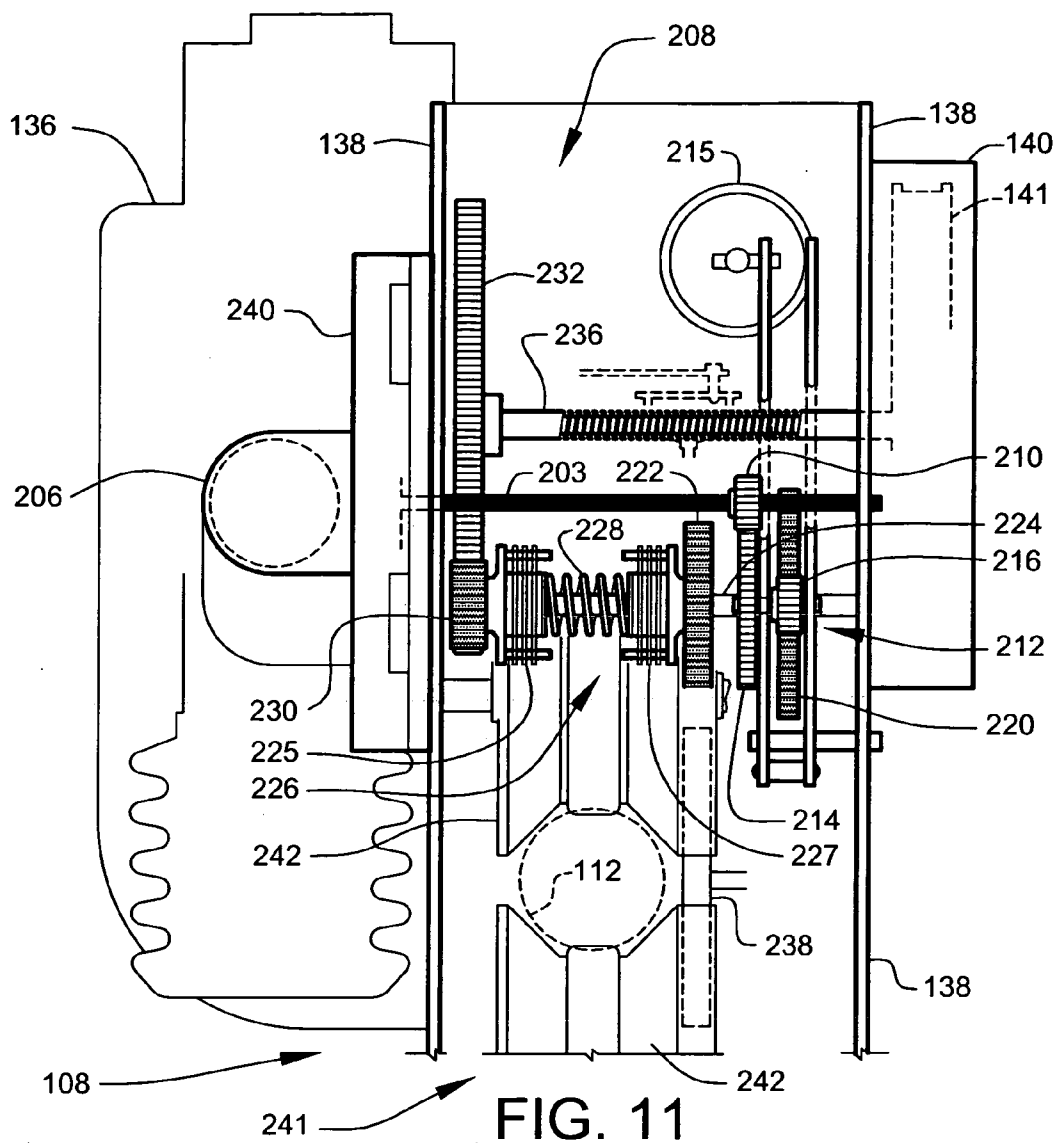
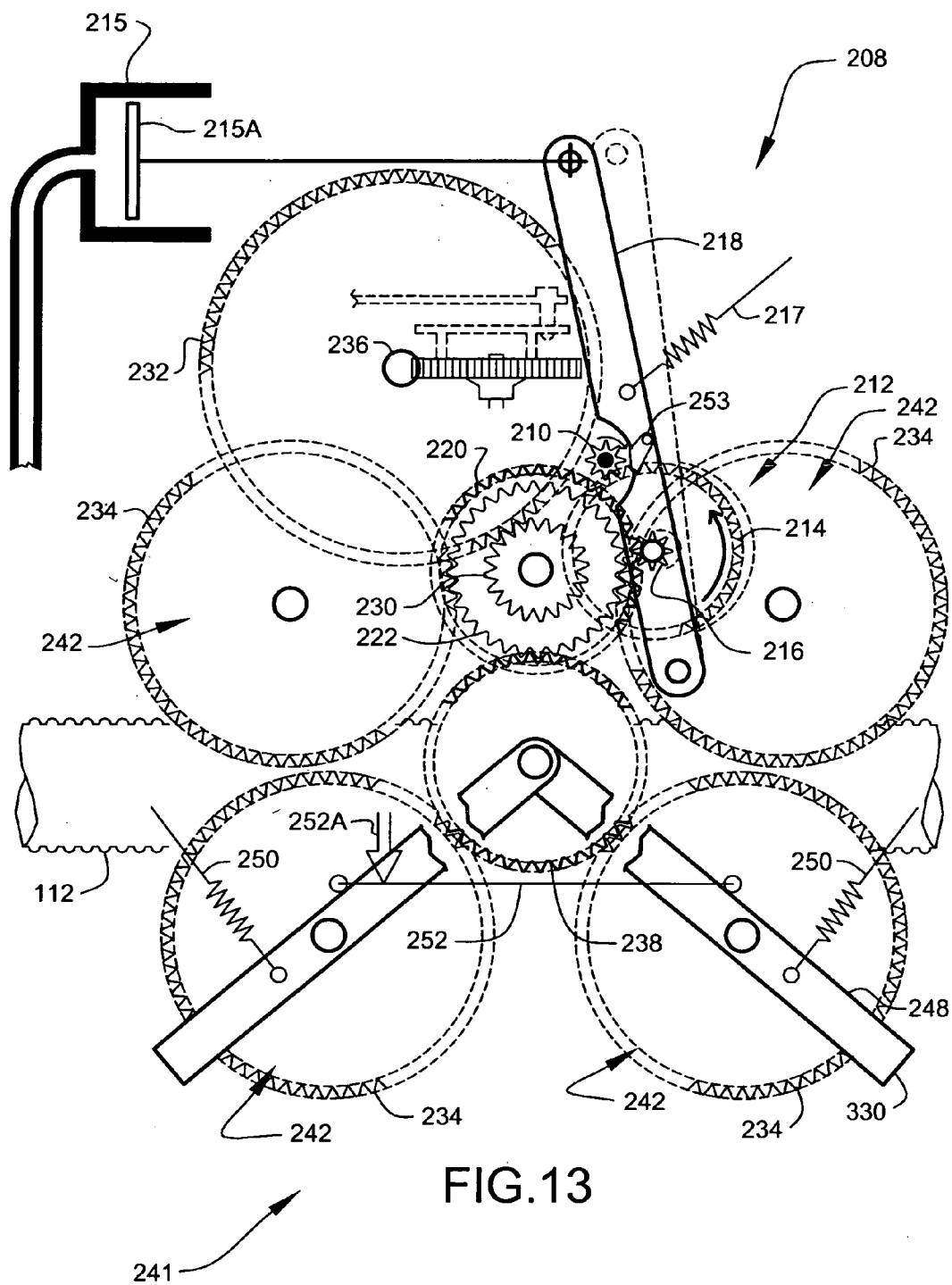


FIG. 6







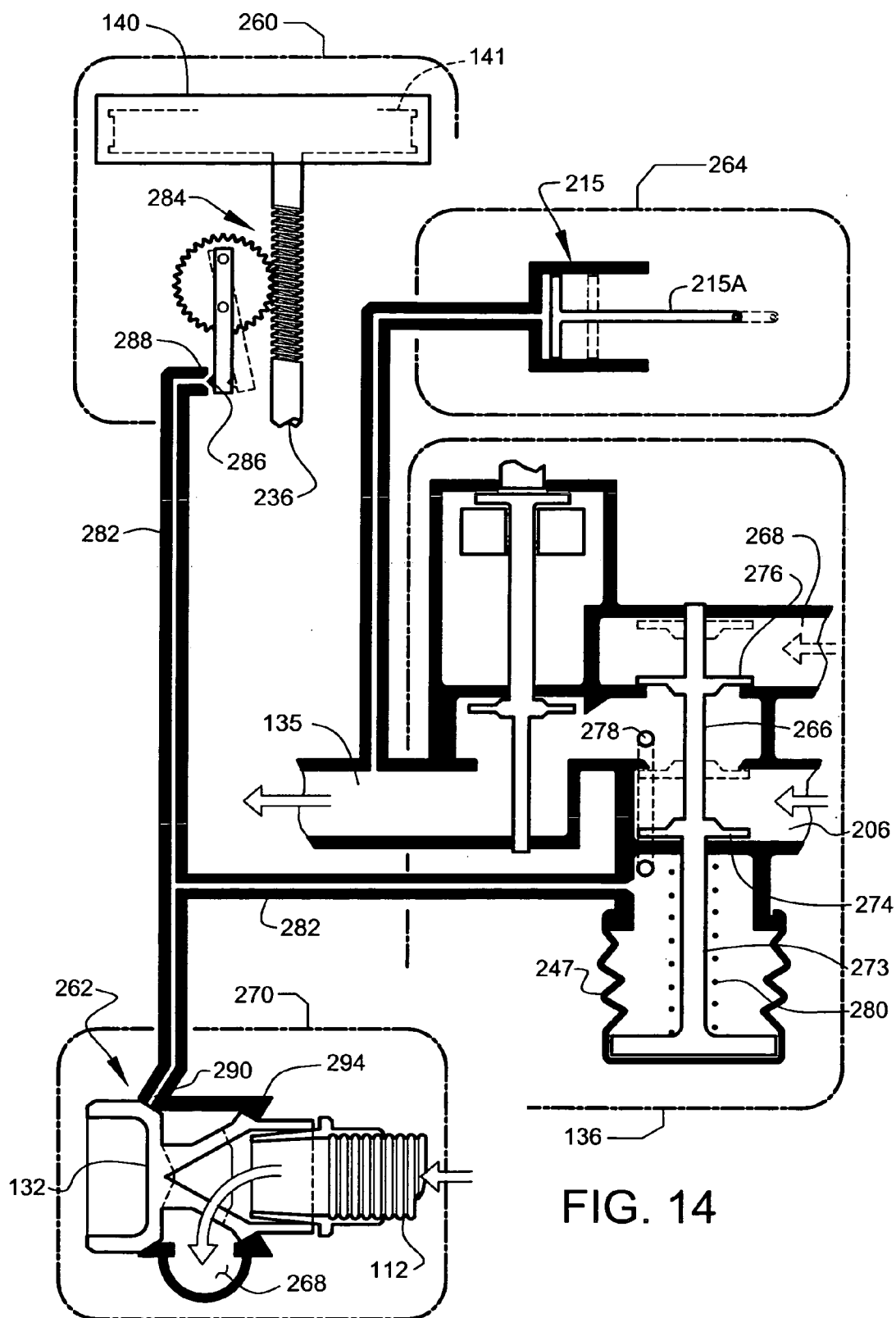
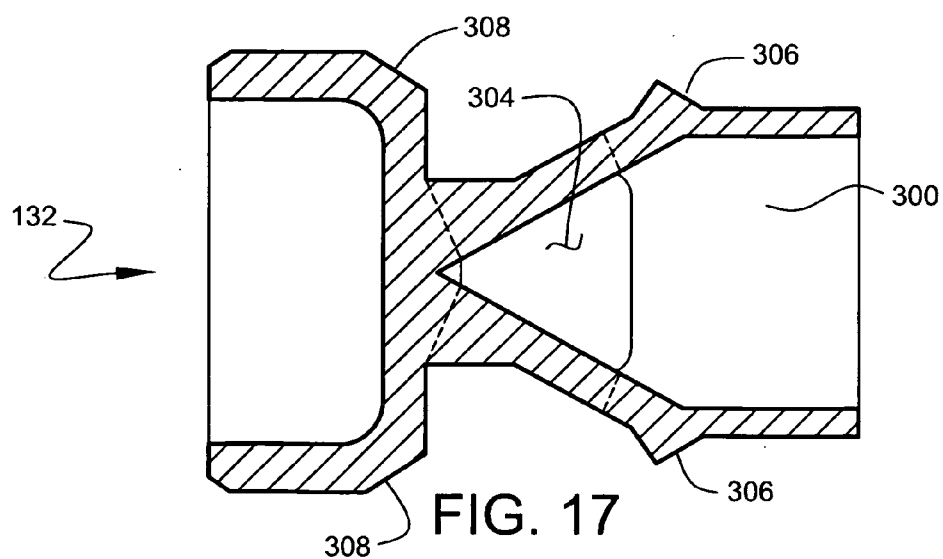
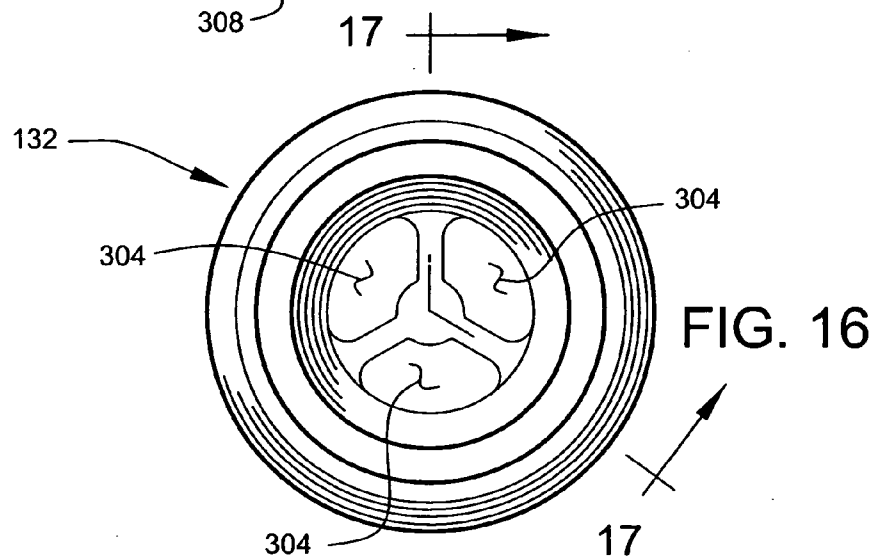
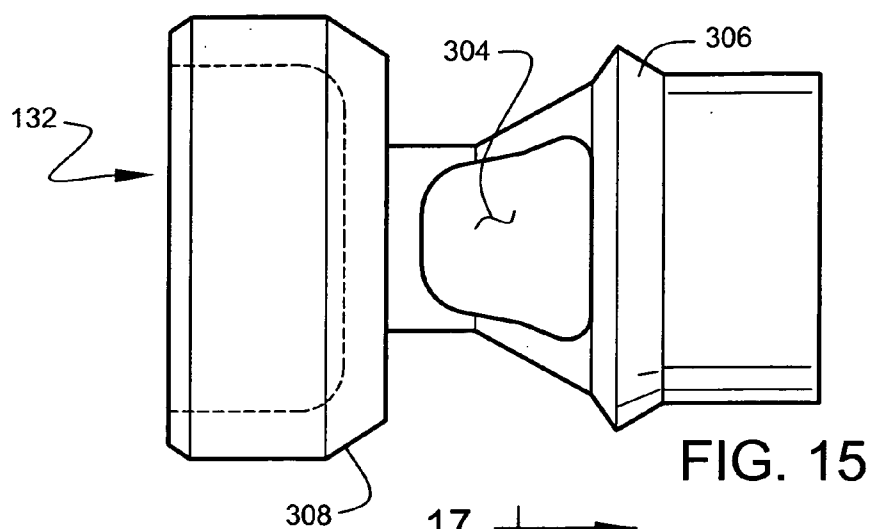


FIG. 14



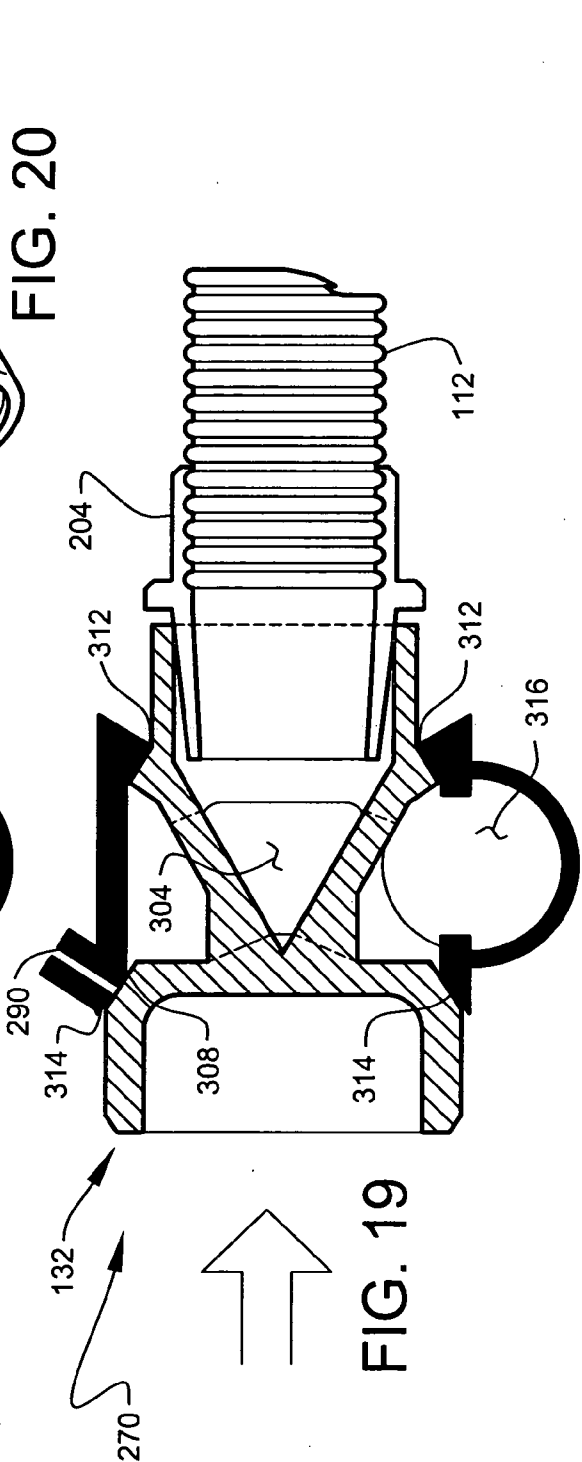
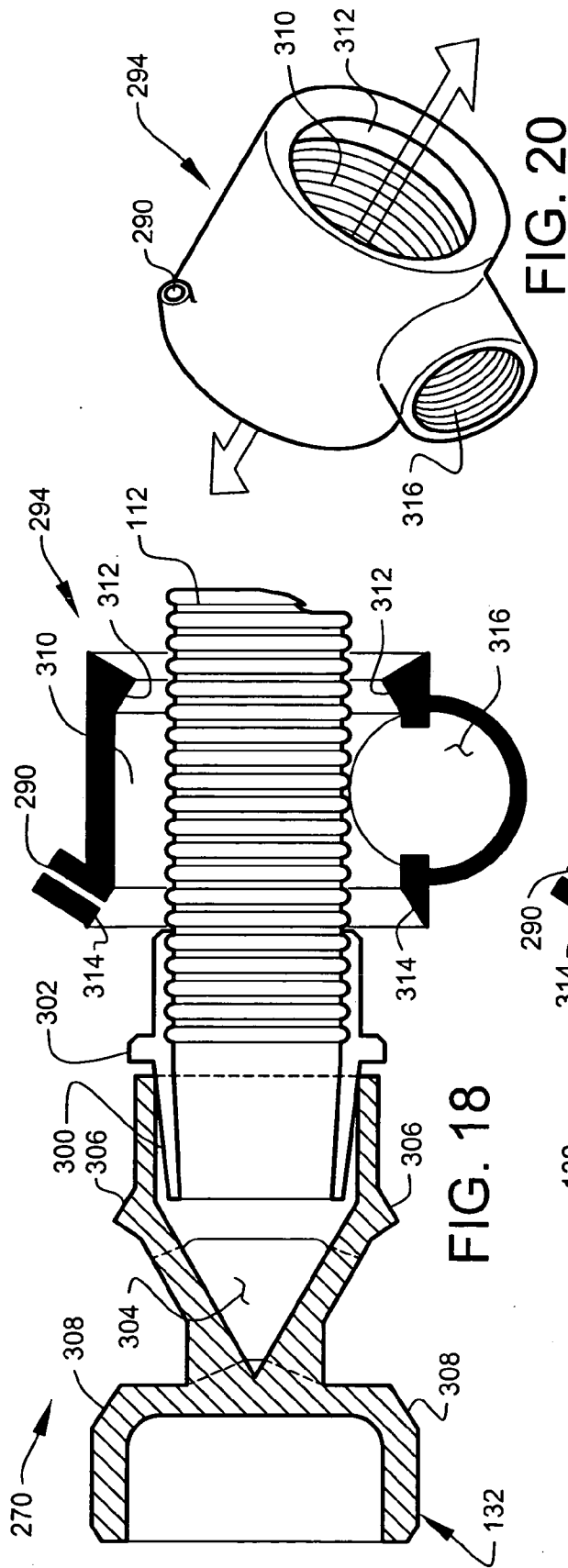
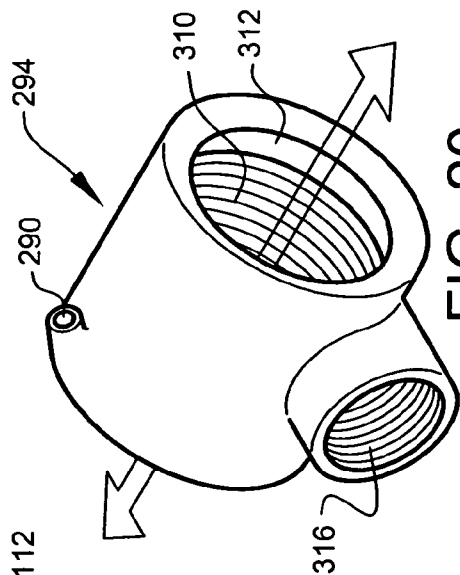
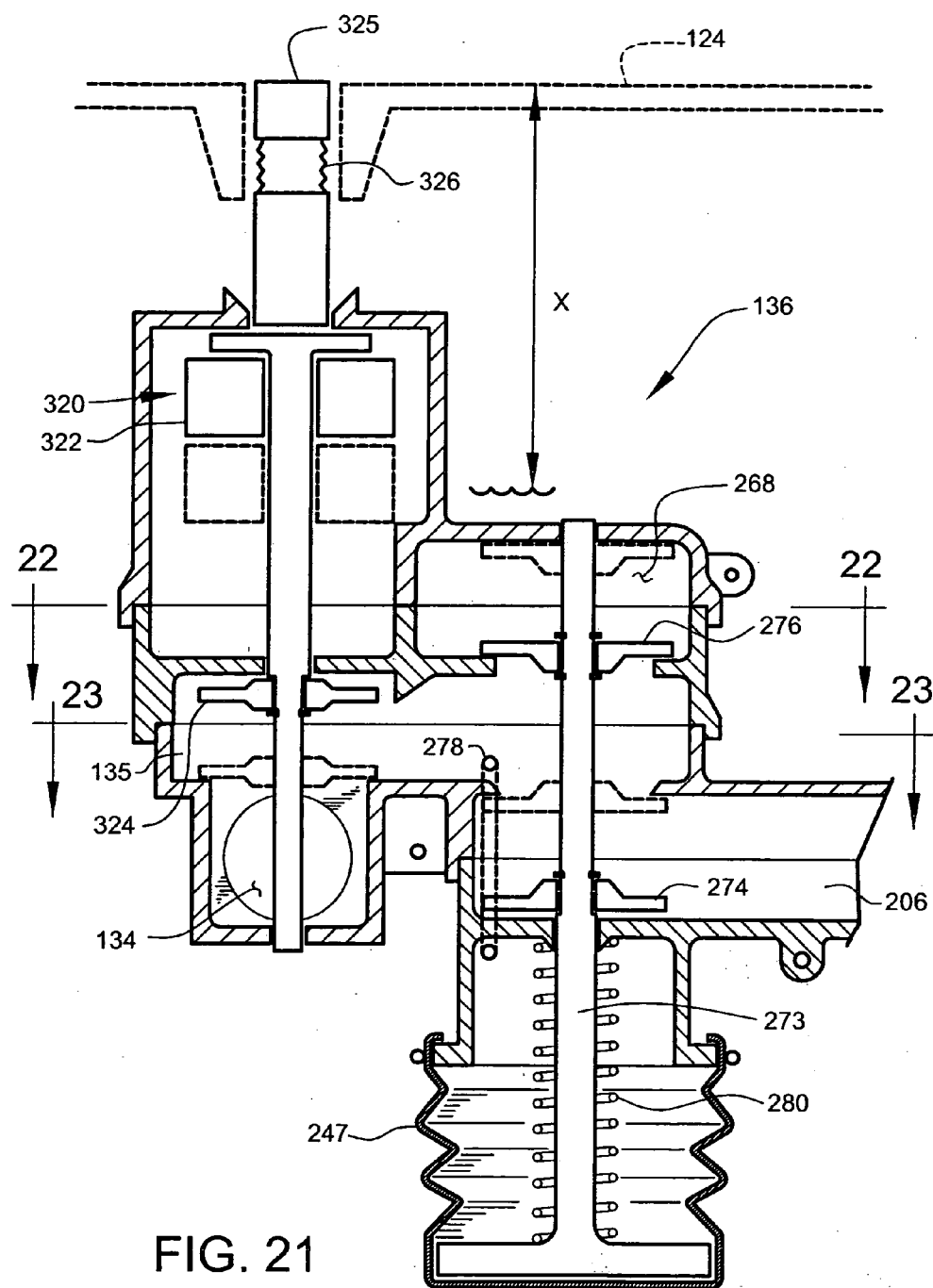


