2015-1177

IN THE
UNITED STATES COURT OF APPEALS
FOR THE FEDERAL CIRCUIT

AQUA PRODUCTS, INC.,

Appellant,

v.

ZODIAC POOL SYSTEMS, INC.,

Appellee.

Appeal from United States Patent and Trademark Office,
Patent Trial and Appeal Board
Case No. IPR2013-00159

CORRECTED BRIEF FOR APPELLANT AQUA PRODUCTS, INC.

JAMES R. BARNEY
TIMOTHY P. MCANULTY
DAVID K. MROZ
FINNEGAN, HENDERSON, FARABOW,
GARRETT & DUNNER, LLP
901 New York Avenue, NW
Washington, DC 20001-4413
(202) 408-4000

Attorneys for Appellant
Aqua Products, Inc.

March 16, 2015

CERTIFICATE OF INTEREST

Counsel for Appellant Aqua Products, Inc. certify the following:

1. The full name of every party represented by us is:

Aqua Products, Inc.

2. The name of the real party in interest represented by us is:

Fluidra, S.A.

3. All parent corporations and any publicly held companies that own 10 percent or more of the stock of the party represented by us are:

Fluidra, S.A.

4. The names of all law firms and the partners or associates that appeared for the party now represented by us in the trial court or agency or are expected to appear in this Court are:

James R. Barney
Timothy P. McAnulty
David K. Mroz
Michael A. Morin[1]
FINNEGAN, HENDERSON, FARABOW,
GARRETT & DUNNER, LLP

Jeffrey A. Schwab
Anthony A. Coppola
ABELMAN, FRAYNE & SCHWAB

[1] Mr. Morin is now with Latham & Watkins.

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STATEMENT OF RELATED CASES

No other appeal in or from the same proceeding in the U.S. Patent and Trademark Office was previously before this or any other appellate court.

Aqua Products, Inc. has asserted the patent at issue in this appeal (U.S. Patent No. 8,273,183) against Zodiac Pool Systems, Inc. in the United States District Court for the Southern District of New York. (Case No. 1:12-cv-09342-TPG.) A decision in this appeal will directly affect that proceeding.

STATEMENT OF JURISDICTION

This appeal is from a final written decision of the U.S. Patent and Trademark Office, Patent Trial and Appeal Board ("PTAB"), issued August 22, 2014, in Case No. IPR2013-00159, finding claims 1-9, 13, 14, 16, and 19-21 in U.S. Patent No. 8,273,183 unpatentable. A1-57. In the final written decision, the PTAB also denied Appellant's motion requesting entry of substitute claims 22-24. The PTAB had jurisdiction to make these rulings under 35 U.S.C. §§ 6(c) and 318(a).

Appellant filed a timely notice of appeal under 35 U.S.C. § 141 and 37 C.F.R. § 90.2 on October 23, 2014. A2911-16; A124. This Court has jurisdiction under 28 U.S.C. § 1295(a)(4)(A) and 35 U.S.C. § 141(c).

I. STATEMENT OF THE ISSUES

1. Whether the PTAB erred in denying Appellant's motion to substitute claims pursuant to 35 U.S.C. § 316(d), where: (1) the PTAB found that the substitute claims satisfied the statutory requirements for amending claims (i.e., they did not broaden the claims or add new matter) but that they failed to overcome the combination of *Henkin* and *Myers*; (2) the PTAB failed to analyze all the limitations in these claims as required by this Court's jurisprudence and the Administrative Procedure Act; (3) the claims recite features not disclosed in the *Henkin/Myers* combination; and (4) the PTAB failed to adequately consider the substantial evidence of nonobviousness.

2. Whether the PTAB erred in interpreting 37 C.F.R. § 42.121(a)(2)(i) as placing the burden of proof on the patentee to show amended claims are not invalid, whereas the governing statute, 35 U.S.C. § 316(e), clearly places the burden of proving invalidity on the petitioner, regardless of the type of claim at issue (i.e., original or substitute).