FIG. 20





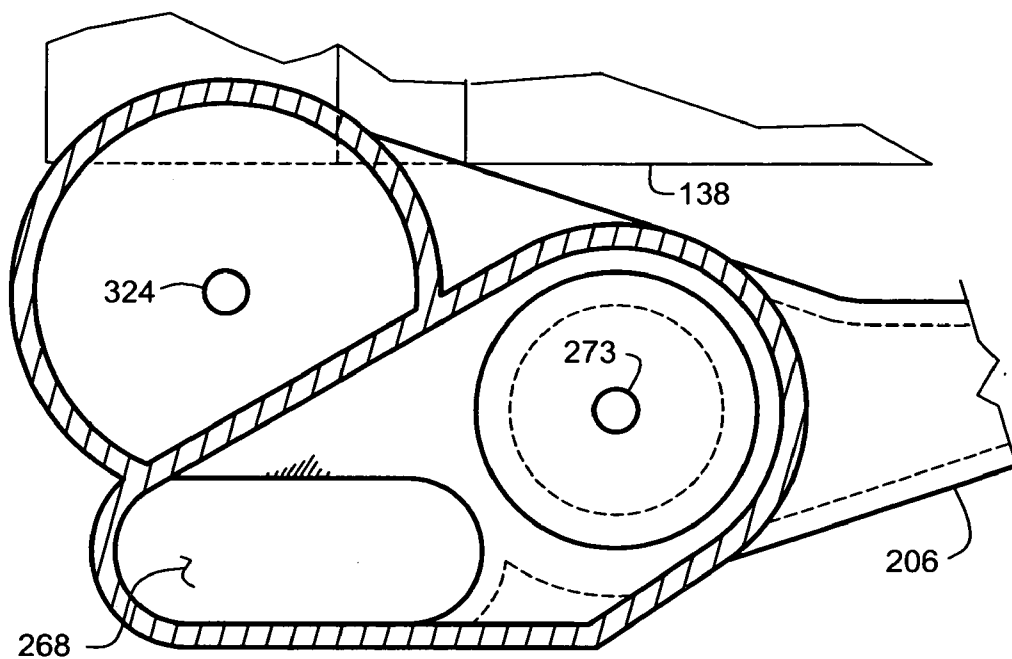


FIG. 22

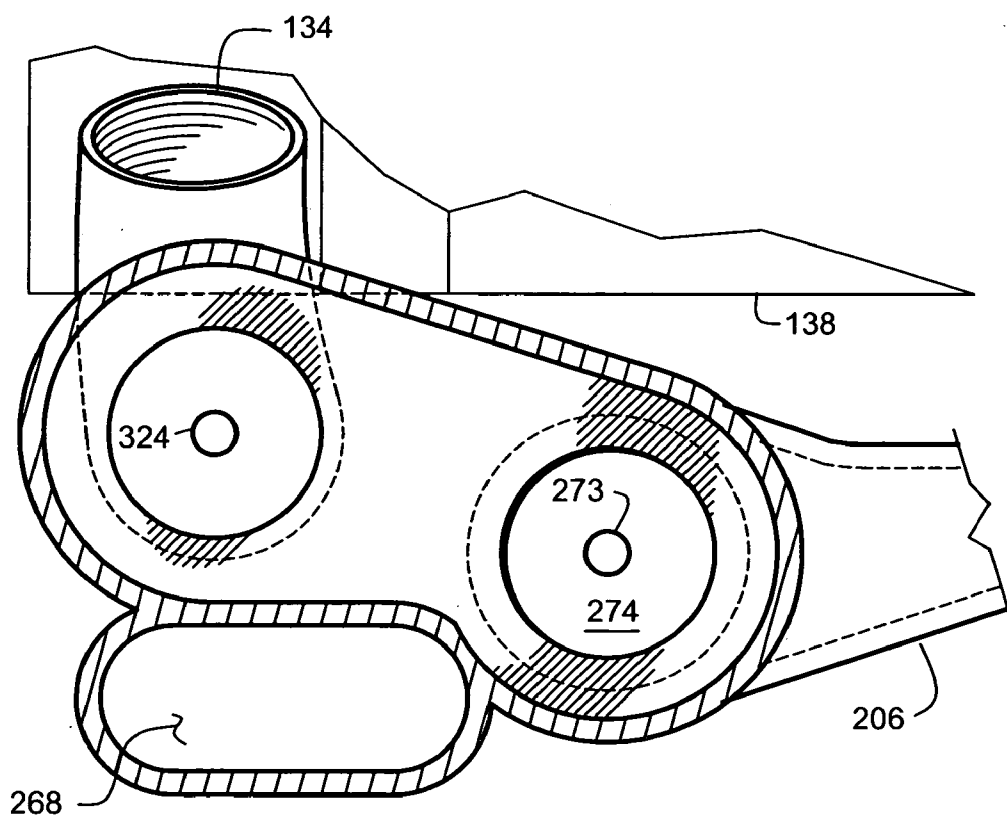


FIG. 23

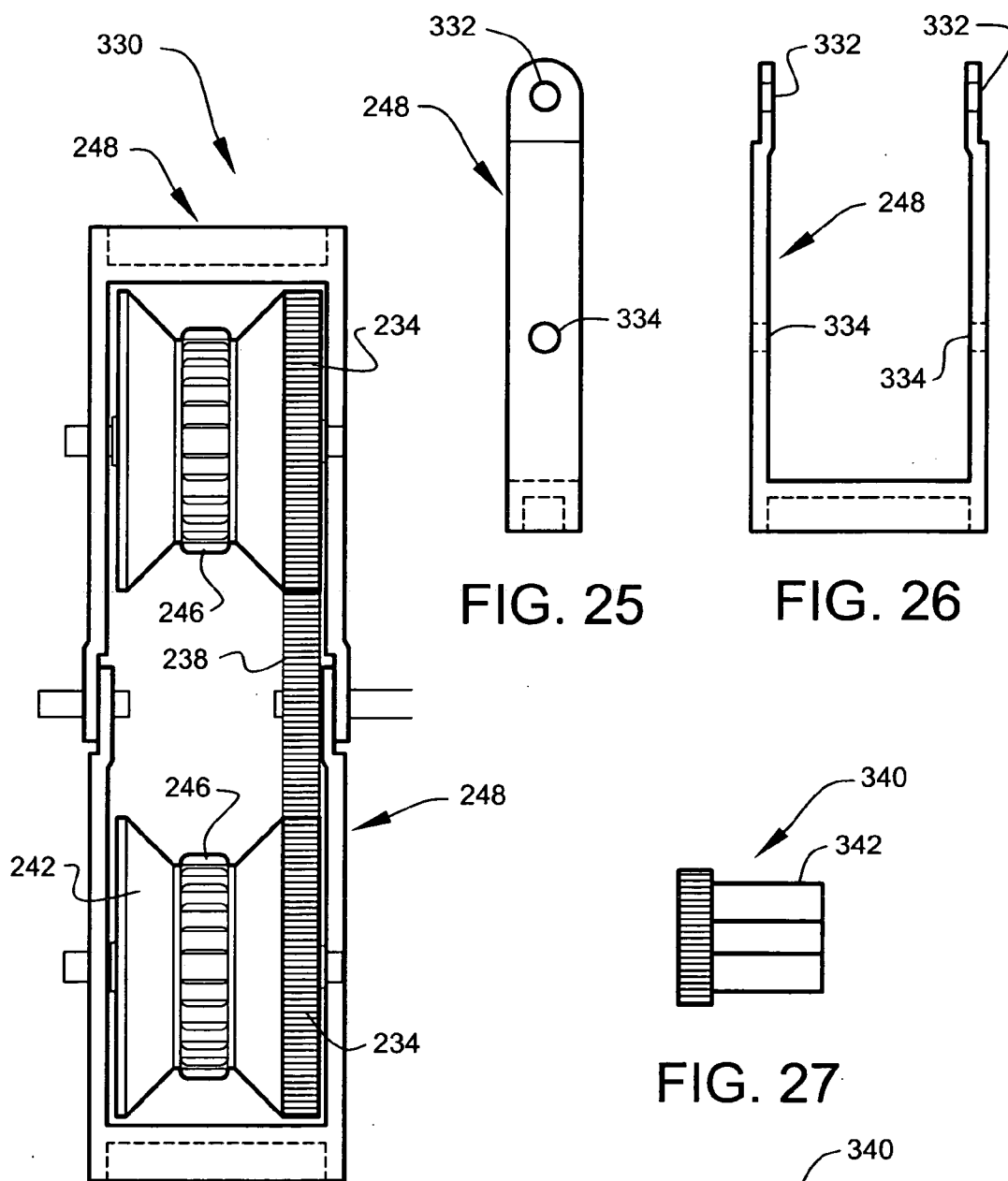


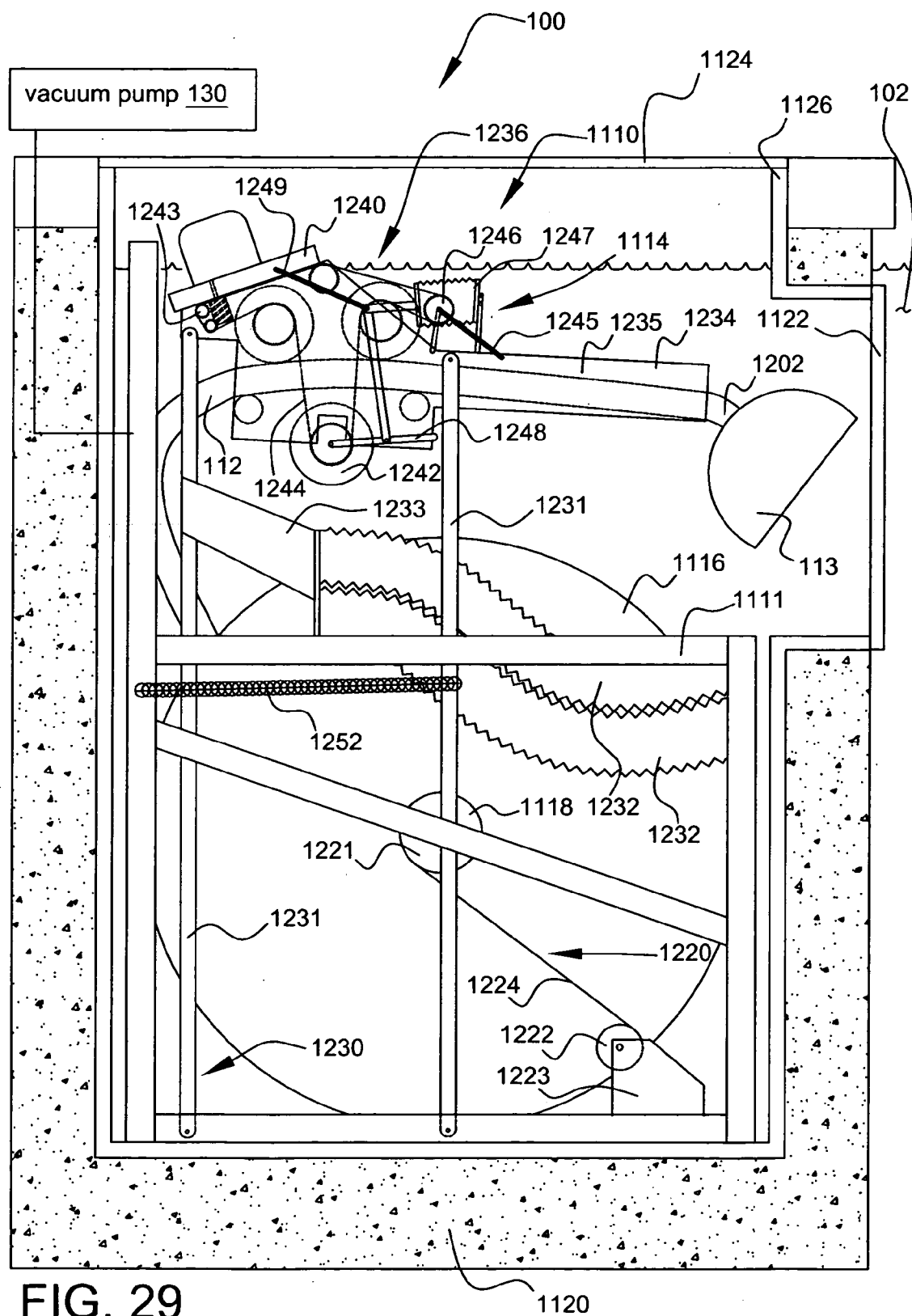
FIG. 24

FIG. 25

FIG. 26

FIG. 27

FIG. 28



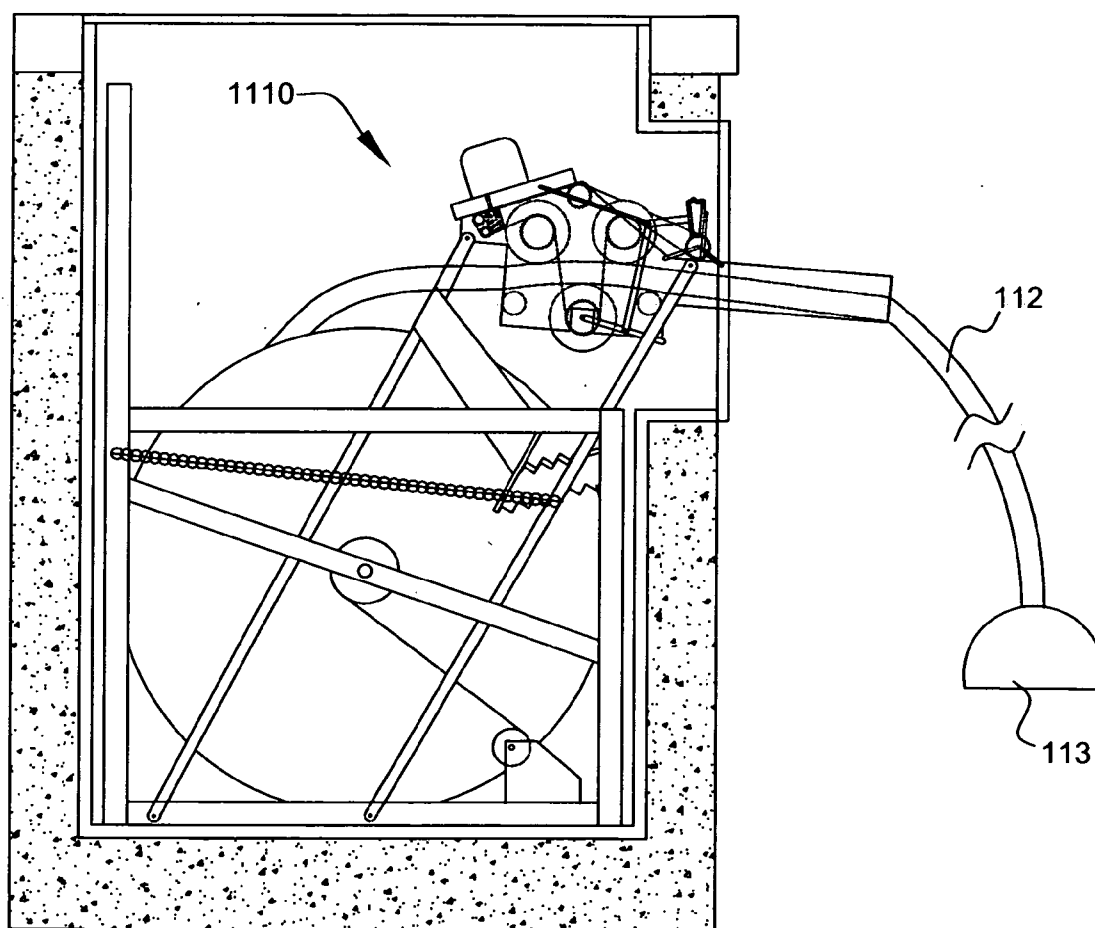


FIG. 30

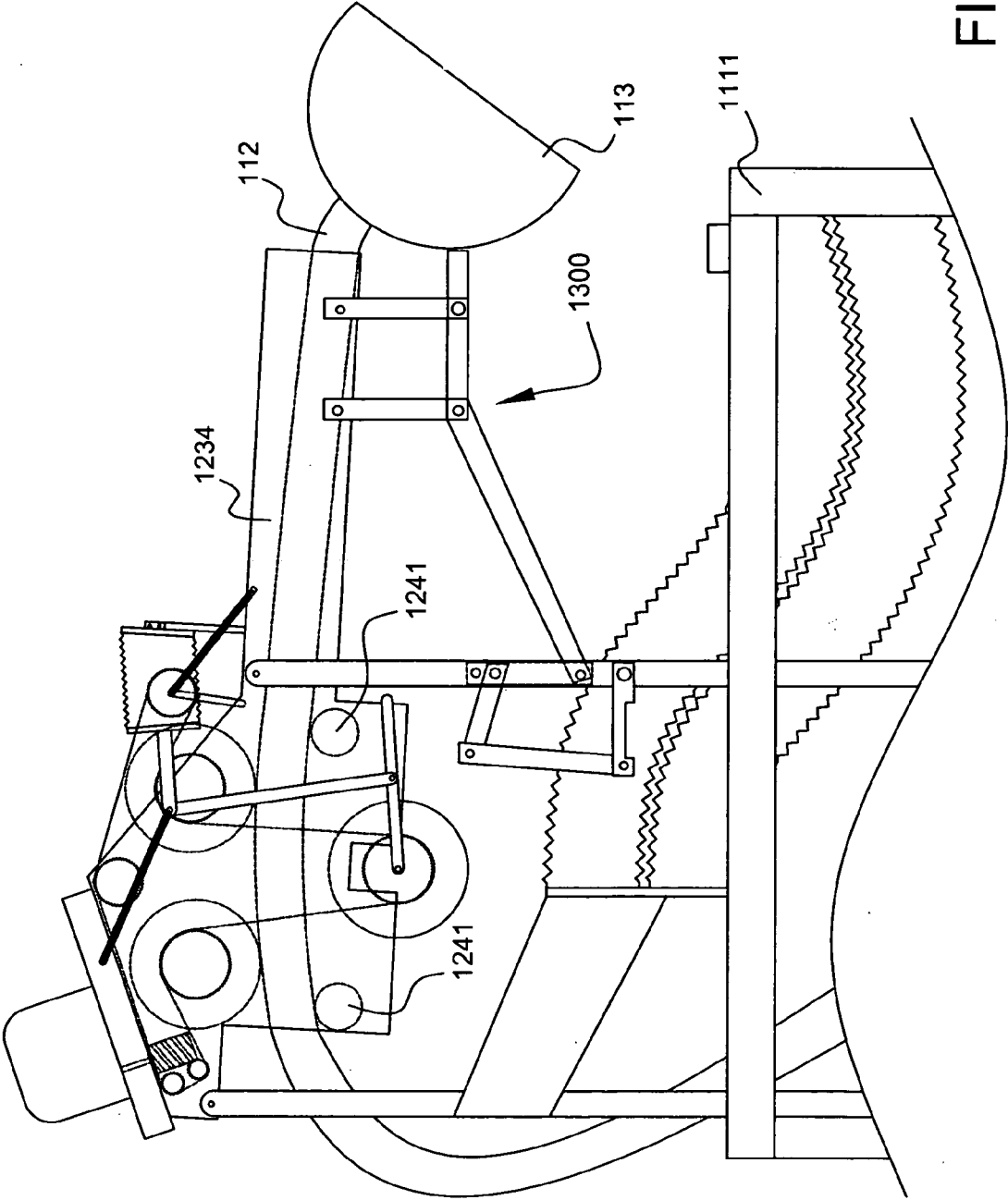


FIG. 31

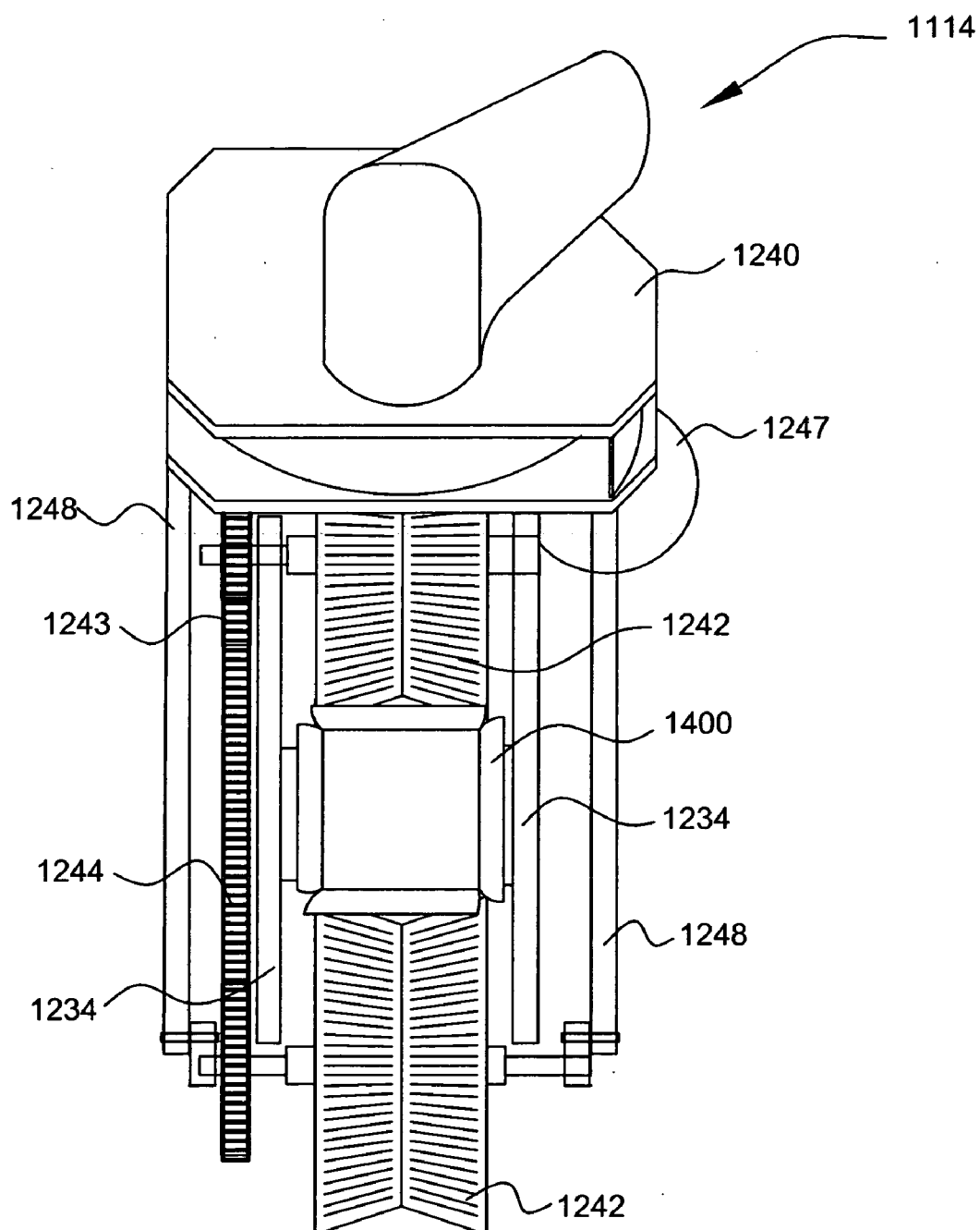


FIG. 32

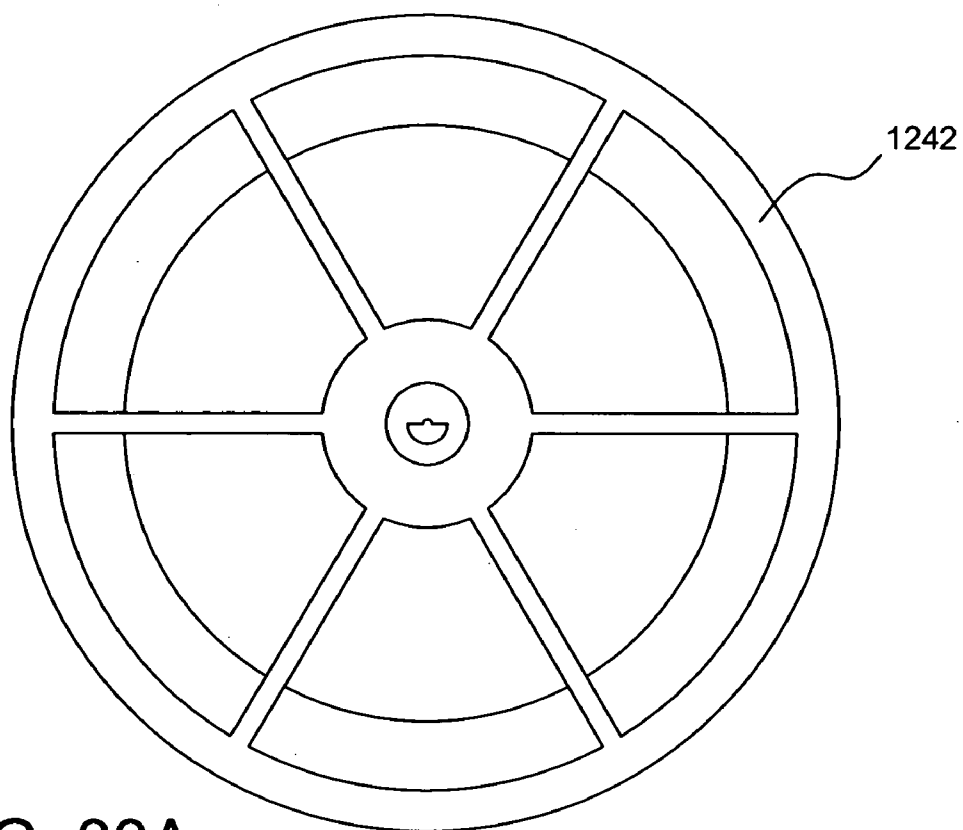


FIG. 33A

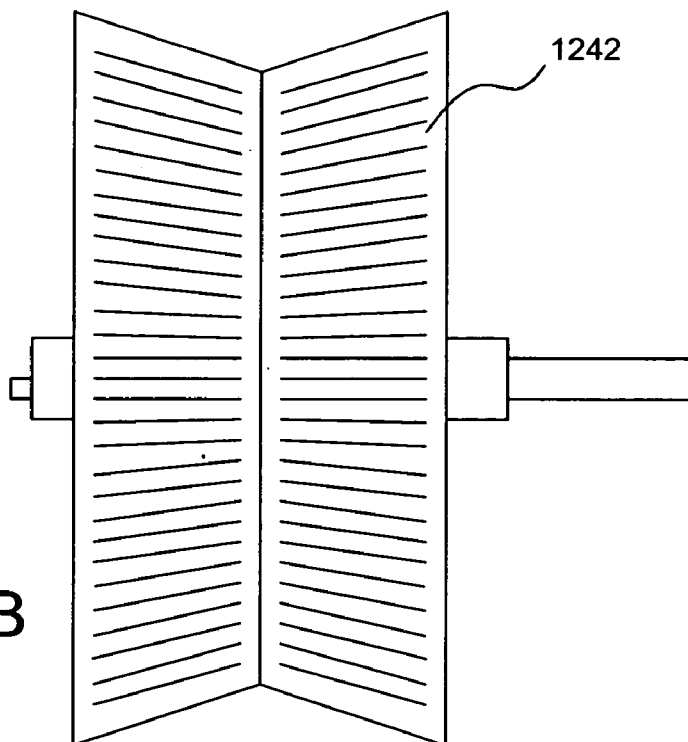


FIG. 33B

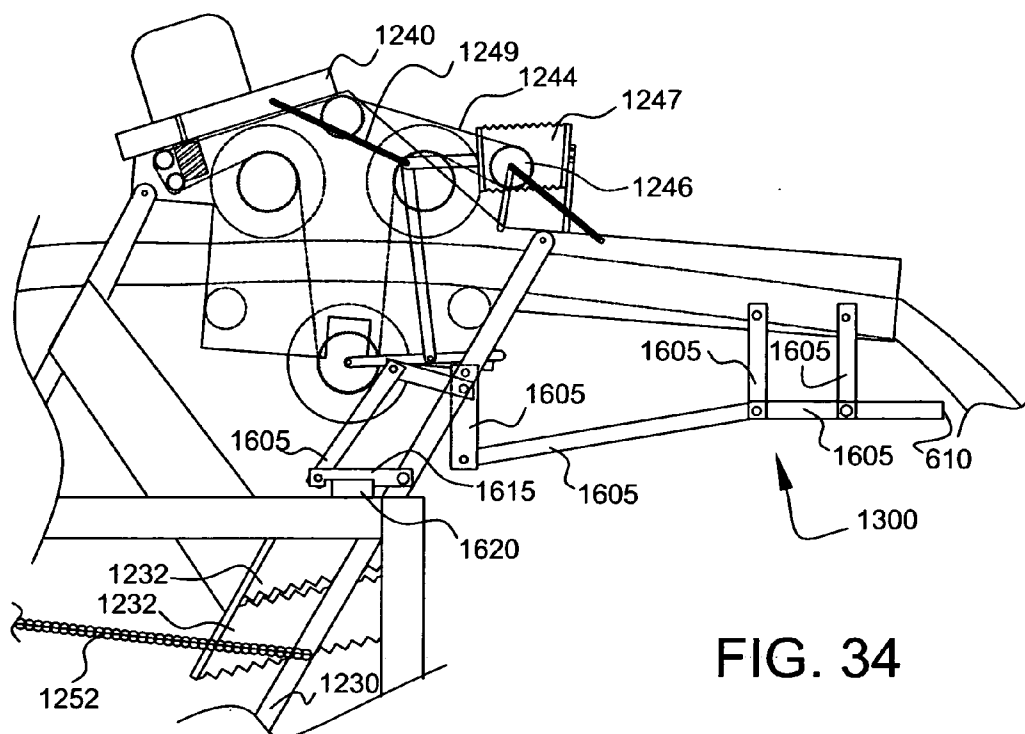


FIG. 34

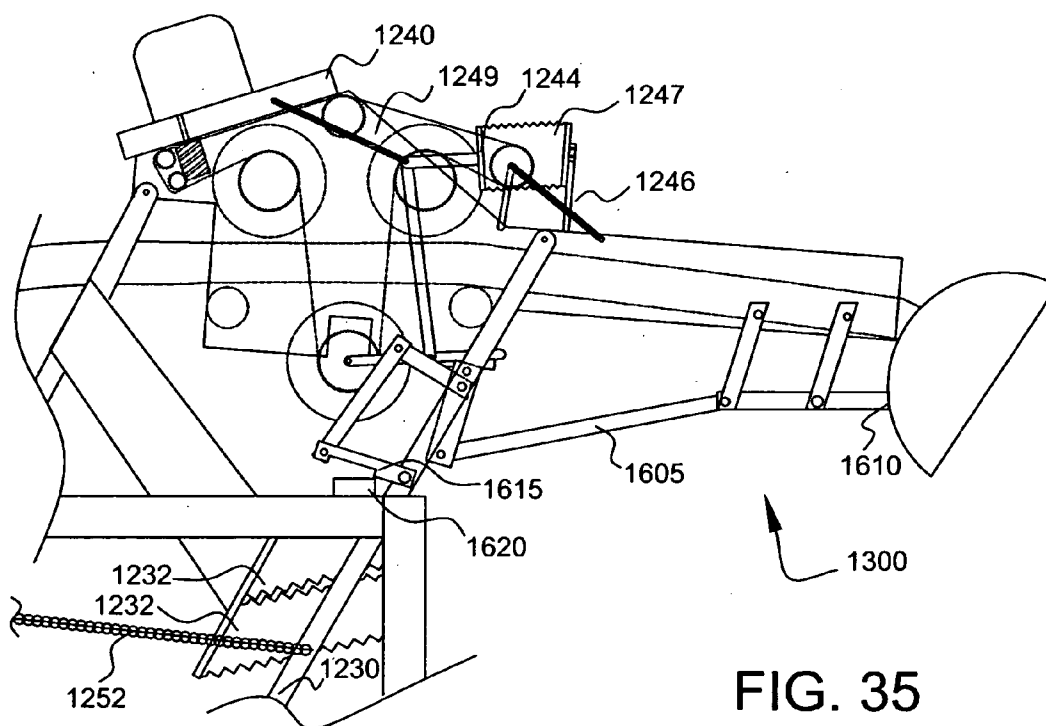
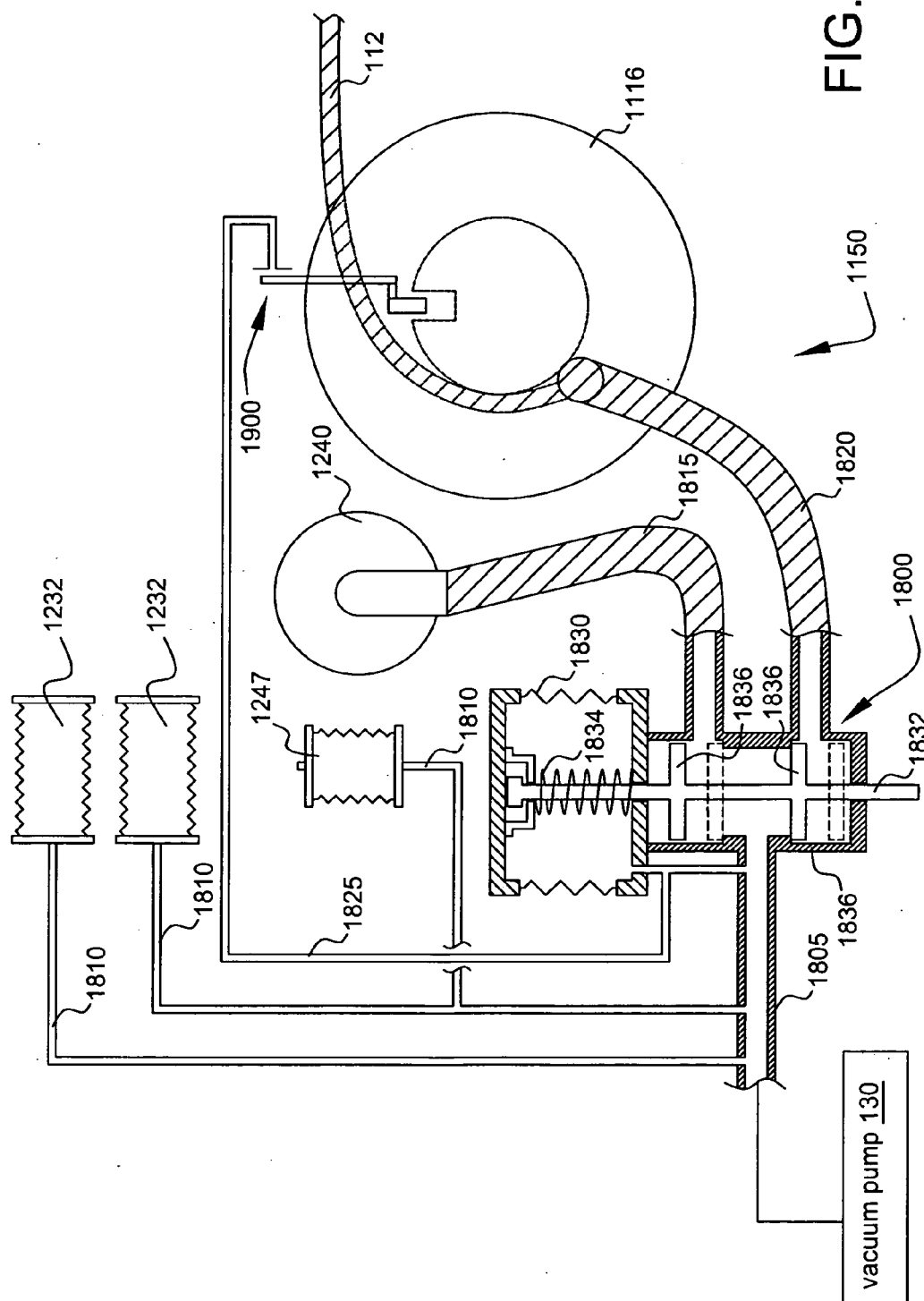
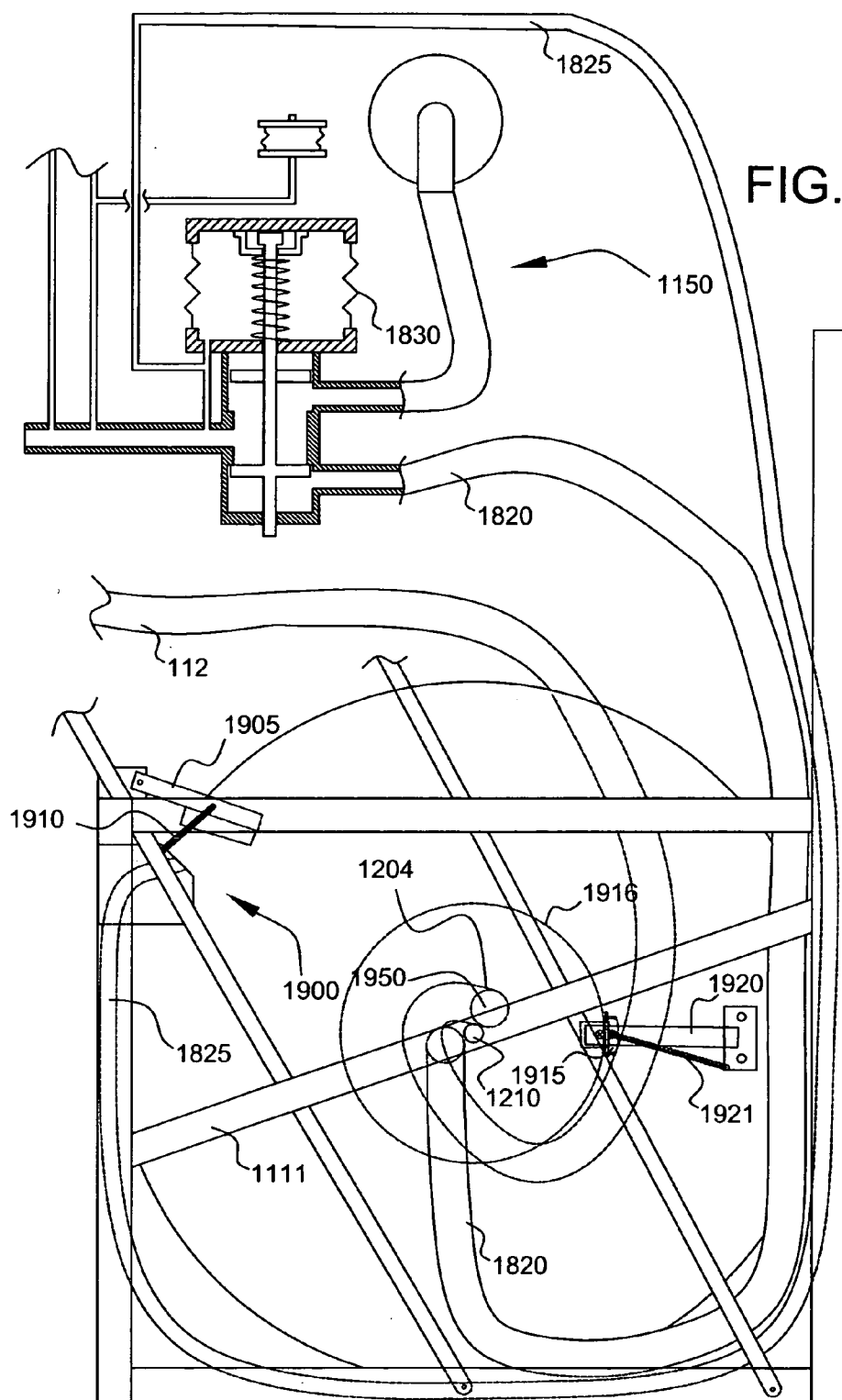
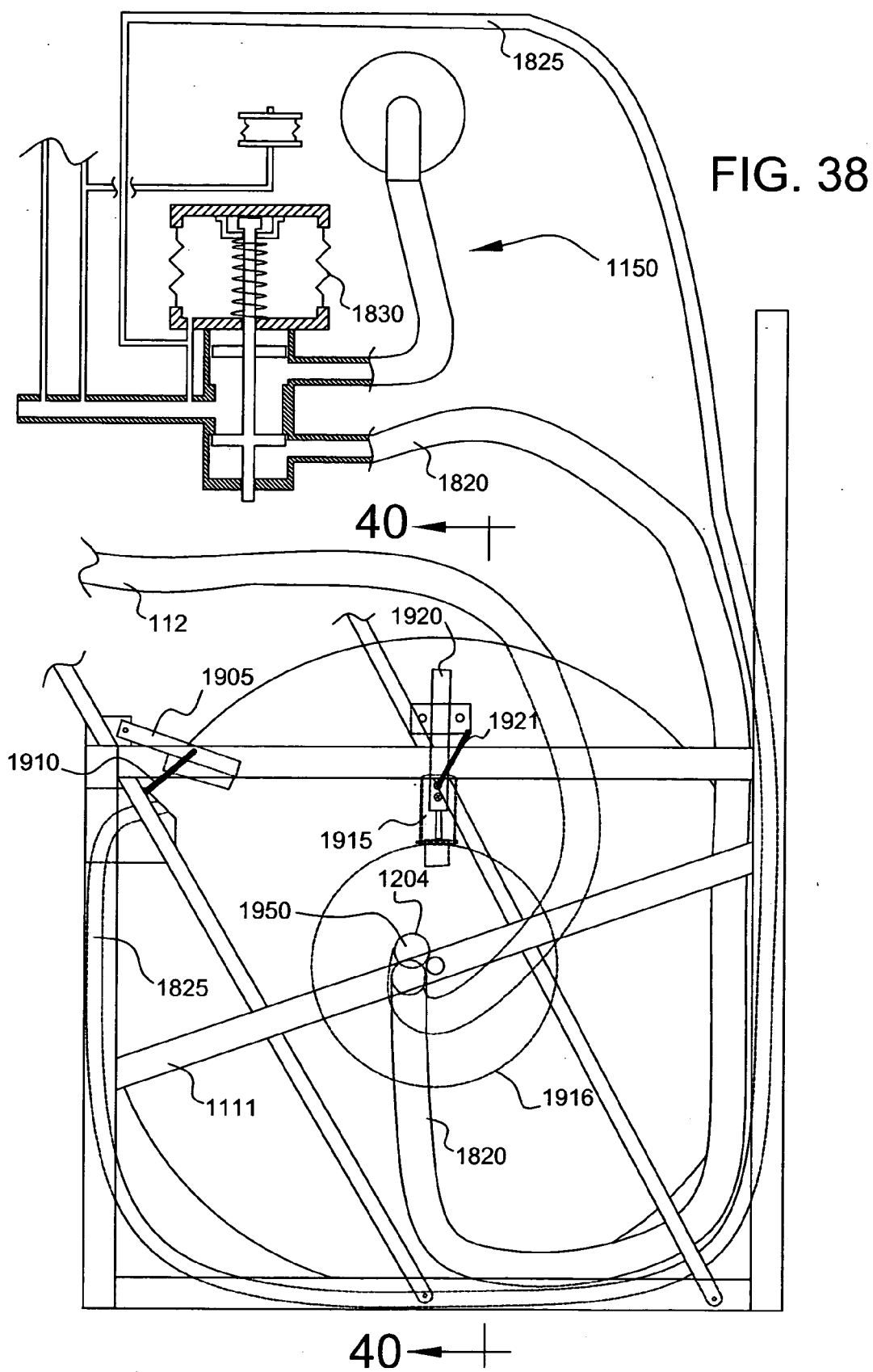
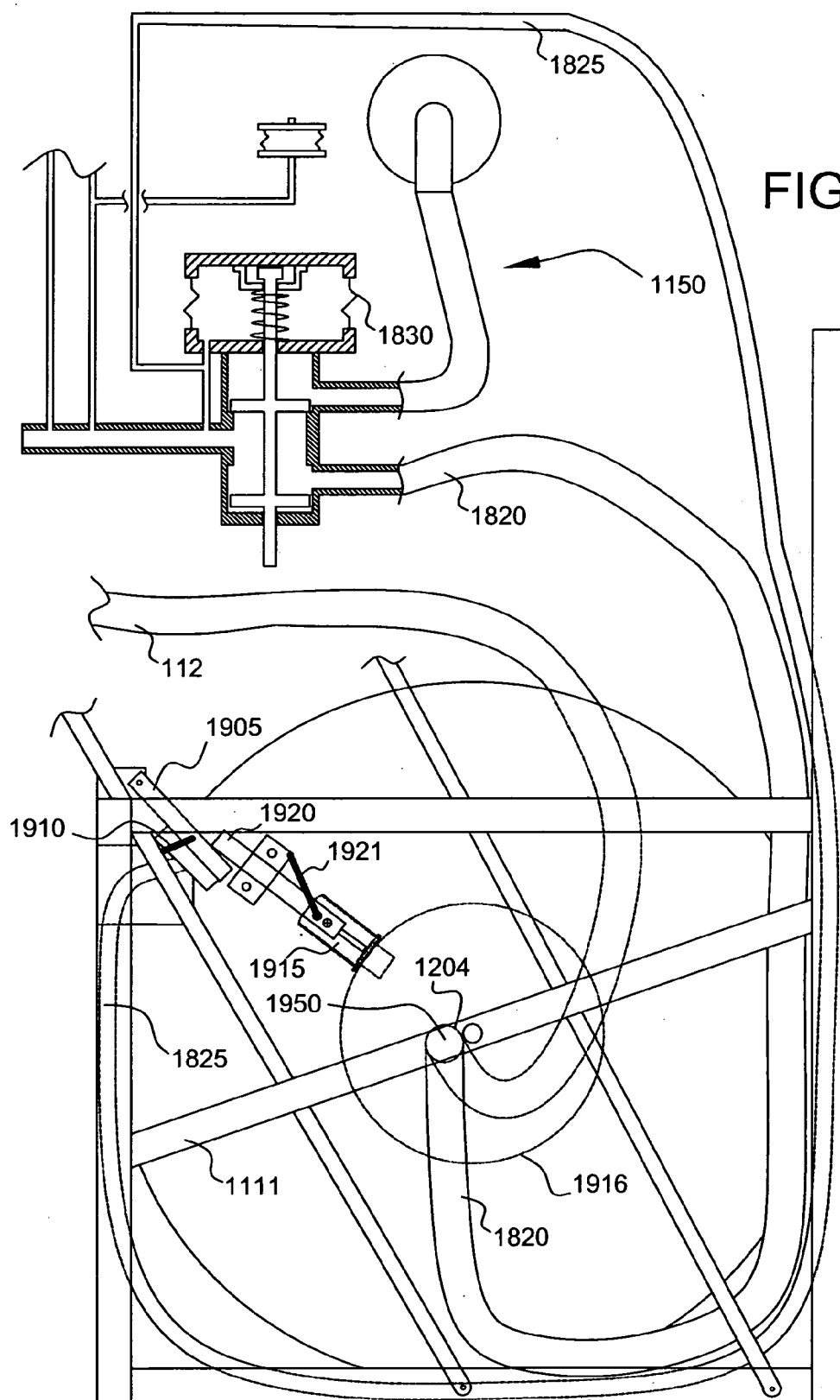