II. STATEMENT OF THE CASE

A. Preliminary Statement

In this appeal, Appellant Aqua Products, Inc. ("Aqua") challenges the PTAB's refusal to enter substitute claims 22-24 of U.S. Patent No. 8,273,183 ("the '183 patent") on the ground that they allegedly fail to distinguish the combination of U.S. Patent No. 3,936,899 to Henkin (A2514-25) and U.S. Patent No. 3,321,787

to Myers (A2507-13). The PTAB's obviousness analysis was per se deficient because it failed to consider all the limitations in these claims. Instead, the PTAB focused on just one limitation and then summarily dismissed the rest of the limitations in a single sentence. This type of perfunctory analysis does not live up to this Court's obviousness jurisprudence, which requires a rigorous analysis of *each and every* claim limitation, nor does it satisfy the requirements of the Administrative Procedure Act ("APA"). In fact, when a proper analysis is conducted, it is clear that the PTAB's proposed *Henkin/Myers* combination does not include all the limitations of amended claims 22-24.

The '183 patent describes a self-propelled robotic pool cleaner that moves in a controlled directional fashion along the bottom of the pool. Propulsion occurs through an internal pump that acts not only for propulsion but also as a vacuum to draw in dirty water from the pool and eject filtered water through a discharge jet. Directional movement is controlled in part by a set of uniquely positioned, axially-mounted supports, which can be two pairs of wheels axially mounted transverse to the robot's longitudinal axis. The controlled directional movement is enhanced by positioning the discharge jet such that the resultant force vector is directed behind the cleaner's front supports (or wheels), providing stability during travel.

The robotic pool cleaner described in the '183 patent is a significant improvement over prior-art cleaners. Before the '183 patent, pool cleaners

powered by water pressure moved erratically over the pool surface, changing direction randomly either by climbing the sides of the pool and "falling off," or "spinning" randomly off the pool's vertical surfaces. These devices did not move in a *controlled* directional manner to create a uniform cleaning pattern and thus took longer to clean the pool.

Prior-art pool cleaners powered by electric motors moved in a controlled directional manner but required multiple electrical and mechanical components to do so (e.g., a microprocessor, an electric drive motor, circuit boards, pulleys, bearings, drive belts, etc.). The cleaning function was performed by a pump that did not contribute to the driving function. These devices consumed excessive power and were expensive to purchase and maintain.

The '183 patent solved these problems by allowing for *controlled* directional movement using filtered water discharged from a jet—not multiple electrical and mechanical components. This controlled directional movement distinguishes the invention from prior-art devices such as *Henkin* and *Myers* that used water-jet propulsion to move randomly or erratically.

The novelty and importance of the claimed technology was acknowledged by Appellee Zodiac Pool Systems, Inc. ("Zodiac"), who was then selling a device similar to that described in *Henkin*. Zodiac expressed interest in purchasing the claimed technology before deciding to simply adopt it without permission after the

negotiations stalled. Aqua's product embodying the '183 patent has also achieved significant commercial success.

For the reasons explained below, this Court should vacate the PTAB's obviousness determination and remand for further proceedings.

B. Nature of the Case, Course of Proceedings, and Disposition Below

On February 25, 2013, Zodiac filed a petition for *inter partes* review of claims 1-14, 16, and 19-21 of the '183 patent. A2005-07. After considering Zodiac's petition and Aqua's preliminary response, the PTAB instituted review of claims 1-9, 13, 14, 16, and 19-21, but not claims 10-12. A90; A121. Regarding claims 10-12, the PTAB found that Zodiac failed to demonstrate "a reasonable likelihood of prevailing on its challenge to the patentability" of those claims. A121.

Claims 10-12, which were not subject to *inter partes* review, recite a novel and nonobvious combination of elements that collectively define a superior pool-cleaning robot. Claim 10 depends from claim 7 and requires that "each pair of wheels [recited in claim 7] is mounted on an axle extending transversely across the housing of the apparatus." A87 at 25:4-6. Claim 11 depends from claim 10 and further requires that the water jet recited in claim 1 be angled to "produce a resultant force vector . . . that is directed to a position that is proximate to, and rearwardly displaced from the axle of the front pair of wheels." *Id.* at 25:7-13.

Claim 12 depends from claim 10 and requires that the force vector from the jet discharge be "directed to intersect the axle of the front pair of wheels." *Id.* at 25:14-19.