FIG. 35









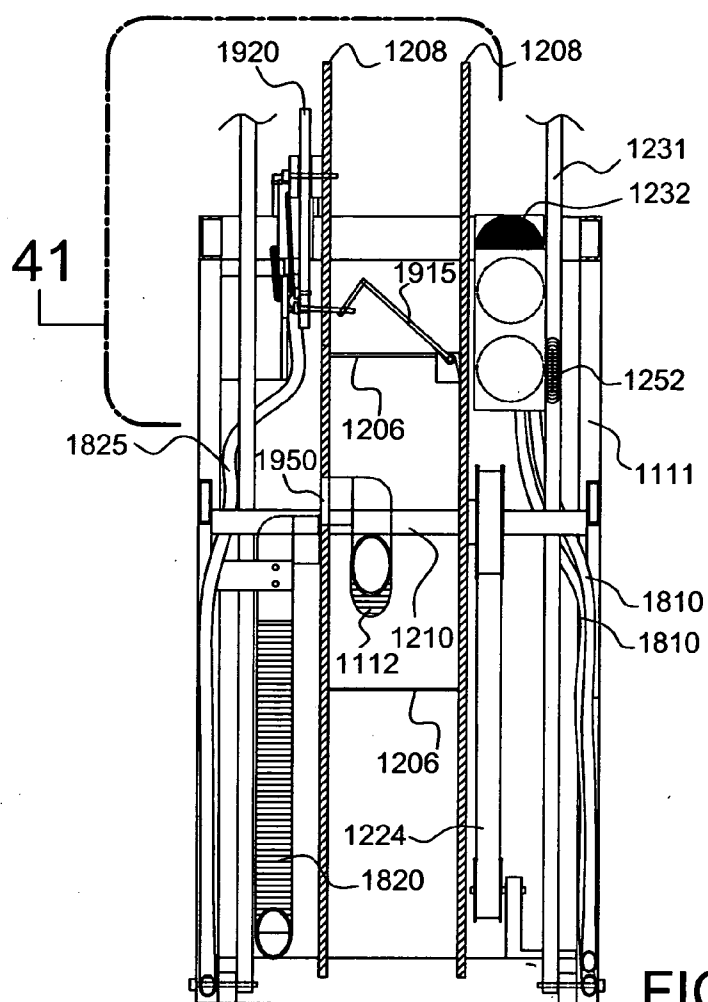


FIG. 40

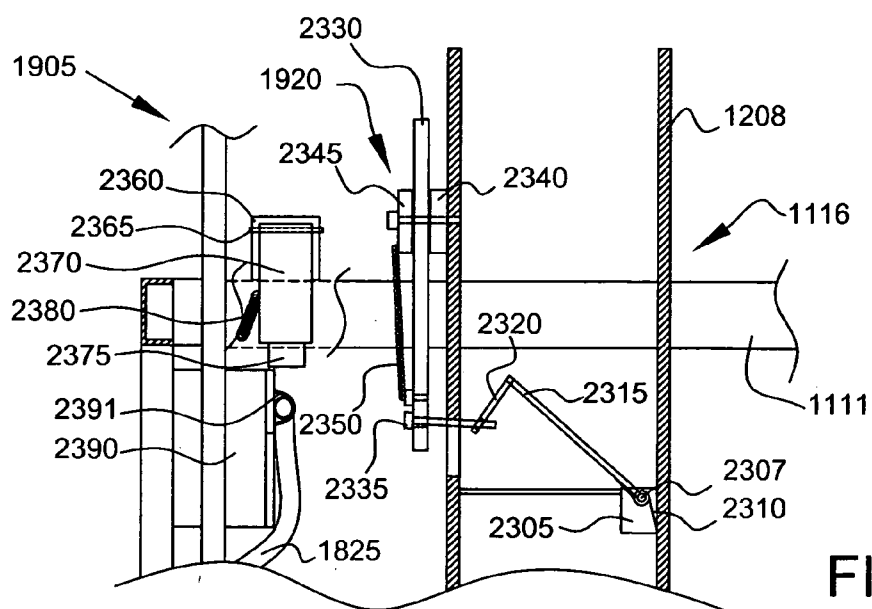


FIG. 41

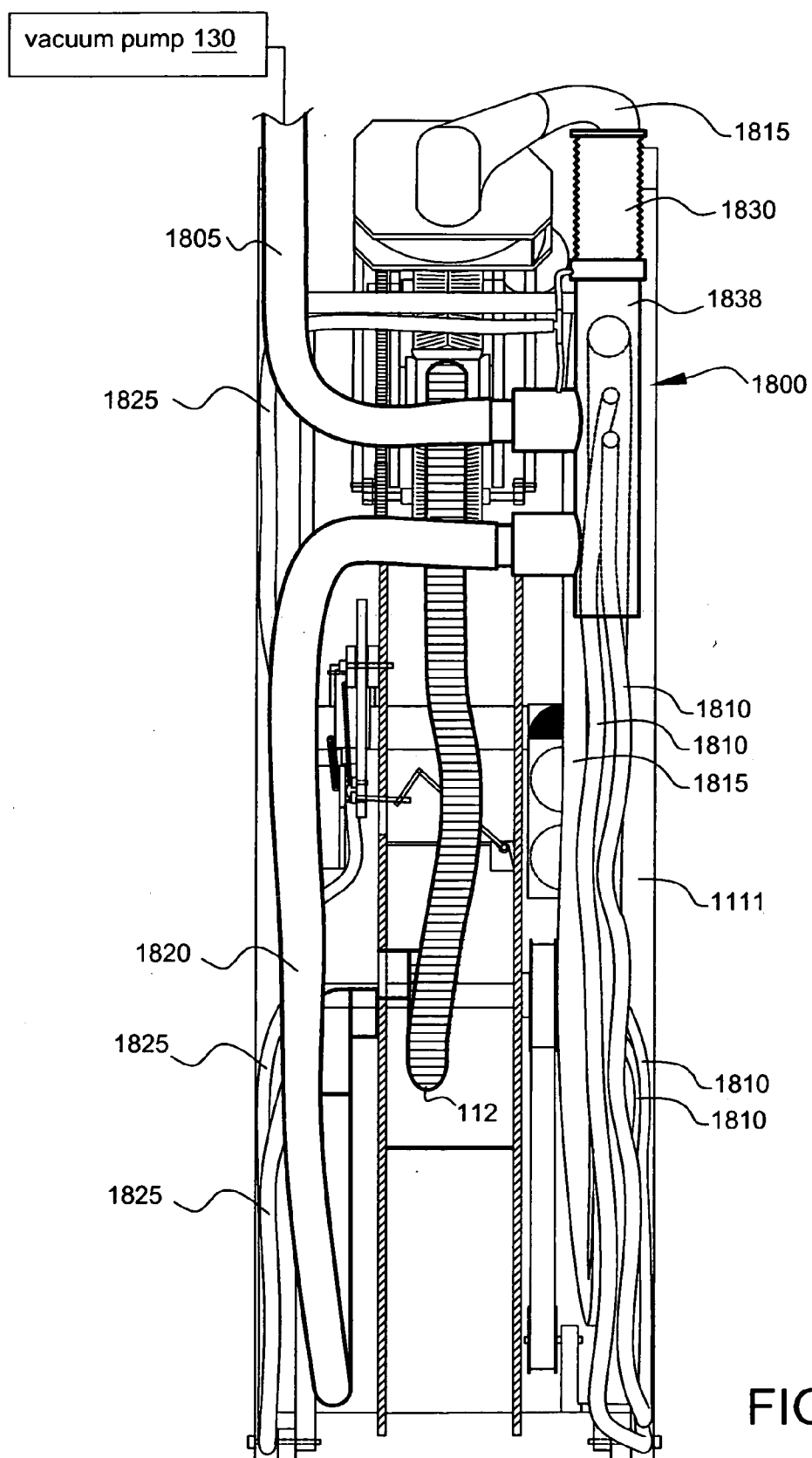


FIG. 42

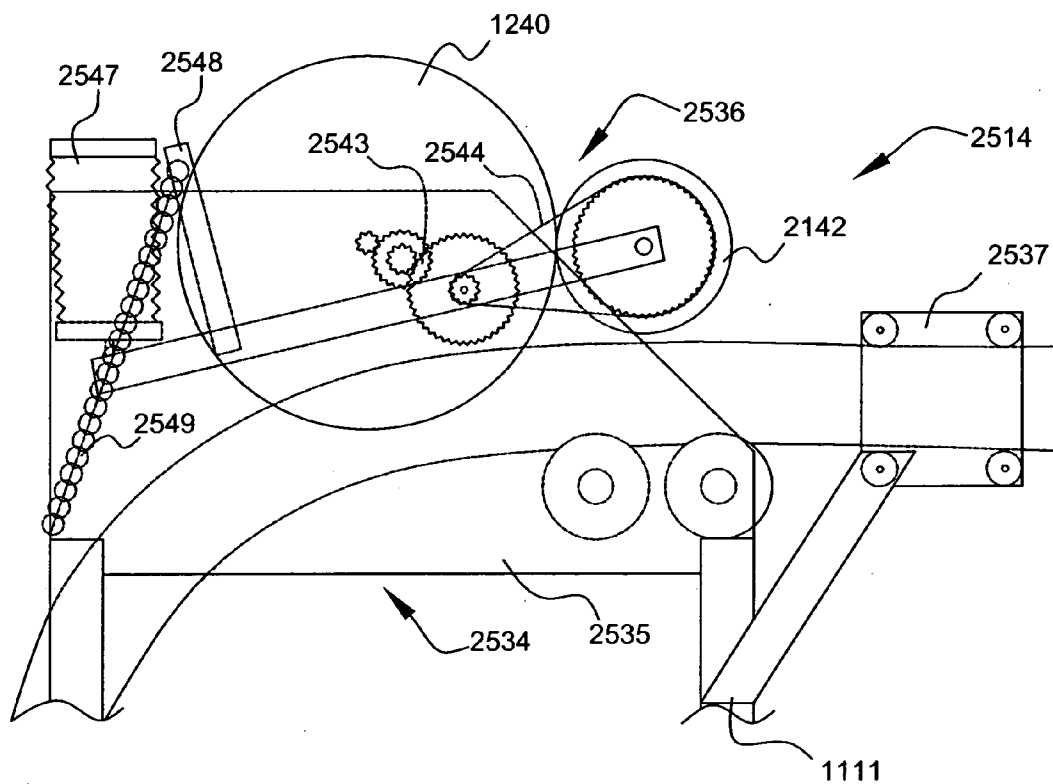


FIG. 43

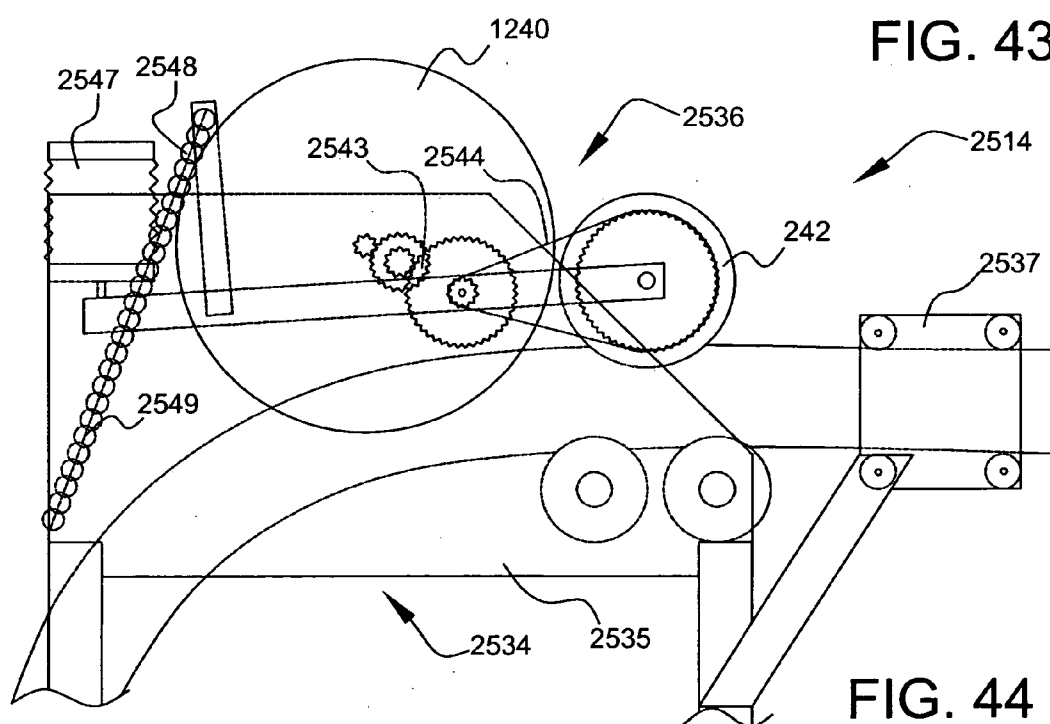


FIG. 44

CONCEALED AUTOMATIC POOL VACUUM SYSTEMS

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] The present application is a continuation-in-part of related application Ser. No. 11/001,557, filed Nov. 30, 2004, entitled "POOL CLEANING SYSTEMS", and is related to and claims priority from prior provisional application Ser. No. 60/528,771 filed Dec. 12, 2003 entitled "SWIMMING POOL VACUUM AND HOSE AUTOMATIC DEPLOYMENT AND RETRIEVAL GARAGE", and is further related to and claims priority from prior provisional application Ser. No. 60/641,607 filed Jan. 6, 2005, entitled "SWIMMING POOL VACUUM HOSE AUTOMATIC DEPLOYMENT AND RETRIEVAL GARAGE WITH SEMI STRAIGHT HOSE STORAGE" the contents of which are incorporated herein by this reference and are not admitted to be prior art with respect to the present invention by the mention in this cross-reference section.

BACKGROUND

[0002] This invention relates to providing pool-cleaning systems. More particularly, this invention relates to providing a system for improved storage and deployment of pool vacuuming components.

[0003] Typically, a random-motion pool vacuum is coupled to a hose that is coupled to the central pool vacuum pump. The pool vacuum pump and hose are placed in the pool, primed for use, and must be removed from the pool and drained of water so that the pool can be used for swimming. This is very labor-intensive and time-consuming.

[0004] In addition, it is highly preferred to store the vacuum hose in an uncoiled rather than a coiled configuration. Storing the hose in an uncoiled configuration improves in-service performance by limiting hose hysteresis, which is the tendency of the hose to retain a coiled shape once deployed. Some manufacturers of pool cleaning heads specifically void the operational warranty of the device if the vacuum hose is stored in a coiled configuration. Currently, uncoiled storage of a vacuum hose is, at best, haphazard, requiring the hose to be stored within the general area of the pool, for example, uncoiled on the surface of the pool deck or nearby landscape area.

[0005] Therefore, a need exists for a system that can deploy a pool vacuum and hose automatically, and retract the pool vacuum and hose automatically. Further, a need exists for a vacuum system that remains continuously primed, preferably storing the hose in an uncoiled or semi-linear configuration.

OBJECTS AND FEATURES OF THE INVENTION

[0006] A primary object and feature of the present invention is to provide pool-cleaning systems to overcome the above-described problems. A further primary object and feature of the present invention is to provide a pool-cleaning system that automatically deploys a pool vacuum, and automatically retracts the pool vacuum.

[0007] It is a further object and feature of the present invention to provide such a system that can be run entirely

on waterpower provided by a connection to the low-pressure side of a pool circulation pump. It is yet another object and feature of the present invention to provide such a system that is stored underwater, to maintain the vacuum hose in a primed (water-filled) state.

[0008] It is another object and feature of the present invention to provide such a system that stores an underwater hose in an uncoiled and substantially linear arrangement. It is yet another object and feature of the present invention to provide such a system having an underwater hose reel as an alternate preferred embodiment.

[0009] It is an additional object and feature of the present invention to provide such a system including methods of cleaning pools.

[0010] A further primary object and feature of the present invention is to provide such a system that is efficient, inexpensive, and handy. Other objects and features of this invention will become apparent with reference to the following descriptions.

SUMMARY OF THE INVENTION

[0011] In accordance with a preferred embodiment hereof, this invention provides a system related to the uncoiled storage of at least one vacuum hose of at least one automatic pool cleaner within at least one pool of water, the at least one vacuum hose comprising at least one first hose end and at least one second hose end, the at least one pool of water comprising at least one low-pressure fluid source, such system comprising: at least one tubular sleeve adapted to removably store at least one substantial portion of the at least one vacuum hose; wherein such at least one tubular sleeve comprises at least one first open end in fluid communication with the at least one pool of water; and wherein such at least one tubular sleeve comprises an aggregate bend of less than three-hundred and sixty degrees.

[0012] Moreover, it provides such a system wherein: such at least one tubular sleeve comprises an aggregate bend of less than one hundred and eighty degrees; and such at least one tubular sleeve comprises no more than two ninety-degree bends. Additionally, it provides such a system wherein: such at least one tubular sleeve comprises at least one second open end; such at least one second open end is positioned above the at least one pool of water; and such at least one second open end comprises at least one removable cover adapted to removably cover such at least one second open end.

[0013] Also, it provides such a system wherein such at least one tubular sleeve comprises at least one plurality of interconnectable segments adapted to provide segmented assembly of such at least one tubular sleeve. In addition, it provides such a system wherein such at least one tubular sleeve is adapted to maintain the at least one substantial portion of the at least one vacuum hose submerged within water from such at least one pool of water. And, it provides such a system further comprising at least one fluid coupler adapted to couple the at least one second hose end of the at least one vacuum hose to the at least one low-pressure fluid source.

[0014] Further, it provides such a system wherein such at least one fluid coupler comprises: at least one vacuum hose end fitting adapted to removably engage the at least one

second hose end of the at least one vacuum hose; and at least one docking receiver adapted to removably receive such at least one vacuum hose end fitting; wherein such at least one at least one docking receiver comprises at least one interior chamber adapted to receive interiorly at least one portion of such at least one vacuum hose end fitting and pass exteriorly the at least one vacuum hose; wherein such at least one vacuum hose end fitting comprises at least one vacuum transfer port adapted to transfer fluid between the at least one vacuum hose and such at least one interior chamber; wherein such at least one interior chamber comprises at least one coupling to the at least one low-pressure fluid source; wherein such at least one interior chamber comprises at least one pressure seal adapted to form at least one pressure seal with such at least one vacuum transfer port; and wherein such at least one pressure seal is adapted to form at least one pressure coupling to couple operationally the at least one vacuum hose with the at least one low-pressure fluid source.

[0015] Even further, it provides such a system further comprising: at least one hose deployer adapted to deploy the at least one first end of the at least one vacuum hose into such at least one pool of water; at least one fluid coupler adapted to couple the at least one second end of the at least one vacuum hose to the at least one low-pressure fluid source; and at least one hose retractor adapted to retract the at least one vacuum hose onto such at least one tubular sleeve; wherein such at least one tubular sleeve is adapted to maintain the at least one substantial portion of the at least one vacuum hose submerged within the water of such at least one pool of water. Moreover, it provides such a system wherein: such at least one hose deployer comprises at least one hydraulic motor adapted to power the deploying of the at least one first hose end of the at least one vacuum hose by such at least one hose deployer; such at least one hydraulic motor is in fluid communication with the at least one low-pressure fluid source; and such at least one hydraulic motor is adapted to operate by directing at least one movement of the water of the at least one pool of water toward the at least one low-pressure fluid source.

[0016] Additionally, it provides such a system further comprising: at least one first housing adapted to house such at least one hose deployer, such at least one fluid coupler, and such at least one hose retractor; and at least one second housing comprising at least one hollow interior adapted to house such at least one first housing; wherein such at least one first housing is removable from such at least one hollow interior of such at least one second housing; and wherein such at least one second housing is prepositionally fixed relative to the at least one pool of water.

[0017] Also, it provides such a system wherein such at least one hollow interior comprises: at least one first passage adapted to provide fluid communication between such at least one hollow interior and the at least one pool of water; and at least one second passage adapted to provide fluid communication between such at least one hollow interior and such at least one tubular sleeve; wherein such at least one first passage comprises at least one door adapted to provide at least one closable and openable barrier between such at least one first passage and the at least one pool of water; and wherein such at least one door is positioned substantially below at least one waterline of such at least one pool of water. In addition, it provides such a system wherein: the at least one low-pressure fluid source comprises at least one

fluid circulation pump adapted to circulate the water of such at least one pool of water; such at least one hose deployer comprises at least one automatic hose deployer adapted to automatically deploy the at least one vacuum hose on activation of the at least one fluid circulation pump; and such at least one hose retractor comprises at least one automatic hose retractor adapted to automatically retract the at least one vacuum hose on deactivation of the at least one fluid circulation pump. And, it provides such a system further comprising at least one automatic switch adapted to automatically switch the coupling of the at least one low-pressure fluid source between such at least one hydraulic motor and such at least one fluid coupler.

[0018] Further, it provides such a system wherein such at least one automatic hose retractor comprises at least one spring tensioner adapted to tension at least one retractor spring during deployment of the at least one vacuum hose by such at least one automatic hose deployer. Even further, it provides such a system, further comprising: at least one hose deployment detector adapted to signal the detection of a completed deployment of the at least one vacuum hose into the at least one pool of water; and at least one spring tension detector adapted to signal the detection of the completed tensioning of such at least one retractor spring by such deployment of the at least one vacuum hose by such at least one automatic hose deployer; wherein such at least one automatic switch is adapted to maintain the coupling of the at least one low-pressure fluid source to such at least one hydraulic motor in the absence of such detection signals from either of such at least one hose deployment detector and such at least one spring tension detector; and wherein such at least one automatic switch is adapted to switch the coupling of the at least one low-pressure fluid source from such at least one hydraulic motor to such at least one fluid coupler in the presence of both such detection signals from such at least one hose deployment detector and such at least one spring tension detector.

[0019] Moreover, it provides such a system wherein such detection signals comprise at least one change in fluid pressure. Additionally, it provides such a system wherein such at least one automatic switch comprises at least one pressure operated actuator adapted to actuate at least one fluid controlling valve. Also, it provides such a system wherein such at least one hose deployer comprises: at least one drive assembly comprising at least one first hose-engaging wheel and at least one second hose-engaging wheel each one adapted to physically engage the at least one vacuum hose; wherein, during such physical engagement, the at least one vacuum hose is movably deployed by rotation of such at least one first hose-engaging wheel and such at least one second hose-engaging wheel by such at least one hydraulic motor; and wherein, during such physical engagement, the at least one vacuum hose is movably retracted by counter-rotation of such at least one first hose-engaging wheel and such at least one second hose-engaging wheel by such at least one spring tensioner.

[0020] In addition, it provides such a system further comprising at least one limited-slip coupler adapted to provide limited-slip decoupling of at least one mechanical force transferred between such at least one hydraulic motor, such at least one spring tensioner, and such at least one drive assembly. And, it provides such a system further comprising such at least one vacuum hose. Further, it provides such a

system further comprising such at least one automatic pool cleaner. Even further, it provides such a system further comprising: at least one water level detector adapted to detect at least one low water level condition within the at least one pool of water; wherein such at least one water level detector comprises at least one automatic retraction initiator adapted to automatically initiate the retraction of the at least one vacuum hose on such detection of such at least one low water level condition within the at least one pool of water. Moreover, it provides such a system wherein such at least one automatic retraction initiator comprises at least one manual actuator adapted to provide manual actuation of such at least one automatic retraction initiator.

[0021] In accordance with another preferred embodiment hereof, this invention provides a pool cleaning system, comprising the steps of: coupling at least one submerged tubular sleeve to at least one body of water; placing at least one vacuum hose onto such at least one submerged tubular sleeve; deploying such at least one vacuum hose from such at least one submerged tubular sleeve into such at least one body of water; and coupling such at least one vacuum hose to at least one vacuum source. Additionally, it provides such a pool cleaning system, wherein the step of deploying such at least one vacuum hose from such at least one submerged tubular sleeve into such at least one body of water further comprises the step of using at least one hydraulic motor to induce such deployment. Also, it provides such a pool cleaning system, further comprising the step of retracting such at least one vacuum hose from such at least one body of water into such at least one submerged tubular sleeve. In addition, it provides such a cleaning system, wherein such the step of retracting such at least one vacuum hose from such at least one body of water into such at least one submerged tubular sleeve further comprises the step of using at least one spring to induce such retraction. And, it provides such a cleaning system, further comprising the step of pulling at least one flow of water through such at least one vacuum hose.

[0022] In accordance with another preferred embodiment hereof, this invention provides a cleaning system, relating to the cleaning of at least one pool of water by at least one automatic vacuum, the at least one pool of water having at least one waterline, such system comprising: at least one vacuum hose having at least one first end and at least one second end; at least one vacuum pump, wherein such at least one vacuum pump is operationally coupled to such at least one second end of such at least one vacuum hose; at least one hose reel adapted to reel such at least one vacuum hose; at least one hose deployer adapted to deploy such at least one first end of such at least one vacuum hose into such at least one pool of water; and at least one hose retractor adapted to retract such at least one vacuum hose onto such at least one hose reel; wherein such at least one vacuum hose is adapted to remain continuously full of water when retracted onto such at least one hose reel; wherein such at least one hose deployer comprises at least one hydraulic actuator; and such at least one hydraulic actuator actuates by vacuum fluid pressure.

[0023] Further, it provides such a cleaning system further comprising: at least one housing adapted to house such at least one vacuum hose, on such at least one hose reel, below such at least one waterline of such at least one pool of water; wherein such at least one housing comprises at least one

door adapted to provide at least one exit from such at least one housing into such at least one pool of water; and wherein such at least one door is located substantially below such at least one waterline of such at least one pool of water. Even further, it provides such a cleaning system wherein: such at least one vacuum hose further comprises at least one vacuum cleaner; and such at least one vacuum cleaner is operationally coupled to such at least one first end of such at least one vacuum hose; and such at least one vacuum hose and such at least one vacuum cleaner are positioned entirely within such at least one housing when such at least one vacuum hose is retracted for storage.

[0024] Moreover, it provides such a cleaning system wherein: such at least one hose deployer comprises at least one automatic hose deployer adapted to automatically deploy such at least one vacuum hose when such at least one vacuum pump is activated; and such at least one hose retractor comprises at least one automatic hose retractor adapted to automatically retract such at least one vacuum hose when such at least one vacuum pump is deactivated. Additionally, it provides such a cleaning system wherein such at least one hose deployer is powered by such at least one vacuum pump. Also, it provides such a cleaning system further comprising at least one automatic switch adapted to automatically switch such at least one vacuum pump from powering such at least one hose deployer to pulling water through such at least one vacuum hose after such at least one hose deployer deploys such at least one vacuum hose.

[0025] In addition, it provides such a cleaning system further comprising at least one hydraulic motor adapted to at least one rotational force from water moved by such at least one vacuum pump. And, it provides such a cleaning system wherein such at least one hose deployer is powered by such at least one hydraulic motor. Further, it provides such a cleaning system wherein such at least one hose retractor comprises at least one spring adapted to wind such at least one hose reel. Even further, it provides such a cleaning system wherein such at least one hose deployer comprises at least one articulated carrier adapted to carry such at least one hose deployer from at least one retracted position to at least one deployed position and from at least one deployed position to at least one retracted position.

[0026] Moreover, it provides such a cleaning system further comprising at least one retraction detector adapted to detect the complete retraction of such at least one vacuum hose onto such at least one reel. Additionally, it provides such a cleaning system further comprising at least one deployment detector adapted to detect the finished deployment of such at least one vacuum hose from such at least one reel. Also, it provides such a cleaning system wherein such at least one hose deployer is powered by such at least one vacuum pump prior to such at least one deployment detector detecting the finished deployment of such at least one vacuum hose from such at least one reel. In addition, it provides such a cleaning system wherein such at least one vacuum pump pulls water through such at least one vacuum hose after such at least one deployment detector detects the finished deployment of such at least one vacuum hose from such at least one reel.

[0027] And, it provides such a cleaning system further comprising at least one automatic switch adapted to automatically switch such at least one vacuum pump from

powering such at least one hose deployer to pulling water through such at least one vacuum hose after such at least one deployment detector detects the finished deployment of such at least one vacuum hose from such at least one reel. Further, it provides such a cleaning system wherein such at least one automatic switch comprises at least one hydraulic actuator. Even further, it provides such a cleaning system wherein such at least one deployment detector comprises: at least one spring-loaded lever adapted to provide at least one spring-loaded lever on the interior of such at least one hose reel wherein such at least one spring-loaded lever is compressed when such at least one vacuum hose presses such at least one spring-loaded lever; and wherein such at least one spring-loaded lever is released when such at least one vacuum hose is removed from such at least one spring-loaded lever; at least one spring-loaded bar adapted to provide at least one spring-loaded bar on the exterior of such at least one hose reel wherein such at least one spring-loaded bar is pulled into at least one retracted position when such at least one spring-loaded lever is compressed; and wherein such at least one spring-loaded bar means is released into at least one extended position when such at least one spring-loaded lever is released; at least one spring-loaded switch wherein such at least one spring-loaded switch is open when such at least one spring-loaded bar is pulled into such at least one retracted position; and wherein such at least one spring-loaded switch is closed when such at least one spring-loaded bar is released into such at least one extended position and contacts such at least one spring-loaded switch.

[0028] Even further, it provides such a cleaning system wherein such at least one hose deployer comprises: at least one hydraulic motor; wherein such at least one hydraulic motor is powered by such at least one vacuum pump; at least one hose-guiding wheel adapted to guide such at least one vacuum hose; at least one hose-moving wheel adapted to move such at least one vacuum hose; at least one wheel compressor adapted to compress such at least one vacuum hose between such at least one hose-guiding wheel and such at least one hose-moving wheel; wherein such at least one wheel compressor is actuated by such at least one vacuum pump; and at least one drive adapted to drive such at least one hose-moving wheel off of such at least one hydraulic motor; whereby, when such at least one vacuum pump is turned on, such at least one vacuum hose is laterally compressed and is rolled longitudinally between such at least one hose-guiding wheel and such at least one hose-moving wheel. Even further, it provides such a cleaning system wherein: such at least one drive comprises at least one drive chain; and at least one drive tensioner adapted to provide consistent tension to such at least one drive chain. Even further, it provides such a cleaning system wherein such at least one hose-guiding wheel comprises such at least one hose-moving wheel.

[0029] In accordance with another preferred embodiment hereof, this invention provides a system, comprising: at least one vacuum pump; at least one hydraulic motor; wherein such at least one hydraulic motor is powered by such at least one vacuum pump; at least one hose-guiding wheel adapted to guide at least one hose; at least one hose-moving wheel adapted to move such at least one hose; at least one wheel tensioner adapted to tension such at least one hose between such at least one hose-guiding wheel and such at least one hose-moving wheel; wherein such at least one wheel tensioner is tensioned by such at least one vacuum pump; and

at least one drive adapted to drive such at least one hose-moving wheel off of such at least one hydraulic motor; whereby, when such at least one vacuum pump is turned on, such at least one hose is laterally compressed and is rolled longitudinally between such at least one hose-guiding wheel and such at least one hose-moving wheel.

[0030] In accordance with another preferred embodiment hereof, this invention provides a cleaning system, comprising the steps of: storing at least one hose reel in at least one body of water; reeling at least one hose onto such at least one hose reel in such at least one body of water; storing such at least one hose reel having such at least one hose in such at least one body of water; and unreeling such at least one hose off of such at least one hose reel in such at least one body of water; wherein such at least one hose is kept constantly filled with water; wherein the step of unreeling such at least one hose off of such at least one hose reel in such at least one body of water further comprises the step of using at least one hydraulic motor to unreel such at least one hose off of such at least one hose reel in such at least one body of water; wherein the step of using at least one hydraulic motor to unreel such at least one hose off of such at least one hose reel in such at least one body of water further comprises the step of using at least one vacuum pump to pull water through such at least one hydraulic motor; switching such at least one vacuum pump from pulling water through such at least one hydraulic motor to pulling water through such at least one vacuum hose after such at least one vacuum hose is unreeled from such at least one reel; wherein such step of automatically switching further comprises the step of actuating at least one hydraulic actuator; wherein such step of reeling such at least one hose on to such at least one hose reel in such at least one body of water further comprises the step of using at least one spring to reel such at least one hose on to such at least one hose reel in such at least one body of water; and pulling at least one flow of water through such at least one hose.

BRIEF DESCRIPTION OF THE DRAWINGS

[0031] FIG. 1 shows a side view, in partial section, of an automatic vacuum assembly of a pool-cleaning system, retracted into a pool-wall housing, according to a preferred embodiment of the present invention.

[0032] FIG. 2 shows a plan view of a swimming pool incorporating the pool-cleaning system of FIG. 1.

[0033] FIG. 3 shows a side view, in partial section, of an automatic vacuum assembly of FIG. 1.

[0034] FIG. 4 shows a side view of a control assembly, hose guide, and vacuum head of the automatic vacuum assembly of FIG. 1.

[0035] FIG. 5 shows an end view of the control assembly of FIG. 1.

[0036] FIG. 6 shows a top view of the control assembly of FIG. 1.

[0037] FIG. 7 shows a top view of a hydraulic drive turbine of the control assembly according to the preferred embodiment of FIG. 1.

[0038] FIG. 8 shows a side view of a turbine housing of the hydraulic drive turbine of FIG. 7.

[0039] FIG. 9 shows a front view of a turbine impeller of the hydraulic drive turbine of FIG. 7.

[0040] FIG. 10 shows a top view of the turbine impeller of FIG. 9.

[0041] FIG. 11 shows an end view diagrammatically illustrating the drive gearing of the control assembly of FIG. 1.

[0042] FIG. 12 shows a side view of a drive wheel of the control assembly of FIG. 1.

[0043] FIG. 13 shows a side view diagrammatically illustrating the drive gearing of the control assembly of FIG. 1.

[0044] FIG. 14 shows a diagram illustrating the detection and control components of the control assembly of FIG. 1.

[0045] FIG. 15 shows a side view of a vacuum hose end fitting according to the preferred embodiment of FIG. 1.

[0046] FIG. 16 shows an end view of the vacuum hose end fitting of FIG. 15.

[0047] FIG. 17 shows the sectional view 17-17 of FIG. 16.

[0048] FIG. 18 shows a partial sectional view illustrating the vacuum hose end hose fitting of FIG. 15 adjacent a vacuum hose docking assembly according to the preferred embodiment of FIG. 1.

[0049] FIG. 19 shows a partial sectional view illustrating the vacuum hose end hose fitting of FIG. 15 engaging the vacuum hose docking assembly of FIG. 18.

[0050] FIG. 20 shows a perspective view illustrating vacuum hose docking assembly of FIG. 18.

[0051] FIG. 21 shows a sectional view of the control valve assembly of FIG. 14.

[0052] FIG. 22 shows the section 22-22 of FIG. 21.

[0053] FIG. 23 shows the section 23-23 of FIG. 21.

[0054] FIG. 24 shows a top view of an articulated drive wheel assembly of the control assembly of FIG. 1.

[0055] FIG. 25 shows a side view of an armature of the articulated drive wheel assembly of FIG. 24.

[0056] FIG. 26 shows a top view of the armature of the articulated drive wheel assembly of FIG. 24.

[0057] FIG. 27 shows a side view of an alternate drive gear embodiment according to a preferred embodiment of the present invention.

[0058] FIG. 28 shows an end view of the alternate drive gear embodiment of FIG. 27.

[0059] FIG. 29 shows a side view of a pool-cleaning system, retracted into its pool-wall housing, according to a preferred embodiment of the present invention.

[0060] FIG. 30 shows a side view of the automatic vacuum assembly according to FIG. 29, in a deployed position.

[0061] FIG. 31 shows a detail of the upper portion of the automatic vacuum assembly of FIG. 29.

[0062] FIG. 32 shows a rear view of the deployer of FIG. 29.

[0063] FIG. 33A shows a side view of a drive wheel of FIG. 29.

[0064] FIG. 33B shows an edge view of the drive wheel of FIG. 33A.

[0065] FIG. 34 shows a detail of the upper portion of the automatic vacuum assembly according to FIG. 29, detailing the retraction sensor in a latched position.

[0066] FIG. 35 shows a detail of the upper portion of the automatic vacuum assembly according to FIG. 29, detailing the retraction sensor in an unlatched position.

[0067] FIG. 36 shows a simplified diagram of a hydraulic system according to a preferred embodiment of the present invention.

[0068] FIG. 37 shows a diagram of the state of the hydraulic system during vacuum hose deployment, with the hose deployment sensor lever depressed.

[0069] FIG. 38 shows a diagram of the state of the hydraulic system during vacuum hose deployment, with the hose deployment sensor lever released.

[0070] FIG. 39 shows a diagram of the state of the hydraulic system during vacuuming.

[0071] FIG. 40 shows a cross-section through section 40-40 of FIG. 38.

[0072] FIG. 41 shows an enlarged portion of FIG. 40, with the reel moved aside to show the workings of the hose deployment sensor.

[0073] FIG. 42 shows a rear view of the embodiment according to FIG. 29.

[0074] FIG. 43 shows a side view of a deployer according to another preferred embodiment of the present invention, in a non-deploying state.

[0075] FIG. 44 shows a side view of the deployer according to FIG. 43, in a deploying state.

DETAILED DESCRIPTION OF THE BEST MODES AND PREFERRED EMBODIMENTS OF THE INVENTION

[0076] FIG. 1 shows a side view, in partial section, of automatic vacuum assembly 110 of pool-cleaning system 100, retracted into pool-wall housing 120, according to a preferred embodiment of the present invention. FIG. 2 shows a plan view of a water-filled swimming pool 102 incorporating pool-cleaning system 100 of FIG. 1.

[0077] In the following specification, the terms “suction” and “vacuum” are used interchangeably to define conditions of decreased fluid pressure within the fluid (water) transporting interstices of pool-cleaning system 100 (generally associated with plumbing assemblies on the “suction side” (low-pressure side) of a water circulation pump). In the present disclosure, “suction side” refers to the pipes and fittings that draw water out of swimming pool 102 to be filtered.

[0078] Preferably, pool-cleaning system 100 comprises an automatic vacuum-cleaning system that automatically deploys swimming pool vacuum hose 112 with an attached pool vacuum head 113, to clean the interior of the pool of

debris, and automatically retracts pool vacuum head 113 after sufficient cleaning has taking place.

[0079] Automatic vacuum assembly 110 is preferably organized around three principal components comprising housing 120, which is preferably installed in the side of swimming pool 102 at the time of pool construction, control assembly 108, which is placed in main housing 120 by the user, and a long storage tube 111 (connected to main housing 120) that is preferably used to store the swimming pool vacuum hose 112 when it is not in use.

[0080] Preferably, pool-cleaning system 100 operates utilizing fluid pressure generated by the circulation of water within the plumbing/filter system of swimming pool 102. Preferably, pool-cleaning system 100 operates by utilizing the force of moving water generated by a coupling to the suction side of the plumbing/filter system of swimming pool 102. The device most often used in pool plumbing/filter systems to circulate water within swimming pools is an electrically driven pump, identified herein as circulation pump 130, as shown (and embodying herein wherein the at least one low-pressure fluid source comprises at least one fluid circulation pump adapted to circulate the water of such at least one pool of water). It should be noted that in the diagrammatic illustration of FIG. 2, a residential size pool having a single circulation pump 130 is shown, however, larger pools, such as competition pools, municipal pools, etc., may comprise multiple pumps and/or multiple automatic vacuum assemblies 110.

[0081] Automatic vacuum assembly 110 is shown in FIG. 1 in a retracted (stored state) where the operational components of automatic vacuum assembly 110 are contained substantially within main housing 120 and storage tube 111 as shown. Preferably, the operational components of automatic vacuum assembly 110 are contained substantially within housing 120 when circulation pump 130 is off, as shown, and automatically deploy into pool 102 through door 122 when circulation pump 130 is operating. Upon reading the teachings of this specification, those with ordinary skill in the art will now understand that, under appropriate circumstances, considering such issues as advances in technology, user preference, etc., other automatic vacuum assembly components, such as timers, sensors, remote controls, chemical addition systems, etc., may suffice.

[0082] Preferably, housing 120 (at least embodying herein at least one second housing comprising at least one hollow interior adapted to house such at least one first housing) is constructed as an integral structure of swimming pool 102, preferably position under a portion of pool deck 103 adjacent the peripheral wall 105 of swimming pool 102, as shown (at least embodying herein wherein such at least one second housing is prepositionally fixed relative to the at least one pool of water). Preferably, the interior of housing 120 is in fluid communication with the water contained within swimming pool 102, as shown. Preferably, automatic vacuum assembly 110 is located within housing 120 at a position submerged below the waterline of the pool, as shown. Similarly, storage tube 111 preferably extends outwardly from swimming pool 102 at an elevation adapted to maintain vacuum hose 112 below the waterline of the pool (at least embodying herein wherein such at least one tubular sleeve is adapted to maintain the at least one substantial portion of the at least one vacuum hose submerged within

water from such at least one pool of water). Preferably maintaining automatic vacuum assembly 110 (including vacuum hose 120) in a submerged condition eliminates the need to physically prime (fill with water to remove air) vacuum hose 112 prior to each use, as typically required to properly operate liquid circulation pumps. Upon reading the teachings of this specification, those with ordinary skill in the art will now understand that, under appropriate circumstances, considering such issues as advances in technology, user preference, etc., other arrangements, such as placing the housing underneath the pool, having a dry housing, and keeping the hoses filled with water by other means, other housing dimensions, etc., may suffice.

[0083] Preferably, the interior of housing 120 extends through peripheral wall 105, as shown (at least embodying herein at least one first passage adapted to provide fluid communication between such at least one hollow interior and the at least one pool of water). Preferably, the opening formed by the extension of housing 120 through peripheral wall 105 is covered by a pivoting door 122, as shown. Preferably, door 122 is positioned substantially below the waterline of swimming pool 102, as shown (at least embodying herein wherein such at least one first passage comprises at least one door adapted to provide at least one closable and openable barrier between such at least one first passage and the least one pool of water; and wherein such at least one door is positioned substantially below at least one waterline of such at least one pool of water). Preferably, door 122 is hinged on one side, and is opened and closed by the deployment and retraction of automatic vacuum assembly 110. Preferably, door 122 is held open, preferably open about 180 degrees against peripheral wall 105, when automatic vacuum assembly 110 is in a deployed state. Preferably, door 122 is held closed when automatic vacuum assembly 110 is in a retracted state. Preferably, door 122 is sized between about fourteen inches and about sixteen inches square. Upon reading the teachings of this specification, those with ordinary skill in the art will now understand that, under appropriate circumstances, considering such issues as advances in technology, user preference, etc., other arrangements, such as bifold doors, sliding doors, no door, a door partially above the waterline, a door large enough to insert and remove the automatic vacuum assembly, etc., may suffice.

[0084] Preferably, access to the interior of housing 120 from the surface of pool deck 103 is provided through surface hatch 124, as shown. Preferably, surface hatch 124 comprises a removable panel set approximately flush within the upper surface of pool deck 103, as shown. Preferably, surface hatch 124 is large enough to permit access to automatic vacuum assembly 110 for cleaning and repairs, as shown. More preferably, surface hatch 124 is large enough to permit automatic vacuum assembly 110 to be conveniently inserted into and removed from housing 120, as shown. Upon reading the teachings of this specification, those with ordinary skill in the art will now understand that, under appropriate circumstances, considering such issues as advances in technology, user preference, etc., other arrangements, such as no surface hatch, access through the underwater door, etc., may suffice. Preferably, surface hatch 124 is constructed from a substantially rigid and durable material with molded plastic being preferred.

[0085] Preferably, surface hatch **124** (and the deployment equipment under it) is locatable at almost any preferred position around the periphery of swimming pool **102** (except over an in-pool bench, stair, or similar structure). Preferably, surface hatch **124** is located on the side of swimming pool **102** adjacent occupied structure **115** to limit the visibility of door **122** located below the waterline, as shown.

[0086] Preferably, housing **120** is formed during construction of the pool walls, by placing concrete form **126** in an appropriate position relative to the finished interior of the pool and waterline elevation. Preferably, concrete form **126** comprises a preformed and substantially rigid structure of appropriate size and interior configuration to produce housing **120**, as shown. Preferably, form **126** is secured within the structural reinforcement of the pool wall and is encased within the concrete used to form peripheral wall **105** (generally a spray-applied concrete material such as Gunitite or Shotcrete). Upon reading the teachings of this specification, those with ordinary skill in the art will now understand that, under appropriate circumstances, considering such issues as advances in technology, user preference, etc., other arrangements, such as retrofitting an existing pool, using other structural materials, not using a form, etc., may suffice. Preferably, form **126** remains permanently embedded within peripheral wall **105**, as shown. Preferably, form **126** comprises at least one substantially rigid material suitable for concrete embedment, such as, for example rigid plastic, preferably including non-corrosive ABS. Upon reading the teachings of this specification, those of ordinary skill in the art will now understand that, under appropriate circumstances, considering such issues as cost, user preference, intended use, etc., other housing constructions, such as welded stainless steel, poly-concretes, fiber reinforced composites, etc., may suffice.

[0087] A problem common in the use of plastic vacuum hoses used in maintaining swimming pools is hose hysteresis. Hose hysteresis is the tendency of the hose material to retain the shape in which it was stored prior to use. For example, if a hose is stored in a conventional coiled arrangement, on deployment, the hose will have a tendency to retain the coiled shape thus reducing the ability of the hose to move freely with the operation of the pool equipment (e.g. pool vacuum head **113**). To significantly reduce hose hysteresis problems, storage tube **111** is preferably adapted to store vacuum hose **112** in an uncoiled and substantially linear configuration, as shown. Preferably, vacuum hose **112** is stored in a substantially linear configuration within storage tube **111**, as shown.

[0088] Preferably, storage tube **111** (at least embodying herein at least one tubular sleeve adapted to removably store at least one substantial portion of the at least one vacuum hose) extends outwardly from swimming pool **102** in a linear or near-linear configuration most accommodating to the physical arrangements of the site. Most preferably, storage tube **111** is arranged along a single linear axis. In sites comprising limited area and/or other physical limitations, storage tube **111** may preferably comprise one or more bends, as shown, preferably an aggregate bend of less than 360 degrees, most preferably less than 180 degrees. Preferably, storage tube **111** comprises the minimum number of bends required to accommodate physical restrictions within the site (that prohibit the more preferred placement along a single axis).

Preferably, for best in-service operation, storage tube **111** comprises no more than two 90-degree bends.

[0089] The overall length of storage tube **111** is preferably determined based on the size and configuration of the pool (a maximum length of about 40 feet being preferred for most home pool applications). Preferably, storage tube **111** extends underground from aperture connection **123** of housing **120** (at least embodying herein at least one second passage adapted to provide fluid communication between such at least one hollow interior and such at least one tubular sleeve) at a substantially constant elevation, as shown. Preferably, the interior of storage tube **111** is in fluid communication with the interior of housing **120** and therefore contains a continuous supply of the water of swimming pool **102** (at least embodying herein wherein such at least one tubular sleeve comprises at least one first open end in fluid communication with the at least one pool of water). This preferred arrangement provides submerged (pre-primed) storage of vacuum hose **112**, as shown. Preferably, the distal end **117** of storage tube **111** is turned upward to terminate at a point above grade level, as shown, to facilitate service and maintenance operations (at least embodying herein wherein such at least one tubular sleeve comprises at least one second open end; such at least one second open end is positioned above the at least one pool of water). Preferably, distal end **117** comprises removable cap **119** for service access to the interior of storage tube **111**, as shown (at least embodying herein wherein such at least one second open end comprises at least one removable cover adapted to removably cover such at least one second open end). To further ensure that no hose memory problems arise, the hose is mechanically turned slightly with each deployment so that it is stored in a different position after each use.

[0090] Preferably, storage tube **111** is constructed from a plurality of interconnectable tubular sections, preferably tubular segments having individual lengths of about five feet and an interior diameter of about four inches (at least embodying herein wherein such at least one tubular sleeve comprises at least one plurality of interconnectable segments adapted to provide segmented assembly of such at least one tubular sleeve). Preferably, the builder of pool **102** assembles the segments to form a continuous and substantially watertight underground storage tube, as shown. Preferably, tube **111** is constructed from at least one durable material suitable for direct burial within soil **106**, as shown. Tube **111** is preferably constructed from a plastic material with Acrylonitrile Butadiene Styrene (ABS) being most preferred. Upon reading the teachings of this specification, those of ordinary skill in the art will now understand that, under appropriate circumstances, considering such issues as user preference, intended use, etc., other storage pipe materials, such as Poly Vinyl Chloride (PVC), High Density Polyethylene (HDPE), low and medium density polyethylenes (PE), etc., may suffice. Preferably, the individual segments of tube **111** are permanently joined during construction, most preferably by chemical bonding. Preferably, to further ensure no hose memory problems arise; vacuum hose **112** is mechanically turned slightly with each deployment so that on retraction it is stored in a different position after each use.

[0091] FIG. 3 shows a side view, in partial section, of automatic vacuum assembly **110** of FIG. 1. FIG. 4 shows a side view of control assembly **108**, hose guide **107**, and

vacuum head **113** of automatic vacuum assembly **110**. **FIG. 5** shows an end view of control assembly **108** of **FIG. 1** with **FIG. 6** showing a top view of control assembly **108** of **FIG. 1**. The following descriptions make specific references to **FIG. 3** through **FIG. 6** with continued references to the prior figures. Preferably, surface hatch **124** is supported within pool deck **103** by a separate pre-formed box identified herein as access riser **109**, as best shown in **FIG. 3**. Preferably, access riser **109** comprises a concrete form element substantially isolated from concrete form **126** defining housing **120**, as shown. Expansion joint material **121** is used to further isolate concrete form **126** from access riser **109** and any thermal movement imparted to access riser **109** by pool deck **103**.

[0092] Preferably, control assembly **108** is positioned within the floor of housing **120**, as shown. To facilitate maintenance and inspection, control assembly **108** is removable from housing **120** (at least embodying herein wherein such at least one first housing is removable from such at least one hollow interior of such at least one second housing). Preferably, vacuum hose **112** extends from storage tube **111** to pass through control assembly **108** and hose guide **107**, as shown. Preferably, vacuum hose **112** comprises a first end **202**, preferably connected to vacuum head **113**, as shown, and a second end **204**, which is preferably coupled to vacuum transfer assembly **270** (as shown in **FIG. 14**).

[0093] Preferably, the lead end of vacuum hose **112** is operably coupled to vacuum head **113**, as shown. Preferably, vacuum head **113** comprises a commercially available suction-type automatic pool cleaner. Automatic pool cleaners suitable for use as vacuum head **113** include the Navigator-series of vacuum-operated products produced by Hayward Pool Products inc., of Pomona, Calif., U.S.A.

[0094] Preferably, housing **120** supports one or more adjustable hose guides **107**, as shown, which function to guide vacuum hose **112**, during deployment and especially during retraction. Preferably, hose guides **107** comprises an internal set of free-running wheels adapted to assist in guiding the movement of vacuum hose **112** through door **122**, as shown. Upon reading the teachings of this specification, those with ordinary skill in the art will now understand that, under appropriate circumstances, considering such issues as advances in technology, user preference, etc., other guide arrangements, such as other hose guides, other hose guide placements, no hose guides, etc., may suffice.

[0095] Preferably, control assembly **108** automatically controls the deployment and retraction of vacuum head **113** and vacuum hose **112**. Control assembly **108** (at least embodying herein at least one hose deployer adapted to deploy the at least one first end of the at least one vacuum hose into such at least one pool of water and at least one hose retractor adapted to retract the at least one vacuum hose onto such at least one tubular sleeve; and at least embodying herein wherein such at least one hose deployer comprises at least one automatic hose deployer adapted to automatically deploy the at least one vacuum hose on activation of the at least one fluid circulation pump; and such at least one hose retractor comprises at least one automatic hose retractor adapted to automatically retract the at least one vacuum hose on deactivation of the at least one fluid circulation pump) preferably comprises a set of internal drive wheels **242** (as

indicated in the dashed line depiction of **FIG. 4**) adapted to engage and power the movement of vacuum hose **112**, as shown.

[0096] Preferably, vacuum hose **112** comprises a reinforced, 1½ inch diameter swimming pool vacuum hose of the sort known in the art of swimming pool maintenance, as shown, such as those manufactured by Hayward Pool Products, Inc., of Pomona, Calif., U.S.A. Preferably, vacuum hose **112** comprises a circumferentially ridged exterior surface. Preferably, vacuum hose **112** comprises first end **202**, preferably connected to vacuum head **113**, as shown, and second end **204** (see **FIG. 1**) that is preferably coupled to vacuum hose end fitting **132**, which preferably detachably engages vacuum hose docking assembly **294** (as shown in **FIG. 14**).

[0097] Preferably, control assembly **108** is driven by hydraulic power derived from the fluid pressure generated by the circulation of water within the plumbing/filter system of swimming pool **102**. Preferably, control assembly **108** comprises an on-board hydraulic turbine **240**, as shown. Water flow from the suction (low-pressure) side of the pool plumbing system is coupled to hydraulic drive turbine **240** by means of suction connection **134**, as shown. Preferably, control valve assembly **136** of control assembly **108** manages the circulation of water between suction connection **134**, hydraulic turbine **240**, automatically switching water flow between hydraulic drive turbine **240** and vacuum hose **112** as further described in **FIG. 14**.

[0098] Preferably, control assembly **108** comprises control assembly housing **138** (at least embodying herein at least one first housing adapted to house such at least one hose deployer, such at least one fluid coupler, and such at least one hose retractor) adapted to house drive wheels **242**, reduction gearing, and related control actuators of the system. Preferably, hydraulic drive turbine **240**, control valve assembly **136**, and constant torque spring housing **140** are each mounted externally of control assembly housing **138**, as shown. Preferably, each opposing end of control assembly housing **138** comprises a circular hose port **142** providing accessible passage of vacuum hose **112** through control assembly **108**, as shown. Upon reading the teachings of this specification, those of ordinary skill in the art will now understand that, under appropriate circumstances, considering such issues as intended use, manufacturing costs, etc., other main body housing arrangements, such as, for example, the inclusion of lifting handles, mounting apertures, etc., may suffice.

[0099] Preferably, control assembly **108** is constructed of materials suitable for prolonged submersion in pool water (such as, for example, ozonated water, chlorinated water, or salt water). Preferred materials include aluminum, stainless steel, with oxidation-resistant plastics being most preferred. Where multiple types of metals are utilized, measures are preferably taken to prevent galvanic corrosion reactions. Upon reading the teachings of this specification, those with ordinary skill in the art will now understand that, under appropriate circumstances, considering such issues as advances in technology, user preference, etc., other materials, such as alternate metals, other plastics, composite materials, coated materials, etc., may suffice.

[0100] **FIG. 7** shows a top view of hydraulic drive turbine **240** of control assembly **108** according to the preferred

embodiment of FIG. 1. FIG. 8 shows a side view of turbine housing 144 of hydraulic drive turbine 240. FIG. 9 shows a front view of turbine impeller 146 while FIG. 10 shows a top view of turbine impeller 146 of hydraulic drive turbine 240. The following teachings of the specification make particular reference to FIG. 7 through FIG. 10 and general reference to the prior figures. Hydraulic drive turbine 240 is preferably adapted to convert a flow circulating pool water to a usable mechanical rotation. Preferably, hydraulic drive turbine 240 comprises a rotating turbine impeller 146 situate within hollow circular cavity 143 of ducted turbine housing 144, as shown. Preferably, turbine housing 144 comprises at least one, preferably six funnel-shaped inlets 145, adapted conduct pool water to hollow circular cavity 143, as shown. Preferably, a first side of each funnel-shaped inlet 145 is aligned approximately tangent to the inner diameter B of hollow circular cavity 143, as shown. The opposite side is preferably set at an angle about 10-degrees divergent from the first, as shown. Each funnel-shaped inlet 145 of the example turbine of FIG. 7 comprises a minimum passage size of about one-quarter square inch. The example turbine housing of FIG. 7 comprises an outer diameter A of about six inches and an inner cavity diameter B of about 4½ inches.

[0101] Preferably, the outer diameter of turbine impeller 146 is sized to fit closely within hollow circular cavity 143 while maintaining appropriate rotational clearances during operation. In the example turbine impeller of FIG. 7, the backing disk 147 of turbine impeller 146 comprises a thickness C of about one-eighth inch. Preferably, the front face of backing disk 147 comprises an array of projecting impeller blades 148, preferably about 18 impeller blades 148, spaced equally about the periphery of the impeller and generally aligned along radius lines of the disk, as shown. Preferably, each planar side of impeller blade 148 comprises a surface area of slightly less than about one-half square inch.

[0102] Preferably, hub 149 of turbine impeller 146 is adapted to receive drive shaft 203 (as best illustrated in FIG. 11). Preferably, drive shaft 203 is rigidly fixed to hub 149 by set screw 205, as shown. A rear cover plate 207 is bolted to turbine housing 144 to complete the assembly, as shown.

[0103] In use, hollow circular cavity 143 of hydraulic drive turbine 240 is coupled to suction (vacuum) originating at suction connection 134 of control valve assembly 136 by means of vacuum transfer conduit 206, as shown. When circulation pump 130 is initially activated, a low-pressure condition is generated within hollow circular cavity 143 preferably drawing jets of water through funnel-shaped inlets 145. Preferably, turbine impeller 146 is forcefully rotated by the impact of the incoming water against impeller blades 148. Preferably, rotation of turbine impeller 146 results in mechanical rotation of drive shaft 203. Thus, hydraulic drive turbine 240 of such at least one hose deployer at least embodies herein at least one hydraulic motor adapted to power the deploying of the at least one first hose end of the at least one vacuum hose by such at least one hose deployer; such at least one hydraulic motor is in fluid communication with the at least one low-pressure fluid source; and such at least one hydraulic motor is adapted to operate by directing at least one movement of the water of the at least one pool of water toward the at least one low-pressure fluid source

[0104] FIG. 11 shows a cut away end view diagrammatically illustrating the interior drive gear arrangements of control assembly 108. FIG. 12 shows a side view of a representative drive wheel 242 of control assembly 108. FIG. 13 shows a side view diagrammatically illustrating the drive gear arrangements of control assembly 108 of FIG. 1.

[0105] The deployment and retraction of vacuum hose 112 by control assembly 108 is performed by an internal drive mechanism that preferably comprises drive assembly 241 operated by gear train assembly 208, as shown. Preferably, rotational torque generated by hydraulic drive turbine 240 is transferred along drive shaft 203 to drive gear 210, as shown. Preferably, drive gear 210 is continuously engaged on pivoting gear assembly 212, as shown. Preferably, pivoting gear assembly 212 comprises two gears, first gear 214 rigidly coupled along a connecting shaft to second gear 216, as shown. Preferably, drive gear 210 is continuously engaged on first gear 214, as shown. Preferably, pivoting gear assembly 212 is mounted within pivoting armature 218, as shown. Preferably, pivoting armature 218 is adapted to movably engage and disengage second gear 216 with clutch input gear 220, as shown.

[0106] When circulation pump 130 is activated, the low-pressure vacuum generated actuates start-stop piston 215 (as further described in FIG. 14). The actuation of start-stop piston 215 moves pivoting armature 218 to a position engaging second gear 216, as shown. Tensioning spring 217 is preferably used to bias pivoting armature 218 to a position of gear disengagement that disengages second gear 216 with clutch input gear 220 when circulation pump 130 is deactivated and vacuum pressure is no longer supplied to start-stop piston 215.