After institution, Aqua moved to amend claims 1, 8, and 20 of the '183 patent, substituting them with claims 22, 23, and 24, to add limitations similar to those in claims 10-12. A2276-95. Substitute claim 22 is an amended version of claim 1, which adds three limitations. First, it requires that the rotationally-mounted supports be "axially mounted transverse to a longitudinal axis of said apparatus." A2280. Second, it requires that the rotationally-mounted supports "*control* the directional movement of said apparatus over the submerged surface." *Id.* (emphasis added). Third, it requires that the water jet "produce a resultant force vector that is directed to a position that is proximate to and rearwardly displaced from a line passing through the transverse axial mountings of the front rotationally-mounted supports." A2281.

Substitute claim 23, which depends from claim 22, is an amended version of claim 8 and adds two additional limitations. First, it requires that "the rotationally-mounted supports comprise first and second pairs of axially mounted wheels respectively positioned proximate to the front and rear portions of the housing." *Id.* Second, it requires that the resultant force vector of the water jet pass

"proximately to and rearwardly of the plane of the axis of rotation of the pair of wheels at the front portion of the apparatus." *Id.*

Substitute claim 24 is an amended version of claim 20 and adds three limitations. First, it requires "at least a front pair of wheels, each wheel axially mounted transverse to the longitudinal axis" of the apparatus. A2282. Second, it requires the water jet that propels the apparatus to be a "*filtered* water jet." *Id.* (emphasis added). Third, it requires that the resultant force vector of the water jet be "directed to a position that is proximate to and rearwardly displaced from a line passing through the transverse axial mountings of the front pair of wheels." A2282-23.

In summary, each of amended claims 22-24 requires wheels or supports that "*control* the directional movement" of the apparatus (hereinafter "the controlled-directional-movement limitation"). Claim 23 requires two pairs of axially-mounted wheels (hereinafter "the four-wheels limitation"). Claim 24 requires a "*filtered* water jet" (hereinafter "the filtered-water-jet limitation"). And each of claims 22-24 requires that the force vector resulting from the water jet be directed to a point "rearwardly displaced" from the front pair of supports or wheels (hereinafter "the rearwardly-displaced-vector limitation"). Each of these limitations was added specifically to distinguish the claimed invention over the

asserted prior art (A2285-93; A2396; A2400-02; A2803-06; A2479-80; A1033; A1055), and each limitation is at issue in this appeal.

In its final written decision, the PTAB found that amended claims 22-24 complied with 37 C.F.R. § 42.121(a)(2)(ii) (i.e., they did not enlarge the scope of the claims or add new matter). A39-46. Accordingly, these amended claims fully satisfied the formal requirements of 35 U.S.C. § 316(d), which permits a patent owner to file one motion to substitute claims, provided the substitute claims do not enlarge the scope of the original claims or add new matter. 35 U.S.C. § 316(d)(3). But the PTAB ultimately ruled that Aqua had failed to show that these substitute clams were distinguishable over *Henkin* and *Myers*; therefore, it denied Aqua's motion to enter the claims. A46-47; A50-52. This appeal followed.

III. STATEMENT OF FACTS

A. Three Types of Automated Pool Cleaners in the Prior Art

Before the '183 patent, there were three primary types of automated pool cleaners on the market: (1) suction-side cleaners; (2) pressure-side cleaners; and (3) robotic motor-driven cleaners. A2781-83. Of particular note, both suction-side cleaners and pressure-side cleaners moved erratically over the pool surface, changing direction randomly either by climbing the sides of the pool and "falling off" or by "spinning" randomly off of the pool's vertical surfaces. They did not move in a controlled directional manner to create a uniform cleaning pattern.

Motor-driven cleaners, in contrast, moved in a controlled directional manner, typically using a microprocessor and an electric drive motor to steer the device along a preprogrammed pattern and a separate motorized pump to create a vacuum.