[0107] Preferably, torque applied by second gear 216 at clutch input gear 220 is delivered to clutch assembly 226 by means of clutch shaft 224, as shown. Preferably, clutch assembly 226 comprises an arrangement of coaxial clutch disks held in frictional contact by clutch spring 228, as shown. Clutch assembly 226 (at least embodying herein at least one limited-slip coupler adapted to provide limited-slip decoupling of at least one mechanical force transferred between such at least one hydraulic motor, such at least one spring tensioner, and such at least one drive assembly) is preferably adapted to decouple rotational torque applied along clutch shaft 224, from both first spring gear 230 and from primary wheel drive gear 222 (when a maximum predetermined level of torque is achieved). Preferably, pluralities of small clutch disks are rigidly fixed to clutch shaft 224, as shown. Preferably, these small clutch disks are interspersed between and frictionally engage; a first set of larger clutch disks 225 firmly coupled to first spring gear 230; and a second independent set of larger clutch disks 227 firmly coupled to primary wheel drive gear 222. Preferably, torque is transferred across clutch assembly 226 so long as friction between the larger clutch disks and smaller clutch disks is maintained. An application of excess torque within clutch assembly 226 overcomes the frictional transfer of force between the disks thereby decoupling the source of the torque force from the remaining components of the system.

[0108] Preferably, first spring gear 230 is adapted to transfer torque from clutch assembly 226 to a larger diameter second spring gear 232, as shown. Preferably, second spring gear 232 is adapted to transfer torque to constant

torque spring **141** (located within constant torque spring housing **140**) through spring drive shaft **236**, as shown.

[0109] Similarly, primary wheel drive gear **222** is preferably adapted to transfer torque from clutch assembly **226** to drive assembly **241**, as shown. Preferably, drive assembly **241** comprises upper and lower drive wheels **242**, pivoting armatures **248**, secondary wheel drive gear **238**, and tension springs **250**, as shown. Preferably, primary wheel drive gear **222** transfers torque from clutch assembly **226** to drive assembly **241** by engaging the peripheral sprocket rings **234** of the upper drive wheels **242**, as shown. In addition, primary wheel drive gear **222** is preferably adapted to transfer torque to secondary wheel drive gear **238**, as shown. Preferably, secondary wheel drive gear **238** transfers operational torque from primary wheel drive gear **222** to the peripheral sprocket rings **234** of the lower drive wheels **242**, as shown.

[0110] Preferably, each drive wheel **242** comprises a cylindrical hub **244** adjoining two opposing frustoconical side spools, as shown. Preferably, at least one of the two frustoconical side spools comprise sprocket ring **234**, as shown. Preferably, a plurality of hose-engaging members **246** project outwardly from hub **244**, as shown. Preferably, hose-engaging members **246** are adapted to mechanically manipulate vacuum hose **112** by engaging the circumferentially ridged exterior surface of vacuum hose **112**. Preferably, each drive wheel **242** comprises a central axle about which drive wheel **242** rotates. Preferably, upper drive wheels **242** are geared to rotate opposite of lower drive wheels **242**, as shown, thus driving vacuum hose **112** (indicated in dash lines) through control assembly **108** in a generally linear manner.

[0111] Preferably, each lower drive wheel **242** is mounted within a pivoting armature **248** forming lower articulated drive wheel assembly **330**, as shown (and further described in FIG. 24). Preferably, both pivoting armatures **248** rotate about the center axis of secondary wheel drive gear **238**, as shown. Preferably, each lower drive wheel **242** is held in operational tension against vacuum hose **112** by a tension spring **250** coupled to each pivoting armature **248**, as shown. A manually depressible bar **252** (or similar actuator structure) is used to manually disengage drive wheels **242** from vacuum hose **112**, as shown. Preferably, by applying a downward force (indicated by arrow **252A**) on each pivoting armature **248**, each lower drive wheel **242** is swung away from a position of engagement with vacuum hose **112** (thus allowing removal or repositioning of the hose).

[0112] In preferred operation, hydraulic drive turbine **240** is operationally coupled to constant torque spring **141** by clutch assembly **226** of gear train assembly **208**. As hydraulic drive turbine **240** operates, drive wheels **242** deploy vacuum hose **112**. As vacuum hose **112** is deployed, constant torque spring **141** within constant torque spring housing **140** is simultaneously wound. If vacuum hose **112** is fully deployed before constant torque spring **141** is fully wound, clutch assembly **226** will allow primary wheel drive gear **222** to slip relative to the rotation of shaft **224** until constant torque spring **141** is fully wound. If constant torque spring **141** (at least one spring tensioner) is fully wound before vacuum hose **112** is fully deployed, clutch assembly **226** will allow first spring gear **230** to slip relative to the rotation of shaft **224** until vacuum hose **112** is fully deployed.

[0113] When constant torque spring **141** is fully wound and vacuum hose **112** is fully deployed, the system detects the condition (as described in FIG. 14) and switches suction flow from hydraulic drive turbine **240** to vacuum hose **112** and vacuum head **113**. Since drive turbine **240** is no longer powered, a gravity actuated ratchet, most preferably a ratchet **253** engaging first gear **214**, holds gear train assembly **208**, drive wheels **242**, and vacuum hose **112** firmly in place during deployment.

[0114] When circulation pump **130** (typically the swimming pool filter pump) turns off, start-stop piston **215** is deactivated allowing pivoting gear assembly **212** to disengage hydraulic drive turbine **240** from the balance of the gear train assembly **208**, as shown. As this happens, constant torque spring **141** (at least embodying herein wherein such at least one automatic hose retractor comprises at least one spring tensioner adapted to tension at least one retractor spring during deployment of the at least one vacuum hose by such at least one automatic hose deployer) releases its wound up energy through spring drive shaft **236**, second spring gear **232**, first spring gear **230**, clutch assembly **226**, primary wheel drive gear **222**, and drive wheels **242**, as shown. This results in vacuum hose **112** being pulled back into storage tube **111** and vacuum head **113** being drawn back into main housing **120**. The above-described arrangements at least embody herein at least one drive assembly comprising at least one first hose-engaging wheel and at least one second hose-engaging wheel each one adapted to physically engage the at least one vacuum hose; wherein, during such physical engagement, the at least one vacuum hose is movably deployed by rotation of such at least one first hose-engaging wheel and such at least one second hose-engaging wheel by such at least one hydraulic motor; and wherein, during such physical engagement, the at least one vacuum hose is movably retracted by counter-rotation of such at least one first hose-engaging wheel and such at least one second hose-engaging wheel by such at least one spring tensioner.

[0115] Preferably, constant torque spring housing **140** comprises a waterproof enclosure for containing constant torque spring **141** in a dry condition. At least one shaft seal is used at the penetration of spring drive shaft **236** with constant torque spring housing **140**. Preferably, constant torque spring **141** comprises an output spool having a diameter of about four inches and a supply spool having a diameter of at least two inches. Preferably, a 301 stainless steel spring having a length of about 33 inches, a thickness of about 0.02 inches, and a width of about one inch operates between the two spools. Preferably, constant torque spring **141** is designed for an operational life of at least about 4000 cycles, more preferably about 10,000 cycles.

[0116] FIG. 14 shows a diagram illustrating the detection and control components of control assembly **108** of FIG. 1. Control assembly **108** preferably comprises four detection and control components identified herein as spring-fully-wound detector **260**, hose deployment detector **262** of vacuum transfer assembly **270**, turbine drive controller **264**, and control valve assembly **136**, as shown. In the prior figures, the general operation of control assembly **108** was discussed in specific regard to the mechanical assemblies directly related to the deployment and retraction of vacuum hose **112**. In FIG. 14, the operation of and control of the suction water flow is discussed in further detail.

[0117] Preferably, turbine drive controller 264 comprises start-stop piston 215 as previously described in FIG. 13. Preferably, start-stop piston 215 is pressure actuated by a vacuum connection originating at primary vacuum chamber 135 of control valve assembly 136, as shown (preferably coupled directly to vacuum pressure originating at connection 134 of FIG. 5). Preferably, piston 215a of start-stop piston 215 is drawn into the housing of start-stop piston 215 in the presence of suction pressure at primary vacuum chamber 135.

[0118] Preferably, control valve assembly 136 (at least embodying herein at least one automatic switch adapted to automatically switch the coupling of the at least one low-pressure fluid source between such at least one hydraulic motor and such at least one fluid coupler) comprises a plurality of pressure actuated, float actuated, and manually actuated valves, as shown. The primary function of control valve assembly 136 is to switch suction water flow between hydraulic drive turbine 240 and vacuum hose 112. A second function of control valve assembly 136 is to provide a means for manual and automatic low water-level retraction of vacuum hose 112 during operation of circulation pump 130.

[0119] The principle component enabling the above-described switch of suction water flow between hydraulic drive turbine 240 and vacuum hose 112 is main diverter valve 266, as shown. Preferably, main diverter valve 266 is adapted to control the flow of water entering primary vacuum chamber 135 from vacuum transfer conduit 206 (coupled to hydraulic drive turbine 240) and/or vacuum hose transfer conduit 268, as shown. Note that vacuum hose transfer conduit 268 of control valve assembly 136 extends to transfer assembly 270, as shown.

[0120] Preferably, main diverter valve 266 is movably retained within control valve body of control valve assembly 136, as shown. Preferably, main diverter valve 266 comprises two valve gates rigidly coupled along common shaft 273. Preferably, first valve gate 274 opens and closes a passageway between primary vacuum chamber 135 and vacuum transfer conduit 206. Similarly, second valve gate 276 preferably opens and closes a passageway between primary vacuum chamber 135 and vacuum hose transfer conduit 268. Preferably, main diverter valve 266 is configured such that first valve gate 274 fully opens as second valve gate 276 fully closes (and vice versa). This preferred arrangement provides a means to establish water flow alternately between hydraulic drive turbine 240 and vacuum hose 112. Main diverter valve 266 is preferably biased toward a condition whereby first valve gate 274 (controlling water flow from the turbine) is normally open and second valve gate 276 (controlling water flow from vacuum hose 112) is normally closed. Preferably, a helical spring 280, located along an extension of common shaft 273, provides the appropriate biasing force.

[0121] Operation of main diverter valve 266 is preferably automatic. Preferably, operation of main diverter valve 266 is controlled by vacuum actuated bellows 247, as shown. Preferably, common shaft 273 of main diverter valve 266 extends through the wall of vacuum transfer conduit 206 and is fixed to the interior of bellows 247, as shown. Preferably, the interior of vacuum actuated bellows 247 is coupled by pressure transfer passage 278 to primary vacuum chamber 135, as shown. During periods when circulation pump 130

is inactive, bellows 247 is held in an expanded configuration by spring 280, as shown. In this condition, first valve gate 274 is open and second valve gate 276 is closed. Preferably, a low-pressure (vacuum) condition within bellows 247 results in the contraction of bellows 247 (at least embodying herein at least one pressure operated actuator adapted to actuate at least one fluid controlling valve) and movement of main diverter valve 266 to contemporaneously close first valve gate 274 (supplying vacuum pressure to the turbine) and open second valve gate 276 (supplying vacuum pressure to vacuum hose 112). Preferably, for contraction of bellows 247 (and switching of water flow between hydraulic drive turbine 240 and vacuum hose 112) to occur, three conditions must be met. First, circulation pump 130 (see FIG. 2) must be active and supplying vacuum to primary vacuum chamber 135. Secondly, pressure transfer conduit 282 at spring-fully-wound detector 260 must be blocked. Thirdly, pressure transfer conduit 282 at hose deployment detector 262 must be blocked.

[0122] Preferably, spring-fully-wound detector 260 is adapted to suppress the actuation of bellows 247 until constant torque spring 141 is fully wound. This is preferred detection procedure is accomplished by adapting spring drive shaft 236 with worm gear assembly 284, as shown. Preferably, worm gear assembly 284 is adapted to rotate seal 286 to block pressure inlet 288 of pressure transfer conduit 282, as shown. The blocking of inlet 288 is preferably calibrated to coincide with an appropriate tensioning of constant torque spring 141. So long as inlet 288 remains open, vacuum pressure within bellows 247 is insufficient to actuate main diverter valve 266.

[0123] Similarly, pressure transfer conduit 282 comprises a second pressure inlet 290 at hose deployment detector 262, as shown. Preferably, pressure inlet 290 is blocked when vacuum hose 112 is fully deployed and a specially designed vacuum hose end fitting 132 is engaged within vacuum hose docking assembly 294 (the preferred arrangements and operation of vacuum hose end fitting 132 and vacuum hose docking assembly 294 are explained in further detail in FIG. 15). When inlet 290 is open, indicating that vacuum hose 112 is not fully deployed, vacuum pressure within bellows 247 is insufficient to actuate main diverter valve 266.

[0124] The above described arrangements at least embody herein at least one hose deployment detector adapted to signal the detection of a completed deployment of the at least one vacuum hose into the at least one pool of water; and at least one spring tension detector adapted to signal the detection of the completed tensioning of such at least one retractor spring by such deployment of the at least one vacuum hose by such at least one automatic hose deployer; wherein such at least one automatic switch is adapted to maintain the coupling of the at least one low-pressure fluid source to such at least one hydraulic motor in the absence of such detection signals from either of such at least one hose deployment detector and such at least one spring tension detector; and wherein such at least one automatic switch is adapted to switch the coupling of the at least one low-pressure fluid source from such at least one hydraulic motor to such at least one fluid coupler in the presence of both such detection signals from such at least one hose deployment detector and such at least one spring tension detector.

[0125] FIG. 15 shows a side view of vacuum hose end fitting 132 according to the preferred embodiment of FIG.

1. FIG. 16 shows an end view of vacuum hose end fitting 132 with FIG. 17 showing the sectional view 17-17 of FIG. 16. FIG. 18 shows a partial sectional view illustrating vacuum hose end fitting 132 adjacent vacuum hose docking assembly 294 according to the preferred embodiment of FIG. 1. FIG. 19 shows a partial sectional view illustrating vacuum hose end fitting 132 operationally engaging vacuum hose docking assembly 294 of FIG. 18 and FIG. 20 shows a perspective view illustrating vacuum hose docking assembly of FIG. 18.

[0126] As previously described, a highly preferred feature of pool-cleaning system 100 comprises the uncoiled or semi-linear storage of vacuum hose 112. To enable the use of substantially linear storage, a means for establishing a vacuum connection to vacuum hose 112 must be provided. Preferably, control assembly 108 comprises vacuum transfer assembly 270, as shown. Preferably, vacuum transfer assembly 270 (at least embodying herein further comprising at least one fluid coupler adapted to couple the at least one second hose end of the at least one vacuum hose to the at least one low-pressure fluid source) comprises a novel vacuum-pressure transfer arrangement combining attachable vacuum hose end hose fitting 132 engagable within vacuum hose docking assembly 294, as shown.

[0127] Preferably, the proximal end of vacuum hose end fitting 132 comprises an internally disposed female receiver 300 (at least embodying herein at least one vacuum hose end fitting adapted to removably engage the at least one second hose end of the at least one vacuum hose) adapted to removably receive male end fitting 302 of vacuum hose 112, as shown. Preferably, female receiver 300 comprises a slight conical taper to facilitate frictional retention of male end fitting 302, as shown. Preferably, female receiver 300 is in fluid communication with at least one, more preferably three symmetrically positioned vacuum transfer ports 304, as shown (at least embodying herein wherein such at least one vacuum hose end fitting comprises at least one vacuum transfer port adapted to transfer fluid between the at least one vacuum hose and such at least one interior chamber).

[0128] Preferably, vacuum hose end hose fitting 132 comprises two circumferential mating surfaces adapted to form a temporary pressure seal with two complementary mating surfaces of vacuum hose docking assembly 294, as shown. Preferably, the exterior circumference of vacuum hose end hose fitting 132 comprises first seating surface 306 and second seating surface 308, as shown. Preferably, vacuum transfer ports 304 of vacuum hose end hose fitting 132 are positioned between first seating surface 306 and second seating surface 308, as shown.

[0129] Preferably, vacuum hose docking assembly 294 (at least embodying herein at least one docking receiver adapted to removably receive such at least one vacuum hose end fitting) comprises a generally cylindrical structure having two open ends joined, coaxially, by a continuous hollow interior chamber 310, as shown (at least embodying herein wherein such at least one at least one docking receiver comprises at least one interior chamber adapted to receive interiorly at least one portion of such at least one vacuum hose end fitting and pass exteriorly the at least one vacuum hose). Preferably, interior chamber 310 comprises inlet port 316 adapted to provide a fluid coupling to vacuum hose transfer conduit 268, as shown (at least embodying herein

wherein such at least one interior chamber comprises at least one coupling to the at least one low-pressure fluid source). Preferably, the interior circumference of hollow interior chamber 310 comprises third seating surface 312 and fourth seating surface 314, as shown. Preferably, inlet port 316 enters interior chamber 310 between third seating surface 312 and fourth seating surface 314, as shown. Third seating surface 312 and fourth seating surface are preferably adapted to form a temporary pressure seal with first seating surface 306 and second seating surface 308, respectively (at least embodying herein wherein such at least one interior chamber comprises at least one pressure seal adapted to form at least one pressure seal with such at least one vacuum transfer port; and wherein such at least one pressure seal is adapted to form at least one pressure coupling to couple operationally the at least one vacuum hose with the at least one low-pressure fluid source).

[0130] Preferably, vacuum hose end hose fitting 132 is constructed of one or more materials suitable for continuous submersion in pool water with at least one molded plastic being preferred. Preferably, vacuum hose end hose fitting 132 is constructed of one or more materials comprising a substantially neutral density relative to the pool water in which it operates. This preferred feature assists in retraction of vacuum hose end hose fitting 132 and vacuum hose 112 into storage tube 111.

[0131] Preferably, vacuum hose docking assembly 294 is mounted within control assembly housing 138, between the circular hose port 142 facing storage tube 111 and drive assembly 241. In preferred use, vacuum hose 112 is preferably positioned to pass through hollow interior chamber 310 of vacuum hose docking assembly 294, as best shown in FIG. 18. Second end 204 of vacuum hose 112 is preferably fitted with vacuum hose end hose fitting 132, as shown. Preferably, drive wheels 242 of drive assembly 241 (see FIG. 13) draw vacuum hose 112 from storage tube 111 (see FIG. 1) through vacuum hose docking assembly 294 during hose deployment. At the full deployment of vacuum hose 112, vacuum hose end hose fitting 132 enters and engages vacuum hose docking assembly 294, as best illustrated in FIG. 19. At full deployment, third seating surface 312 forms a temporary pressure seal with first seating surface 306 as fourth seating surface forms a temporary pressure seal with second seating surface 308, as shown. This "sealed" engagement of vacuum hose end hose fitting 132 within vacuum hose docking assembly 294 provides a fluid coupling between hollow interior chamber 310, vacuum transfer ports 304, female receiver 300, and the interior of vacuum hose 112, as shown.

[0132] FIG. 18, FIG. 19, and FIG. 20 illustrate the preferred configuration of hose deployment detector 262 at vacuum hose docking assembly 294. Preferably, fourth seating surface 314 comprises pressure inlet 290 of transfer conduit 282 (as best illustrated in FIG. 14). Preferably, second seating surface 308 blocks pressure inlet 290 as vacuum hose end hose fitting 132 engages vacuum hose docking assembly 294 thus indicating to control valve assembly 136, by mechanical pressure, the full deployment of vacuum hose 112.

[0133] FIG. 21 shows a sectional view of control valve assembly 136 of FIG. 14. Preferably, control valve assembly 136 comprises low water level detector 320, as shown.

Preferably, low water level detector 320 comprises float 322 that detects when the swimming pool water level is below a level allowing pool-cleaning system 100 to operate properly. Preferably, float 322 is coupled to valve 324 that preferably operates to block off vacuum pressure applied to primary vacuum chamber 135 by circulation pump 130 at suction connection 134, as shown. If water level drops below elevation X, as shown, both float 322 and valve 324 (at least embodying herein wherein such at least one water level detector comprises at least one automatic retraction initiator adapted to automatically initiate the retraction of the at least one vacuum hose on such detection of such at least one low water level condition within the at least one pool of water) lower to block the flow of water drawn from primary vacuum chamber 135 toward suction connection 134 by the action of circulation pump 130, as shown. With vacuum pressure blocked, control assembly 108 reacts by performing the same retraction operations that occur when circulation pump 130 is deactivated, i.e. vacuum hose 112 and vacuum head 113 are retracted into main housing 120 and storage tube 111.

[0134] In addition, control valve assembly 136 comprises manual stow button 325, as shown. When a pool user wants to remove vacuum hose 112 and vacuum head 113 from swimming pool 102, he/she can press manual stow button 325 that is connected to valve 324 to lower and block off vacuum pressure applied to primary vacuum chamber 135 by circulation pump 130. Again, with vacuum pressure blocked, control assembly 108 performs the same retraction operations that occur when circulation pump 130 is deactivated, i.e. vacuum hose 112 and vacuum head 113 are retracted into main housing 120 and storage tube 111.

[0135] Preferably, manual stow button 325 (at least embodying herein wherein such at least one automatic retraction initiator comprises at least one manual actuator adapted to provide manual actuation of such at least one automatic retraction initiator) extends upwardly through an access aperture located within surface hatch 124, as shown. Preferably, manual stow button 325 comprises adjustment feature 326 adapted to allow adjustments to the elevational position of manual stow button 325 relative to surface hatch 124.

[0136] For ease of assembly, maintenance, and manufacture, control valve assembly 136 is constructed as a multi-part assembly, as shown. Preferably, valve assembly 136 is constructed of one or more durable materials suitable for continuous submersion in pool water with plastics being preferred.

[0137] FIG. 22 shows the section 22-22 of FIG. 21 and FIG. 23 shows the section 23-23 of FIG. 21. Both FIG. 22 and FIG. 23 enable preferred arrangements of a preferred commercial embodiment of control valve assembly 136. FIG. 24 shows a top view of lower articulated drive wheel assembly 330 comprising a set of drive wheels 242 engaged within two pivoting armatures 248, as shown. FIG. 25 shows a side view of a single pivoting armature 248 with FIG. 26 showing a top view of pivoting armature 248 of lower articulated drive wheel assembly 330. Preferably, lower articulated drive wheel assembly 330 is adapted to provide a means of manually disengaging vacuum hose 112 from control assembly 108 at any point of engagement along the hose. In addition, lower articulated drive wheel assembly

330 maintains a proper engagement tension with vacuum hose 112 to avoid slippage during deployment and retraction. Preferably, each pivoting armature 248 comprises a generally U-shaped member, as shown. Preferably, each pivoting armature 248 comprises end apertures 332, about which the arms pivot, and mid apertures 334 adapted to receive the central axle of drive wheels 242, as shown. The Linear distance between end aperture 332 and mid aperture 334 is approximately equal to the combined radiuses secondary wheel drive gear 238 and peripheral sprocket ring 234, as best shown in FIG. 13. This preferred arrangement places the central axle of secondary wheel drive gear 238 at end aperture 332 to thus allowing a continuous engagement of secondary wheel drive gear 238 with both peripheral sprocket rings 234 in all operational positions of pivoting armatures 248, as shown.

[0138] FIG. 27 shows a side view of alternate gear embodiment 340 according to a preferred embodiment of the present invention. FIG. 28 shows an end view of the alternate gear embodiment 340 of FIG. 27. Preferably, alternate gear embodiment 340 comprises a unitary gear assembly adapted for use at primary wheel drive gear 222 and first spring gear 230. Preferably, one side of alternate gear embodiment 340 comprises hollow cylindrical extension 342 having a set of projecting tabs 344 interiorly disposed therein. Preferably, projecting tabs 344 function to properly position and retain larger clutch disks 227 of clutch assembly 226. Preferably, alternate gear embodiment 340 comprises a central aperture 346 adapted to pass shaft 224.

[0139] FIG. 29 shows a side view of an alternate embodiment of pool-cleaning system 100 identified herein as automatic vacuum assembly 1110 according to another preferred embodiment of the present invention. FIG. 29 illustrates automatic vacuum assembly 1110 retracted into its pool-wall housing 1120. Preferably, automatic vacuum assembly 1110 comprises a reel-type vacuum hose storage arrangement that is used in situations where use of the more preferred linear hose storage embodiments is impractical. Preferably, the alternate embodiment of pool-cleaning system 100 comprises automatic vacuum assembly 1110, housing 1120, and circulation pump 130, as shown. Preferably, automatic vacuum assembly 1110 is housed within housing 1120 (at least embodying herein filler means for providing for such vacuum hose means to remain continuously full of water; and at least embodying herein at least one filler adapted to provide for such at least one vacuum hose to remain continuously full of water; and at least embodying herein wherein such at least one filler further comprises at least one housing adapted to provide at least one housing adapted to contain such at least one vacuum hose, on such reel means, below such at least one waterline of such at least one pool of water; and at least embodying herein wherein such at least one vacuum hose is entirely within such at least one housing when such at least one vacuum hose is in a retracted position), and is connected to circulation pump 130, as shown. Preferably, automatic vacuum assembly 1110 is stored in housing 1120 when circulation pump 130 is off, as shown, and automatic vacuum assembly 1110 automatically deploys vacuum hose 112 into pool 102 through door 1122 when circulation pump 130 is on, as shown. Automatic vacuum assembly 1110 is shown in FIG. 29 in a retracted, stored state, where automatic vacuum assembly 1110 is entirely within housing 1120. Upon reading the teachings of this specification, those with ordinary skill in the art will

now understand that, under appropriate circumstances, considering such issues as advances in technology, user preference, etc., other automatic vacuum assembly components, such as timers, sensors, remote controls, chemical addition systems, etc., may suffice.

[0140] Preferably, housing 1120 is built into the side of a pool, preferably under a portion of the pool deck, which communicates with the water in the pool, so that automatic vacuum assembly 1110 may be placed into housing 1120 and be substantially submerged below the waterline of the pool, as shown (at least embodying herein the step of storing at least one hose reel in at least one body of water). Preferably, housing 1120 is about one foot wide by about two feet deep (excluding the tunnel to door 1122) by about four feet tall. Preferably automatic vacuum assembly 1110 is submerged within housing 1120 and automatic vacuum assembly 1110 is kept constantly full of water, which is necessary for most vacuum pumps 1130. This eliminates the typical step of priming a vacuum hose 112 prior to use. Preferably, automatic vacuum assembly 1110 is kept conveniently close to the pool, and retracts out of sight when not in use. Upon reading the teachings of this specification, those with ordinary skill in the art will now understand that, under appropriate circumstances, considering such issues as advances in technology, user preference, etc., other arrangements, such as placing the housing underneath the pool, having a dry housing, and keeping the hoses filled with water by other means, other housing dimensions, etc., may suffice.

[0141] Preferably, housing 1120 communicates to the pool through door 1122 (at least embodying herein wherein such at least one housing further comprises at least one door adapted to provide at least one exit from such at least one housing into such at least one pool of water; and at least embodying herein wherein such at least one door is below such at least one waterline of such at least one pool of water), as shown. Preferably, door 1122 is entirely below the waterline of the pool, as shown. Preferably, door 1122 is hinged on one side, and is opened and closed by the deployment and retraction of automatic vacuum assembly 1110. Preferably, door 1122 is held open, preferably open about 180 degrees against the adjacent pool wall, when automatic vacuum assembly 1110 is in a deployed state. Preferably, door 1122 is held closed when automatic vacuum assembly 1110 is in a retracted state. Preferably, door 1122 is about fourteen inches wide by about fourteen inches tall. Upon reading the teachings of this specification, those with ordinary skill in the art will now understand that, under appropriate circumstances, considering such issues as advances in technology, user preference, etc., other arrangements, such as bifold doors, sliding doors, no door, a door partially above the waterline, a door large enough to insert and remove the automatic vacuum assembly, etc., may suffice.

[0142] Preferably, housing 1120 communicates to the pool deck surface through surface hatch 1124, as shown. Preferably, surface hatch 1124 is large enough to permit access to automatic vacuum assembly 1110 for cleaning and repairs, as shown. More preferably, surface hatch 1124 is large enough to permit automatic vacuum assembly 1110 to be conveniently inserted into and removed from housing 1120, as shown. Upon reading the teachings of this specification, those with ordinary skill in the art will now understand that, under appropriate circumstances, considering such issues as

advances in technology, user preference, etc., other arrangements, such as no surface hatch, etc., may suffice.

[0143] Preferably, housing 1120 is constructed while the pool is being constructed, by digging a sufficiently-sized hole, inserting concrete form 1126 positioned to connect with the interior of the pool, and then filling the remainder of the hole with concrete (preferably Gunit or Shotcrete). Upon reading the teachings of this specification, those with ordinary skill in the art will now understand that, under appropriate circumstances, considering such issues as advances in technology, user preference, etc., other arrangements, such as retrofitting an existing pool, using other structural materials, not using a form, etc., may suffice.

[0144] Preferably, vacuum pump 1130 is a central vacuum pump of the sort commonly known in the art of swimming pools. Preferably, vacuum pump 1130 connects to hydraulic system 1150 of automatic vacuum assembly 1110, further described below.

[0145] Preferably, automatic vacuum assembly 1110 comprises vacuum hose 112, deployer 1114, reel 1116, and retractor 1118, as shown. Preferably, automatic vacuum assembly 1110 also comprises chassis 1111 and vacuum head 113 (at least embodies herein wherein such at least one vacuum hose further comprises at least one vacuum cleaner adapted to provide at least one vacuum cleaner, wherein such at least one vacuum cleaner is attached to such at least one first end of such at least one vacuum hose), as shown. Upon reading the teachings of this specification, those with ordinary skill in the art will now understand that, under appropriate circumstances, considering such issues as advances in technology, user preference, etc., other components, such as timers, sensors, chemical adding equipment, etc., may suffice.

[0146] Preferably, vacuum hose 112 comprises a reinforced, two-inch diameter swimming pool vacuum hose of the sort known in the art of swimming pool maintenance, as shown, such as those manufactured by Hayward Pool Products, Inc., of Elizabeth, N.J., US. Preferably, vacuum hose 112 has a laterally-ridged exterior surface. Preferably, vacuum hose 112 has a first end 1202, preferably connected to vacuum head 113, as shown, and a second end 1204, which is preferably secured inside reel 1116 and which preferably detachably connects to hydraulic system 1150 (as shown in FIG. 37). Preferably, vacuum hose 112 is wound onto reel 1116 (at least embodying herein hose reel means for providing at least one hose reel for such vacuum hose means; and at least embodying herein at least one hose reel adapted to provide at least one hose reel for such at least one vacuum hose) for storage, as shown (at least embodying herein the step of reeling at least one hose onto such at least one hose reel in such at least one body of water; and at least embodying herein the step of storing such at least one hose reel having such at least one hose in such at least one body of water). Upon reading the teachings of this specification, those with ordinary skill in the art will now understand that, under appropriate circumstances, considering such issues as advances in technology, user preference, etc., other arrangements, such as a stopper on the end of the vacuum hose to prevent the vacuum hose from retracting into the deployer when the vacuum cleaner is removed, other vacuum hose types, other vacuum hose diameters, etc., may suffice.

[0147] Preferably, reel 1116 comprises hub 1206, sides 1208, and axle 1210 (shown in cross-section in FIG. 41).

Preferably, axle **1210** connects to chassis **1111**, as shown. Preferably, hub **1206** is two hose-widths wide, as shown in **FIG. 41**, and sides **1208** are tall enough to hold about seven lengths of standard four-foot long vacuum hoses **112** (about 28 feet of two-inch diameter vacuum hose **112**). Upon reading the teachings of this specification, those with ordinary skill in the art will now understand that, under appropriate circumstances, considering such issues as advances in technology, user preference, pool size, etc., other arrangements, such as the reel being wide enough to hold three hose-widths, sized to hold ten hose-lengths, holding a length of hose suited for a particular pool, a single-piece hose of the required length, etc., may suffice.

[0148] Preferably, chassis **1111** supports the other components of automatic vacuum assembly **1110**, as shown. Preferably, chassis **1111** comprises aluminum bar stock, as shown.

[0149] Preferably, automatic vacuum assembly **1110** is constructed of materials able to withstand prolonged submersion in pool water, such as, for example, ozonated water, chlorinated water, or salt water. Preferred materials include aluminum, stainless steel, oxidation-resistant plastics such as, for example, Teflon and PVC, etc. Where multiple types of metals are used, care should be taken to prevent galvanic corrosion reactions. Upon reading the teachings of this specification, those with ordinary skill in the art will now understand that, under appropriate circumstances, considering such issues as advances in technology, user preference, etc., other materials, such as other metals, other plastics, composite materials, coated materials, etc., may suffice.

[0150] Preferably, retractor **1118** (at least embodying herein hose retractor means for retracting such vacuum hose means onto such hose reel means; and at least embodying herein at least one hose retractor adapted to retract such at least one vacuum hose onto such at least one hose reel; and at least embodying herein wherein such at least one hose retractor comprises at least one automatic hose retractor adapted to automatically retract such at least one vacuum hose when such at least one vacuum pump is turned off.) retracts vacuum hose **112** when vacuum hose **112** is released from deployer **1114** and is allowed to move freely. Preferably, retractor **1118** rotates reel **1116** counterclockwise to wind vacuum hose **112** onto reel **1116**, as shown. Preferably, retractor **1118** comprises spring **1220**, as shown, which is wound when vacuum hose **112** is deployed from reel **1116** (at least embodying herein wherein such step of reeling such at least one hose on to such at least one hose reel in such at least one body of water further comprises the step of using at least one spring to reel such at least one hose on to such at least one hose reel in such at least one body of water). Preferably, spring **1220** comprises a constant-force spring, as shown. Preferably, spring **1220** comprises spring hub **1221**, which is preferably attached to axle **1210**, drum **1222**, which is preferably attached to chassis **1111** by bracket **1223**, and spring band **1224**, as shown. Upon reading the teachings of this specification, those with ordinary skill in the art will now understand that, under appropriate circumstances, considering such issues as advances in technology, user preference, etc., other retractors, such as other types of springs, motorized retractors, etc., may suffice.

[0151] Preferably, deployer **1114** (at least embodies herein hose deployer means for deploying such at least one first end

of such vacuum hose means into the at least one pool of water; and at least embodies herein at least one hose deployer adapted to deploy such at least one first end of such at least one vacuum hose into such at least one pool of water; and at least embodies herein wherein such at least one hose deployer comprises at least one automatic hose deployer adapted to automatically deploy such at least one vacuum hose when such at least one vacuum pump is turned on; and at least embodies herein wherein such at least one vacuum pump simultaneously powers such at least one articulated carrier and such at least one hose deployer) comprises carriage **1230**, deployment bellows **1232**, housing **1234**, and drive system **1236**, as shown. Preferably, deployer **1114** moves to deploy the first end **1202** of vacuum hose **112** into the pool during vacuuming (at least embodying herein the step of unreeling such at least one hose off of such at least one hose reel in such at least one body of water), and retracts into housing **1120** for storage, as shown. Upon reading the teachings of this specification, those with ordinary skill in the art will now understand that, under appropriate circumstances, considering such issues as advances in technology, user preference, etc., other deployers, such as a motorized reel, etc., may suffice.

[0152] Preferably, carriage **1230** (at least embodying herein wherein such at least one hose deployer comprises at least one articulated carrier adapted to carry such at least one hose deployer from at least one retracted position to at least one deployed position and vice versa) comprises four carriage bars **1231**, which are each pivotally connected to housing **1234** at one end, and to chassis **1111** at the other end, as shown. Preferably, carriage **1230** moves from the upright, retracted position shown into a tilted, deployed position (as shown in **FIG. 30**) when pulled by deployment bellows **1232** (at least embodying herein wherein such at least one vacuum pump powers such at least one articulated carrier; and at least embodies herein wherein such at least one hose deployer comprises at least one hydraulic actuator). Upon reading the teachings of this specification, those with ordinary skill in the art will now understand that, under appropriate circumstances, considering such issues as advances in technology, user preference, etc., other arrangements, such as other numbers of carriage bars, other types of carriages, motorized carriage movement, other types of carriage movement such as sliding on rails, etc., may suffice.

[0153] Preferably, deployment bellows **1232** comprise one or more deployment bellows **1232**, as shown. Preferably, deployment bellows **1232** are attached to carriage **1230** at one end, preferably with bracket **1233**, and are attached to chassis **1111** at the other end, as shown. Preferably, deployment bellows **1232** are also attached to hydraulic system **1150**, preferably near the end of deployment bellows **1232** attached to chassis **1111**, as shown. Preferably, when circulation pump **130** is turned on, hydraulic system **1150** pulls water out of deployment bellows **1232**, compressing deployment bellows **1232**, and pulling carriage **1230** forward (as shown in **FIG. 30**). Upon reading the teachings of this specification, those with ordinary skill in the art will now understand that, under appropriate circumstances, considering such issues as advances in technology, user preference, etc., other types of hydraulic actuators, such as other numbers of bellows, other shapes of bellows, other diameters of bellows, hydraulic pistons, hydraulic motors, etc., may suffice.

[0154] Preferably, housing 1234 comprises two substantially flat, parallel metal plates 1235, which preferably provide structural support for drive system 1236 and connection points for carriage 1230, as shown. Upon reading the teachings of this specification, those with ordinary skill in the art will now understand that, under appropriate circumstances, considering such issues as advances in technology, user preference, etc., other housings, such as an arrangement of bars, additional enclosed sides, other shapes, other sizes, other materials, etc., may suffice.

[0155] Preferably, drive system 1236 (at least embodies herein at least one drive adapted to drive such at least one hose-moving wheel off of such at least one hydraulic motor) comprises hydraulic motor 1240, drive wheels 1242, gears 1243, drive chain 1244, idle sprocket 1246, wheel positioner bellows 1247, wheel positioner lever 1248, and wheel positioner spring 1249, as shown.

[0156] Preferably, hydraulic motor 1240 (at least embodying herein wherein such at least one hose deployer is powered by such at least one vacuum pump; and at least embodying herein at least one hydraulic motor adapted to power at least one motor with water moved by such at least one vacuum pump; and at least embodying herein wherein such at least one hose deployer is powered by such at least one hydraulic motor; and at least embodying herein at least one hydraulic motor adapted to provide at least one hydraulic motor; and at least embodying herein wherein such at least one hydraulic motor is powered by such at least one vacuum pump) comprises a vane-type hydraulic motor of the sort known in the art of hydraulics. Preferably, circulation pump 130 draws water from inside housing 1120 through hydraulic motor 1240, causing hydraulic motor 1240 to turn and drive gears 1243.

[0157] Preferably, when vacuum pump 1130 is turned on, hydraulic motor 1240 drives gears 1243, which in turn drive chain 1244, which turns drive wheels 1242, as shown (at least embodying herein wherein the step of unreeling such at least one hose off of such at least one hose reel in such at least one body of water further comprises the step of using at least one hydraulic motor to unreel such at least one hose off of such at least one hose reel in such at least one body of water). Preferably simultaneously, hydraulic system 1150 pulls water out of wheel positioner bellows 1247, pivoting wheel positioner lever 1248, and moving drive wheels 1242 to engage vacuum hose 112 (as shown in FIG. 30). Preferably, drive chain 1244 tension is maintained by idle sprocket 1246, which is preferably tensioned by sprocket spring 1245, as shown (at least embodying herein further comprising at least one drive tensioner adapted to provide consistent tension to such at least one drive chain). Upon reading the teachings of this specification, those with ordinary skill in the art will now understand that, under appropriate circumstances, considering such issues as advances in technology, user preference, etc., other arrangements, such as a motorized wheel positioner, other methods of engaging the drive wheels with the vacuum hose, gears instead of a drive chain, etc., may suffice.

[0158] Preferably, when circulation pump 130 is turned on, hydraulic system 1150 simultaneously powers hydraulic motor 1240, retracts wheel positioner bellows 1247 (at least embodying herein wherein such at least one wheel compressor is actuated by such at least one vacuum pump; and at

least embodying herein wherein such at least one wheel tensioner is tensioned by such at least one vacuum pump; and at least embodying herein wherein such at least one hose deployer comprises at least one hydraulic actuator), and retracts deployment bellows 1232, thereby automatically deploying automatic vacuum assembly 1110, as shown. Upon reading the teachings of this specification, those with ordinary skill in the art will now understand that, under appropriate circumstances, considering such issues as advances in technology, user preference, etc., other arrangements, such as timing these actions separately, etc., may suffice.

[0159] Preferably, when drive wheels 1242 (at least embodying herein at least one hose-moving wheel adapted to move such at least one vacuum hose; and at least embodying herein wherein such at least one hose-guiding wheel comprises such at least one hose-moving wheel; and at least embodying herein at least one hose-moving wheel adapted to move such at least one hose) are engaged with vacuum hose 112 and are turning, vacuum hose 112 is pulled off reel 116, and is pushed out into the pool (as shown in FIG. 30). Preferably, this continues until vacuum hose 112 is substantially entirely reeled off reel 1116, as shown.

[0160] Preferably, when vacuum hose 112 is fully deployed, hydraulic system 1150 automatically switches circulation pump 130 suction from deployer 1114 to vacuum hose 112, as shown, pulling water through vacuum hose 112, preferably to be filtered and returned to the pool (at least embodying herein the step of pulling at least one flow of water through such at least one hose). Preferably, vacuum head 113 is connected to the first end 1202 of vacuum hose 112, and is deployed with vacuum hose 112, as shown. Preferably, vacuum head 113 is a vacuum-powered random-motion pool vacuum of the sort known in the art, such as, for example, the Navigator Automatic Pool Cleaner manufactured by Hayward Pool Products, Inc. Once deployed, vacuum head 113 preferably cleans the pool until circulation pump 130 is turned off. Upon reading the teachings of this specification, those with ordinary skill in the art will now understand that, under appropriate circumstances, considering such issues as advances in technology, user preference, etc., other arrangements, such as no vacuum cleaner, a surface skimmer, wand vacuums, etc., may suffice.

[0161] Preferably, when circulation pump 130 is turned off, automatic vacuum assembly 1110 automatically retracts, as shown. Preferably, when circulation pump 130 is turned off, deployment bellows 1232 are released from suction and fill with water, permitting retraction spring 1252 (at least embodying herein wherein such at least one hose retractor comprises at least one spring adapted to wind such at least one hose reel) to pull carriage 1230 back into the upright, retracted position, as shown. Preferably simultaneously, wheel positioner bellows 1247 is released from suction and fills with water, permitting wheel positioner spring 1249 to pull wheel positioner lever 1248 (at least embodying herein at least one wheel compressor adapted to compress such at least one vacuum hose between such at least one hose-guiding wheel and such at least one hose-moving wheel; and at least embodying herein at least one wheel tensioner adapted to tension such at least one hose between such at least one hose-guiding wheel and such at least one hose-moving wheel) to disengage drive wheels 1242 from vacuum hose 112, as shown. Preferably, when vacuum hose

112 is released from drive wheels 1242, retractor 1118 rotates reel 1116 counterclockwise to wind vacuum hose 112 onto reel 1116, as shown. Upon reading the teachings of this specification, those with ordinary skill in the art will now understand that, under appropriate circumstances, considering such issues as advances in technology, user preference, etc., other arrangements, such as motorized retraction, timed sequences of retraction steps, etc., may suffice.

[0162] FIG. 30 shows a side view of automatic vacuum assembly 1110 according to FIG. 29, in a deployed position. Preferably, when automatic vacuum assembly 1110 is deployed, vacuum head 113 is carried far enough away from the wall of the pool that vacuum head 113 does not scrape against the side of the pool during deployment or retraction, as shown.

[0163] FIG. 31 shows a detail of the upper portion of automatic vacuum assembly 1110 of FIG. 29. Preferably, housing 1234 supports one or more hose guide wheels 1241, as shown, which guide vacuum hose 112, especially during retraction (at least embodying herein at least one hose-guiding wheel adapted to guide such at least one vacuum hose; and at least embodying herein at least one hose-guiding wheel adapted to guide at least one hose). Retraction sensor 1300 is further shown and described in FIGS. 34 and 35. Upon reading the teachings of this specification, those with ordinary skill in the art will now understand that, under appropriate circumstances, considering such issues as advances in technology, user preference, etc., other arrangements, such as other hose guides, other hose guide placements, etc., may suffice.

[0164] FIG. 32 shows a rear view of deployer 1114 of FIG. 29. Preferably, housing 1234 comprises hose guide 1400, as shown, which is preferably flared at the ends to prevent vacuum hose 112 from catching during deployment, as shown. Upon reading the teachings of this specification, those with ordinary skill in the art will now understand that, under appropriate circumstances, considering such issues as advances in technology, user preference, etc., other arrangements, such as hose guide wheels, etc., may suffice.

[0165] FIG. 33A shows a side view of a drive wheel 1242 of FIG. 29.

[0166] FIG. 33B shows an edge view of the drive wheel 1242 of FIG. 33A. Preferably, drive wheel 1242 has a v-shaped, ridged interior, as shown, adapted to grip and pull vacuum hose 112. Preferably, drive wheels 1242 are molded of plastic, with metal axles. Upon reading the teachings of this specification, those with ordinary skill in the art will now understand that, under appropriate circumstances, considering such issues as advances in technology, user preference, etc., other arrangements, such as pairs of wheels instead of v-shaped wheels, smooth wheels, other sizes of wheels, other wheel materials, etc., may suffice.

[0167] FIG. 34 shows a detail of the upper portion of automatic vacuum assembly 110 according to FIG. 29, detailing retraction sensor 1300 (at least embodying herein at least one retraction detector adapted to detect the complete retraction of such at least one vacuum hose onto such at least one reel; and at least embodying herein wherein such at least one articulated carrier is adapted to carry such at least one hose deployer from at least one deployed position to at least one retracted position when such at least one

retraction detector detects the complete retraction of such at least one vacuum hose onto such at least one reel) in a latched position, during vacuum hose 112 retraction. Preferably, retraction sensor 1300 comprises a system of levers 1605 connecting stopper 1610 with latch 1615, as shown. Preferably, when carriage 1230 is in a deployed position, latch 1615 catches on block 1620, locking carriage 1230 in the deployed position, as shown. Upon reading the teachings of this specification, those with ordinary skill in the art will now understand that, under appropriate circumstances, considering such issues as advances in technology, user preference, etc., other types of retraction sensors, such as electronic sensors, other mechanical sensors, other sensing criteria, etc., may suffice.

[0168] FIG. 35 shows a detail of the upper portion of automatic vacuum assembly 1110 according to FIG. 29, detailing retraction sensor 1300 in an unlatched position, after vacuum hose 112 retraction. Preferably, when vacuum hose 112 is fully retracted, vacuum head 113 bumps stopper 1610, moving levers 1605 and releasing latch 1615 from block 1620, as shown. Preferably, at this point in the retraction process, deployment bellows 1232 has also been released from suction by hydraulic system 1150, and retraction spring 1252 pulls carriage 1230 into the retracted position, as shown. Upon reading the teachings of this specification, those with ordinary skill in the art will now understand that, under appropriate circumstances, considering such issues as advances in technology, user preference, etc., other retraction sensors, such as electronic sensors, other mechanical sensors, other lever arrangements, other types of latches, etc., may suffice.

[0169] FIG. 36 shows a diagram of hydraulic system 1150 according to a preferred embodiment of the present invention. Preferably, hydraulic system 1150 comprises automatic switch 1800, trunk hose 1805, bellows hoses 1810, hydraulic motor hose 1815, vacuum supply hose 1820, and deployment sensor hose 1825, as shown. Preferably, automatic switch 1800 automatically switches the vacuum provided by circulation pump 130 from deployer 1114 to vacuum hose 112 when vacuum hose 112 is fully deployed, as shown. Upon reading the teachings of this specification, those with ordinary skill in the art will now understand that, under appropriate circumstances, considering such issues as advances in technology, user preference, etc., other automatic switches, such as electric valve switches, other types of automatic switch valves, other hose arrangements, etc., may suffice.

[0170] Preferably, automatic switch 1800 (at least embodying herein at least one automatic switch adapted to automatically switch such at least one vacuum pump from powering such at least one hose deployer to pulling water through such at least one vacuum hose after such at least one hose deployer deploys such at least one vacuum hose; and at least embodying herein wherein such at least one hose deployer is powered by such at least one vacuum pump prior to such at least one deployment detector detecting the finished deployment of such at least one vacuum hose off of such at least one reel; and at least embodying herein wherein such at least one vacuum pump pulls water through such at least one vacuum hose after such at least one deployment detector detects the finished deployment of such at least one vacuum hose from such at least one reel; and at least embodying herein at least one automatic switch adapted to

automatically switch such at least one vacuum pump from powering such at least one hose deployer to pulling water through such at least one vacuum hose after such at least one deployment detector detects the finished deployment of such at least one vacuum hose from such at least one reel; and at least embodying herein at least one automatic switch adapted to automatically switch such at least one vacuum pump from powering such at least one hose deployer to pulling water through such at least one vacuum hose after such at least one spring-loaded switch is closed) comprises switch bellows **1830**, piston **1832**, piston spring **1834**, valves **1836**, and chamber **1838**, as shown. Preferably, two valves **1836** are spaced along piston **1832** in chamber **1838**, and slidably seal against the sides of chamber **1838**, as shown. Preferably, piston **1832** with valves **1836** is moved longitudinally within chamber **1838** by switch bellows **1830**, as shown (at least embodying herein wherein such at least one automatic switch comprises at least one hydraulic actuator). Upon reading the teachings of this specification, those with ordinary skill in the art will now understand that, under appropriate circumstances, considering such issues as advances in technology, user preference, etc., other arrangements, such as flapper valves, multiple valve bellows, electronic switches, etc., may suffice.

[0171] Preferably, trunk hose **1805** connects to chamber **1838** between valves **1836** at one end, and connects to circulation pump **130** at the other end, as shown. Preferably, hydraulic motor hose **1815** connects to chamber **1838** so that hydraulic motor hose **1815** communicates with trunk hose **1805** when switch bellows **1830** is extended, as shown. Preferably, piston spring **1834** acts to keep switch bellows **1830** extended, as shown. Preferably, vacuum supply hose **1820** connects to chamber **1838** so that vacuum supply hose **1820** communicates with trunk hose **1805** when switch bellows **1830** is compressed, as shown in hidden lines. Upon reading the teachings of this specification, those with ordinary skill in the art will now understand that, under appropriate circumstances, considering such issues as advances in technology, user preference, etc., other arrangements, such as other hose routings, other numbers of hoses, other hose connections, etc., may suffice.

[0172] Preferably, bellows hoses **1810** are connected to trunk hose **805** so that bellows hoses **1810** are under vacuum whenever circulation pump **130** is on, as shown. Preferably, bellows hoses **1810** connect to deployment bellows **1232** and wheel positioner bellows **1247**, so that deployment bellows **1232** and wheel positioner bellows **1247** are under vacuum whenever circulation pump **130** is on, as shown. Upon reading the teachings of this specification, those with ordinary skill in the art will now understand that, under appropriate circumstances, considering such issues as advances in technology, user preference, etc., other arrangements, such as latches to keep the bellows compressed during vacuuming, etc., may suffice.

[0173] Preferably, deployment sensor hose **1825** is cross linked between trunk hose **1805** and switch bellows **1830**, as shown, so that deployment sensor hose **1825** is under vacuum whenever circulation pump **130** is on. Preferably, deployment sensor hose **1825** is open to water at the far end when vacuum hose **112** is reeled on reel **1116**, as shown in **FIG. 37**. Preferably, deployment sensor hose **1825** is closed at the far end when vacuum hose **112** is substantially unreel from reel **1116** (i.e., when vacuum hose **112** is fully

deployed), as shown in **FIG. 39**. Preferably, when deployment sensor hose **1825** is closed at the far end, suction is applied to switch bellows **1830**, compressing switch bellows **1830** and moving valves **1836** so that vacuum supply hose **1820** communicates with trunk hose **1805**, as shown, so that pool vacuuming automatically begins (at least embodying herein wherein such step of automatically switching further comprises the step of actuating at least one liquid-actuated bellows). Upon reading the teachings of this specification, those with ordinary skill in the art will now understand that, under appropriate circumstances, considering such issues as advances in technology, user preference, etc., other arrangements, such as other types of deployment sensors, etc., may suffice.

[0174] **FIG. 37** shows a diagram of the state of hydraulic system **1150** during vacuum hose **112** deployment, with sprung lever **1915** depressed. Preferably, automatic vacuum assembly **1110** comprises hose deployment sensor **1900**, as shown. Preferably, hose deployment sensor **1900** (at least embodying herein at least one deployment detector adapted to detect the finished deployment of such at least one vacuum hose off of such at least one reel) comprises deployment sensor hose **1825**, sensor hose stopper **1905**, hose stopper spring **1910**, sprung lever **1915**, and sprung bar **1920**, as shown. Preferably, sprung lever **1915** (at least embodying herein at least one spring-loaded lever adapted to provide at least one spring-loaded lever on the interior of such at least one reel wherein such at least one spring-loaded lever is compressed when such at least one vacuum hose presses such at least one spring-loaded lever; and wherein such at least one spring-loaded lever is released when such at least one vacuum hose is removed from such at least one spring-loaded lever) lies across reel hub **1916**, so that sprung lever **1915** is compressed when vacuum hose **112** is wound around reel hub **1916** and over sprung lever **1915**, as shown, and so that sprung lever **1915** is released into an upward slanted position when vacuum hose **112** is wound off of sprung lever **1915**, as shown. Preferably, one end of sprung lever **1915** is hinged and sprung, and the other end of sprung lever **1915** is connected to the lower end of sprung bar **1920**, as shown, preferably through a slot in reel **1116**, as shown.

[0175] Preferably, sprung bar **1920** is radially mounted on the outside of reel **1116**, as shown. Preferably, sprung bar **1920** is in a lowered position when sprung lever **1915** is compressed, and is pulled into a raised position (away from reel hub **1916**) by sprung lever **1915** and bar spring **1921** when sprung lever **1915** is released (as shown in **FIG. 38**, and shown in cross-section in **FIG. 42**).

[0176] Preferably, when sprung bar **1920** (at least embodying herein at least one spring-loaded bar adapted to provide at least one spring-loaded bar on the exterior of such at least one reel wherein such at least one spring-loaded bar is pulled into at least one retracted position when such at least one spring-loaded lever is compressed; and wherein such at least one spring-loaded bar means is released into at least one extended position when such at least one spring-loaded lever is released) is lowered, the top end of sprung bar **1920** does not touch sensor hose stopper **1905** as reel **1116** turns. Preferably, when sprung bar **1920** is raised, the top end of sprung bar **1920** presses hose stopper **1905** (at least embodying herein at least one spring-loaded switch adapted to provide at least one spring-loaded switch wherein such at least one spring-loaded switch is open when such at

least one spring-loaded bar is pulled into such at least one retracted position; and wherein such at least one spring-loaded switch is closed when such at least one spring-loaded bar is released into such at least one extended position and contacts such at least one spring-loaded switch) against the open end of deployment sensor hose 1825 as reel 1116 turns, sealing the end of deployment sensor hose 1825 (as shown in FIG. 39) and causing suction to be applied to switch bellows 1830.

[0177] Preferably, when sprung bar 1920 presses hose stopper 1905 against the open end of deployment sensor hose 1825, the rotation of reel 1116 is stopped at that point, as shown. Preferably, the second end 1204 of vacuum hose 112 is connected to an opening 1950 in reel 1116 near axle 1210, as shown. Preferably, vacuum supply hose 1820 is fixed to chassis 1111, with the end of vacuum supply hose 1820 flush with the exterior of reel 1116, as shown. Preferably, when sprung bar 1920 presses hose stopper 1905 against the open end of deployment sensor hose 1825 and reel 1116 is stopped in that position, the end of vacuum supply hose 1820 aligns with opening 1950 which communicates with vacuum hose 112 (as shown in FIG. 39), thereby connecting vacuum supply hose 1820 to vacuum hose 112, as shown (at least embodying herein further comprising the step of automatically switching such at least one vacuum pump from pulling water through such at least one hydraulic motor to pulling water through such at least one vacuum hose after such at least one vacuum hose is unreeled from such at least one reel). Upon reading the teachings of this specification, those with ordinary skill in the art will now understand that, under appropriate circumstances, considering such issues as advances in technology, user preference, etc., other arrangements, such as a swivel joint inlet on the axle connecting the vacuum hose to the vacuum supply hose, etc., may suffice.

[0178] FIG. 38 shows a diagram of the state of hydraulic system 1150 during vacuum hose 112 deployment, with sprung lever 1915 released.

[0179] FIG. 39 shows a diagram of the state of hydraulic system 1150 during vacuuming.

[0180] FIG. 40 shows a cross-section through section 40-40 of FIG. 38.

[0181] FIG. 41 shows detail 41 of FIG. 40, exploded, with reel 1116 omitted to clearly show the workings of hose deployment sensor 1900. Preferably, sprung lever 1915 comprises bracket 2305, hinge 2307, spring 2310, lever 2315, and arm 2320, as shown. Preferably, bracket 2305 connects lever 2315 to reel 1116, through hinge 2307, as shown. Preferably, spring 2310 holds lever 2315 up when lever 2315 is not compressed by vacuum hose 112, as shown.

[0182] Preferably, sprung bar 1920 comprises bar 2330, bolt 2335, spacer 2340, bracket 2345, and spring 2350, as shown. Preferably, bar 2330 slides freely between spacer 2340 and bracket 2345, as shown. Preferably, spring 2350 connects at one end to bracket 2345, and at the other end to the lower portion of bar 2330, so that spring 2350 pulls bar 2330 upward (away from reel hub 1916) when sprung lever 1915 is released, as shown.

[0183] Preferably, sprung lever 1915 is connected to bar 2330 by bolt 2335, as shown. Preferably, the bolt-hole in

arm 2320 is loose, to accommodate various angles of intersection of arm 2320 and bolt 2335, as shown. Upon reading the teachings of this specification, those with ordinary skill in the art will now understand that, under appropriate circumstances, considering such issues as advances in technology, user preference, etc., other arrangements, such as hinged connections, etc., may suffice.

[0184] Preferably, hose stopper 1905 comprises bracket 2360, hinge 2365, lever 2370, pad 2375, and spring 2380, as shown. Preferably, deployment sensor hose 1825 is supported by bracket 2390 and strap 2391, as shown.

[0185] Preferably, bracket 2360 is fixedly connected to chassis 1111, as shown, and is connected to lever 2370 by hinge 2365, as shown. Preferably, lever 2370 is held away from the end of deployment sensor hose 1825 by spring 2380, as shown. Preferably, pad 2375 is attached to the underside of lever 2370, as shown. Preferably, pad 2375 comprises a resilient, water-resistant material able to seal against the end of deployment sensor hose 1825 when lever 2370 is pressed down by sprung bar 1920. More preferably, pad 2375 comprises polyurethane foam. Upon reading the teachings of this specification, those with ordinary skill in the art will now understand that, under appropriate circumstances, considering such issues as advances in technology, user preference, etc., other arrangements, electronic sensors, electronic valve switches, other pad materials, other types of deployment sensors, etc., may suffice.

[0186] FIG. 42 shows a rear view of the embodiment according to FIG. 29. Preferably, chamber 1838 is constructed from PVC pipe sections. Preferably, vacuum hose 1112 is attached to reel 1116 with a 90-degree PVC pipe fitting, as shown. Preferably, vacuum hose 1112 is attached to reel 1116 with a 90-degree PVC pipe fitting, as shown. Preferably, hydraulic motor hose 1815 is attached to hydraulic motor 1240 with a 90-degree PVC pipe fitting, as shown. Preferably, vacuum supply hose 1820 is attached to chassis 1111 adjacent reel 1116 with a 90-degree PVC pipe fitting, as shown. Upon reading the teachings of this specification, those with ordinary skill in the art will now understand that, under appropriate circumstances, considering such issues as advances in technology, user preference, etc., other arrangements, such as other types of pipe fittings, custom parts manufactured, other materials, etc., may suffice.

[0187] In this preferred alternate embodiment, bellows hoses 1810 are connected to chamber 1838 adjacent trunk hose 1805, as shown, instead of directly to trunk hose 1805, as was shown in FIG. 36. This arrangement functions in the same way as was described in FIG. 36.

[0188] FIG. 43 shows a side view of deployer 2514 according to another preferred embodiment of the present invention, in a non-deploying state. Preferably, deployer 2514 comprises housing 2534 and drive system 2536, as shown.

[0189] Preferably, housing 2534 comprises two substantially flat, parallel metal plates 2535, as shown, which preferably provide structural support for drive system 2536 and connection points for chassis 1111, as shown. Preferably, housing 2534 is fixedly connected to chassis 1111, preferably near door 1122. Therefore, in this preferred embodiment, deployment bellows 1232 and retraction sensor 1300 are not required.

[0190] Preferably, housing 2534 comprises hose guide 2537. Preferably, hose guide 2537 is fixedly attached to chassis 1111. Upon reading the teachings of this specification, those with ordinary skill in the art will now understand that, under appropriate circumstances, considering such issues as advances in technology, user preference, etc., other arrangements, such as a hose guide that extends when the door is opened, a hose guide that extends when the hose is deployed, etc., may suffice.

[0191] Preferably, drive system 2536 comprises hydraulic motor 1240, drive wheel 1242, gears 2543, drive chain 2544, wheel positioner bellows 2547, wheel positioner lever 2548, and wheel positioner spring 2549, as shown. Vacuum supply hose 1815 is attached to hydraulic motor 1140, but is not shown.

[0192] FIG. 44 shows a side view of deployer 2514 according to FIG. 44, in a deploying state. Preferably, when circulation pump 130 is turned on, hydraulic motor 1240 drives gears 2543, which in turn drive chain 2544, which turns drive wheel 1242, as shown. Preferably simultaneously, hydraulic system 1150 pulls water out of wheel positioner bellows 2547, pivoting wheel positioner lever 2548, and moving drive wheel 1242 to engage vacuum hose 1112, as shown (at least embodying herein wherein the step of using at least one hydraulic motor to unreel such at least one hose off of such at least one hose reel in such at least one body of water further comprises the step of using at least one vacuum pump to pull water through such at least one hydraulic motor).

[0193] Preferably, when circulation pump 130 is turned off, wheel positioner spring 2549 pulls wheel positioner lever 2548 to disengage drive wheel 1242 from vacuum hose 1112, returning deployer 2514 to the state shown in FIG. 43, as shown.

[0194] Although applicant has described applicant's preferred embodiments of this invention, it will be understood that the broadest scope of this invention includes modifications such as diverse shapes, sizes, and materials. Such scope is limited only by the below claims as read in connection with the above specification.

[0195] Further, many other advantages of applicant's invention will be apparent to those skilled in the art from the above descriptions and the below claims.

What is claimed is:

1) A system related to the uncoiled storage of at least one vacuum hose of at least one automatic pool cleaner within at least one pool of water, the at least one vacuum hose comprising at least one first hose end and at least one second hose end, the at least one pool of water comprising at least one low-pressure fluid source, said system comprising:

- a) at least one tubular sleeve adapted to removably store at least one substantial portion of the at least one vacuum hose;
- b) wherein said at least one tubular sleeve comprises at least one first open end in fluid communication with the at least one pool of water; and
- c) wherein said at least one tubular sleeve comprises an aggregate bend of less than three-hundred and sixty degrees.

2) The system according to claim 1 wherein:

- a) said at least one tubular sleeve comprises an aggregate bend of less than one hundred and eighty degrees; and
- b) said at least one tubular sleeve comprises no more than two ninety-degree bends.

3) The system according to claim 2 wherein:

- a) said at least one tubular sleeve comprises at least one second open end;
- b) said at least one second open end is positioned substantially above at least one waterline of such at least one pool of water; and
- c) said at least one second open end comprises at least one removable cover adapted to removably cover said at least one second open end.

4) The system according to claim 1 wherein said at least one tubular sleeve comprises at least one plurality of interconnectable segments adapted to provide segmented assembly of said at least one tubular sleeve.

5) The system according to claim 1 wherein said at least one tubular sleeve is adapted to maintain the at least one substantial portion of the at least one vacuum hose submerged within the water from such at least one pool of water.

6) The system according to claim 1 further comprising at least one fluid coupler adapted to couple the at least one second hose end of the at least one vacuum hose to the at least one low-pressure fluid source.

7) The system according to claim 6 wherein said at least one fluid coupler comprises:

- a) at least one vacuum hose end fitting adapted to removably engage the at least one second hose end of the at least one vacuum hose; and

- b) at least one docking receiver adapted to removably receive said at least one vacuum hose-end fitting;

- c) wherein said at least one at least one docking receiver comprises at least one interior chamber adapted to receive interiorly at least one portion of said at least one vacuum hose end fitting and pass exteriorly the at least one vacuum hose;

- d) wherein said at least one vacuum hose end fitting comprises at least one vacuum transfer port adapted to transfer fluid between the at least one vacuum hose and said at least one interior chamber;

- e) wherein said at least one interior chamber comprises at least one coupling to the at least one low-pressure fluid source;

- f) wherein said at least one interior chamber comprises at least one pressure seal adapted to form at least one pressure seal with said at least one vacuum transfer port; and

- g) wherein said at least one pressure seal is adapted to form at least one pressure coupling to couple operationally the at least one vacuum hose with the at least one low-pressure fluid source.

8) The system according to claim 1 further comprising:

- a) at least one hose deployer adapted to deploy the at least one first end of the at least one vacuum hose into such at least one pool of water;

- b) at least one fluid coupler adapted to couple the at least one second end of the at least one vacuum hose to the at least one low-pressure fluid source; and
- c) at least one hose retractor adapted to retract the at least one vacuum hose onto said at least one tubular sleeve;
- d) wherein said at least one tubular sleeve is adapted to maintain the at least one substantial portion of the at least one vacuum hose submerged within the water of said at least one pool of water.
- 9) The system according to claim 8 wherein:
 - a) said at least one hose deployer comprises at least one hydraulic motor adapted to power the deploying of the at least one first hose end of the at least one vacuum hose by said at least one hose deployer;
 - b) said at least one hydraulic motor is in fluid communication with the at least one low-pressure fluid source; and
 - c) said at least one hydraulic motor is adapted to operate by directing at least one movement of the water of the at least one pool of water toward the at least one low-pressure fluid source.
- 10) The system according to claim 8 further comprising:
 - a) at least one first housing adapted to house said at least one hose deployer, said at least one fluid coupler, and said at least one hose retractor; and
 - b) at least one second housing comprising at least one hollow interior adapted to house said at least one first housing;
 - c) wherein said at least one first housing is removable from said at least one hollow interior of said at least one second housing; and
 - d) wherein said at least one second housing is positionally fixed relative to the at least one pool of water.
- 11) The system according to claim 10 wherein said at least one hollow interior comprises:
 - a) at least one first passage adapted to provide fluid communication between said at least one hollow interior and the at least one pool of water; and
 - b) at least one second passage adapted to provide fluid communication between said at least one hollow interior and said at least one tubular sleeve;
 - c) wherein said at least one first passage comprises at least one door adapted to provide at least one closable and openable barrier between said at least one first passage and the at least one pool of water; and
 - d) wherein said at least one door is positioned substantially below at least one waterline of such at least one pool of water.
- 12) The system according to claim 9 wherein:
 - a) the at least one low-pressure fluid source comprises at least one fluid circulation pump adapted to circulate the water of such at least one pool of water;
 - b) said at least one hose deployer comprises at least one automatic hose deployer adapted to automatically deploy the at least one vacuum hose on activation of the at least one fluid circulation pump; and
 - c) said at least one hose retractor comprises at least one automatic hose retractor adapted to automatically retract the at least one vacuum hose on deactivation of the at least one fluid circulation pump.
- 13) The system according to claim 12 further comprising at least one automatic switch adapted to automatically switch the coupling of the at least one low-pressure fluid source between said at least one hydraulic motor and said at least one fluid coupler.
- 14) The system according to claim 12 wherein said at least one automatic hose retractor comprises at least one spring tensioner adapted to tension at least one retractor spring during deployment of the at least one vacuum hose by said at least one automatic hose deployer.
- 15) The system according to claim 14, further comprising:
 - a) at least one hose deployment detector adapted to signal the detection of a completed deployment of the at least one vacuum hose into the at least one pool of water; and
 - b) at least one spring tension detector adapted to signal the detection of the completed tensioning of said at least one retractor spring by such deployment of the at least one vacuum hose by said at least one automatic hose deployer;
 - c) wherein said at least one automatic switch is adapted to maintain the coupling of the at least one low-pressure fluid source to said at least one hydraulic motor in the absence of such detection signals from either of said at least one hose deployment detector and said at least one spring tension detector; and
 - d) wherein said at least one automatic switch is adapted to switch the coupling of the at least one low-pressure fluid source from said at least one hydraulic motor to said at least one fluid coupler in the presence of both such detection signals from said at least one hose deployment detector and said at least one spring tension detector.
- 16) The system according to claim 15 wherein such detection signals comprise at least one change in fluid pressure.
- 17) The system according to claim 16 wherein said at least one automatic switch comprises at least one pressure operated actuator adapted to actuate at least one fluid controlling valve.
- 18) The system according to claim 17 wherein said at least one hose deployer comprises:
 - a) at least one drive assembly comprising at least one first hose-engaging wheel and at least one second hose-engaging wheel each one adapted to physically engage the at least one vacuum hose;
 - b) wherein, during such physical engagement, the at least one vacuum hose is movably deployed by rotation of said at least one first hose-engaging wheel and said at least one second hose-engaging wheel by said at least one hydraulic motor; and
 - c) wherein, during such physical engagement, the at least one vacuum hose is movably retracted by counter-rotation of said at least one first hose-engaging wheel and said at least one second hose-engaging wheel by said at least one spring tensioner.
- 19) The system according to claim 18 further comprising at least one limited-slip coupler adapted to provide limited-

slip decoupling of at least one mechanical force transferred between said at least one hydraulic motor, said at least one spring tensioner, and said at least one drive assembly.

20) The system according to claim 18 further comprising such at least one vacuum hose.

21) The system according to claim 18 further comprising such at least one automatic pool cleaner.

22) The system according to claim 18 further comprising:

- a) at least one water level detector adapted to detect at least one low water level condition within the at least one pool of water;
- b) wherein said at least one water level detector comprises at least one automatic retraction initiator adapted to automatically initiate the retraction of the at least one vacuum hose on such detection of such at least one low water level condition within the at least one pool of water.

23) The system according to claim 22 wherein said at least one automatic retraction initiator comprises at least one manual actuator adapted to provide manual actuation of said at least one automatic retraction initiator.

24) A pool cleaning system, comprising the steps of:

- a) coupling at least one submerged tubular sleeve to at least one body of water;
- b) placing at least one portion of at least one vacuum hose onto such at least one submerged tubular sleeve;
- c) deploying such at least one vacuum hose from such at least one submerged tubular sleeve into such at least one body of water; and
- d) coupling such at least one vacuum hose to at least one vacuum source.

25) The pool cleaning system, according to claim 24, wherein the step of deploying such at least one vacuum hose from such at least one submerged tubular sleeve into such at least one body of water further comprises the step of using at least one hydraulic motor to induce such deployment.

26) The pool cleaning system, according to claim 25 further comprising the step of retracting such at least one portion of such at least one vacuum hose from such at least one body of water into such at least one submerged tubular sleeve.

27) The cleaning system, according to claim 26, wherein such the step of retracting such at least one vacuum hose from such at least one body of water into such at least one submerged tubular sleeve further comprises the step of using at least one spring to induce such retraction.

28) The cleaning system, according to claim 27, further comprising the step of pulling at least one flow of water through such at least one vacuum hose.

29) A cleaning system, relating to the cleaning of at least one pool of water by at least one automatic vacuum, the at least one pool of water having at least one waterline, said system comprising:

- a) at least one vacuum hose having at least one first end and at least one second end;
- b) at least one vacuum pump, wherein said at least one vacuum pump is operationally coupled to said at least one second end of said at least one vacuum hose;
- c) at least one hose reel adapted to reel said at least one vacuum hose;

d) at least one hose deployer adapted to deploy said at least one first end of said at least one vacuum hose into such at least one pool of water; and

e) at least one hose retractor adapted to retract said at least one vacuum hose onto said at least one hose reel;

f) wherein said at least one vacuum hose is adapted to remain continuously full of water when retracted onto said at least one hose reel;

g) wherein said at least one hose deployer comprises at least one hydraulic actuator; and

h) said at least one hydraulic actuator actuates by vacuum fluid pressure.

30) The cleaning system according to claim 29 further comprising:

a) at least one housing adapted to house said at least one vacuum hose, on said at least one hose reel, below such at least one waterline of such at least one pool of water;

b) wherein said at least one housing comprises at least one door adapted to provide at least one exit from said at least one housing into such at least one pool of water; and

c) wherein said at least one door is located substantially below such at least one waterline of such at least one pool of water.

31) The cleaning system according to claim 30 wherein:

a) said at least one vacuum hose further comprises at least one vacuum cleaner; and

b) said at least one vacuum cleaner is operationally coupled to said at least one first end of said at least one vacuum hose; and

c) said at least one vacuum hose and said at least one vacuum cleaner are positioned entirely within said at least one housing when said at least one vacuum hose is retracted for storage.

32) The cleaning system according to claim 29 wherein:

a) said at least one hose deployer comprises at least one automatic hose deployer adapted to automatically deploy said at least one vacuum hose when said at least one vacuum pump is activated; and

b) said at least one hose retractor comprises at least one automatic hose retractor adapted to automatically retract said at least one vacuum hose when said at least one vacuum pump is deactivated.

33) The cleaning system according to claim 29 wherein said at least one hose deployer is powered by said at least one vacuum pump.

34) The cleaning system according to claim 34 further comprising at least one automatic switch adapted to automatically switch said at least one vacuum pump from powering said at least one hose deployer to pulling water through said at least one vacuum hose after said at least one hose deployer deploys said at least one vacuum hose.

35) The cleaning system according to claim 29 further comprising at least one hydraulic motor adapted to at least one rotational force from water moved by said at least one vacuum pump.

36) The cleaning system according to claim 35 wherein said at least one hose deployer is powered by said at least one hydraulic motor.

37) The cleaning system according to claim 29 wherein said at least one hose retractor comprises at least one spring adapted to wind said at least one hose reel.

38) The cleaning system according to claim 29 wherein said at least one hose deployer comprises at least one articulated carrier adapted to carry said at least one hose deployer from at least one retracted position to at least one deployed position and from at least one deployed position to at least one retracted position.

39) The cleaning system according to claim 38 further comprising at least one retraction detector adapted to detect the complete retraction of said at least one vacuum hose onto said at least one reel.

40) The cleaning system according to claim 29 further comprising at least one deployment detector adapted to detect the finished deployment of said at least one vacuum hose from said at least one reel.

41) The cleaning system according to claim 40 wherein said at least one hose deployer is powered by said at least one vacuum pump prior to said at least one deployment detector detecting the finished deployment of said at least one vacuum hose from said at least one reel.

42) The cleaning system according to claim 40 wherein said at least one vacuum pump pulls water through said at least one vacuum hose after said at least one deployment detector detects the finished deployment of said at least one vacuum hose from said at least one reel.

43) The cleaning system according to claim 40 further comprising at least one automatic switch adapted to automatically switch said at least one vacuum pump from powering said at least one hose deployer to pulling water through said at least one vacuum hose after said at least one deployment detector detects the finished deployment of said at least one vacuum hose from said at least one reel.

44) The cleaning system according to claim 43 wherein said at least one automatic switch comprises at least one hydraulic actuator.

45) The cleaning system according to claim 40 wherein said at least one deployment detector comprises:

- a) at least one spring-loaded lever adapted to provide at least one spring-loaded lever on the interior of said at least one hose reel
 - i) wherein said at least one spring-loaded lever is compressed when said at least one vacuum hose presses said at least one spring-loaded lever; and
 - ii) wherein said at least one spring-loaded lever is released when said at least one vacuum hose is removed from said at least one spring-loaded lever;
- b) at least one spring-loaded bar adapted to provide at least one spring-loaded bar on the exterior of said at least one hose reel
 - i) wherein said at least one spring-loaded bar is pulled into at least one retracted position when said at least one spring-loaded lever is compressed; and
 - ii) wherein said at least one spring-loaded bar means is released into at least one extended position when said at least one spring-loaded lever is released;

c) at least one spring-loaded switch

- i) wherein said at least one spring-loaded switch is open when said at least one spring-loaded bar is pulled into such at least one retracted position; and
- ii) wherein said at least one spring-loaded switch is closed when said at least one spring-loaded bar is released into such at least one extended position and contacts said at least one spring-loaded switch.

46) The cleaning system according to claim 29 wherein said at least one hose deployer comprises:

- a) at least one hydraulic motor;
- b) wherein said at least one hydraulic motor is powered by said at least one vacuum pump;
- c) at least one hose-guiding wheel adapted to guide said at least one vacuum hose;
- d) at least one hose-moving wheel adapted to move said at least one vacuum hose;
- e) at least one wheel compressor adapted to compress said at least one vacuum hose between said at least one hose-guiding wheel and said at least one hose-moving wheel;
- f) wherein said at least one wheel compressor is actuated by said at least one vacuum pump; and
- g) at least one drive adapted to drive said at least one hose-moving wheel off of said at least one hydraulic motor;
- h) whereby, when said at least one vacuum pump is turned on, said at least one vacuum hose is laterally compressed and is rolled longitudinally between said at least one hose-guiding wheel and said at least one hose-moving wheel.

47) The cleaning system according to claim 46 wherein:

- a) said at least one drive comprises at least one drive chain; and
- b) at least one drive tensioner adapted to provide consistent tension to said at least one drive chain.

48) The cleaning system according to claim 46 wherein said at least one hose-guiding wheel comprises said at least one hose-moving wheel.

49) A system, comprising:

- a) at least one vacuum pump;
- b) at least one hydraulic motor;
- c) wherein said at least one hydraulic motor is powered by said at least one vacuum pump;
- d) at least one hose-guiding wheel adapted to guide at least one hose;
- e) at least one hose-moving wheel adapted to move such at least one hose;
- f) at least one wheel tensioner adapted to tension such at least one hose between said at least one hose-guiding wheel and said at least one hose-moving wheel;
- g) wherein said at least one wheel tensioner is tensioned by said at least one vacuum pump; and

h) at least one drive adapted to drive said at least one hose-moving wheel off of said at least one hydraulic motor;

i) whereby, when said at least one vacuum pump is turned on, such at least one hose is laterally compressed and is rolled longitudinally between said at least one hose-guiding wheel and said at least one hose-moving wheel.

50) A cleaning system, comprising the steps of:

a) storing at least one hose reel in at least one body of water;

b) reeling at least one hose onto such at least one hose reel in such at least one body of water;

c) storing such at least one hose reel having such at least one hose in such at least one body of water; and

d) unreeling such at least one hose off of such at least one hose reel in such at least one body of water;

e) wherein such at least one hose is kept constantly filled with water;

f) wherein the step of unreeling such at least one hose off of such at least one hose reel in such at least one body of water further comprises the step of using at least one hydraulic motor to unreel such at least one hose off of such at least one hose reel in such at least one body of water;

g) wherein the step of using at least one hydraulic motor to unreel such at least one hose off of such at least one hose reel in such at least one body of water further comprises the step of using at least one vacuum pump to pull water through such at least one hydraulic motor;

h) switching such at least one vacuum pump from pulling water through such at least one hydraulic motor to pulling water through such at least one vacuum hose after such at least one vacuum hose is unreeled from such at least one reel;

i) wherein such step of automatically switching further comprises the step of actuating at least one hydraulic actuator;

j) wherein such step of reeling such at least one hose on to such at least one hose reel in such at least one body of water further comprises the step of using at least one spring to reel such at least one hose on to such at least one hose reel in such at least one body of water; and

k) pulling at least one flow of water through such at least one hose.

* * * * *