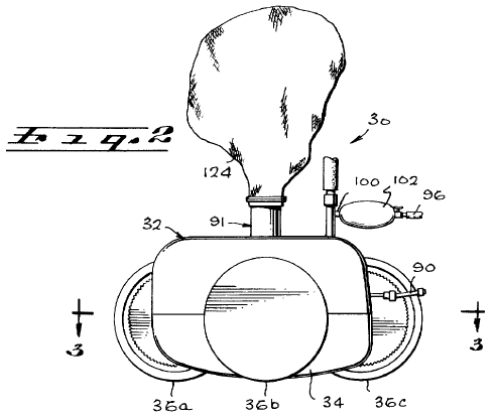
1. Suction-Side Cleaners

Typical suction-side cleaners consisted of a vacuum head connected to the pool's filtration system through a long hose. A2772-806 at A2781. The vacuum head moved along the bottom of the pool using either "walkers" that gripped the pool surface or a vibratory motion that repeatedly bounced the vacuum head off the bottom of the pool. *Id.* As it moved, the vacuum head sucked up debris and sent it to the pool's filtration system through the hose. *See id.* While inexpensive to buy, suction-side cleaners were energy inefficient. A2781-82. The pool's entire pumping and filtration system had to remain operative for the system to work. They also moved randomly, which meant they took much longer to clean the pool than a cleaner that moves in a controlled directional manner. *Id.*

2. Pressure-Side Cleaners

Typical pressure-side cleaners used the water pressure from an external pump to provide propulsion, drive a flexible tail that stirred up debris, and create an upward suction for collecting debris. A2782. While the upward suction collected some of the debris, the debris stirred up by the flexible hose was intended to be collected by the pool's drains and skimmers—not the cleaner itself. *Id.*

Because pressure-side cleaners required the use of external filtration systems and pumps, the operational cost associated with these devices was high. A2784. The *Henkin* device, illustrated below, is typical of a prior-art pressure-side cleaner. A2514-25 at A2516.



Pressure-Side Cleaner

Pressure-side cleaners relied on random movement to clean the pool. A2784. Typically, they moved randomly as a flexible tail stirred up debris by whipping back and forth. A2522 at 5:52-68. This randomness played a major role in how pressure-side cleaners turned at vertical pool surfaces. Typically, they turned by either "spin[ning] off" of the wall, a maneuver facilitated in *Henkin* by an offset three-wheel design with a pivotally mounted rear wheel (A2520 at 2:11-30), or by climbing up and "fall[ing] off" the wall (A2522 at 5:6-51).

While necessary to allow pressure-side cleaners to move about and clean the pool, random movement came at a cost. Namely, pressure-side cleaners took much longer to clean a pool than controlled-movement cleaners, and they could not use

internal electric pumps because doing so would cause the external power cord to twist and knot during the random movement of the device. A2782-83.

3. Robotic Motor-Driven Cleaners

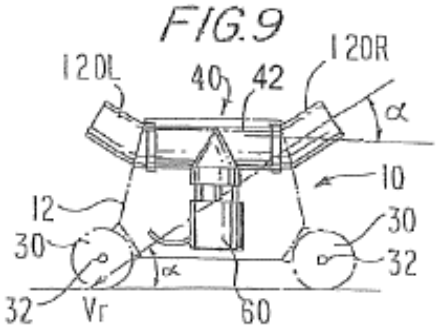
The third type of automated pool cleaner, the robotic motor-driven cleaner, did not rely on a pump as a drive means at all. Instead, these devices typically had two different electric motors, one to drive the wheels and one to power an internal pump. A2783. The internal pump created a suction force that helped maintain contact between the robot and the pool's surface, and also allowed the device to draw in unfiltered water for cleaning. *Id.*

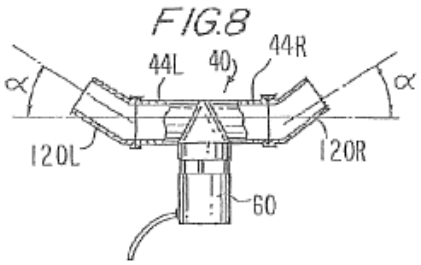
Robotic motor-driven cleaners are expensive to purchase and use. A2778-79. They consume significant power, especially in the Sun Belt where they operate year round and approximately 20-30 times per month. A2778. With extended use, the drive motor suffers significant wear and tear, requiring service and repairs for its numerous electrical and mechanical components (e.g., motor, circuit boards, pulleys, bearings, drive belts, and drive tracks). A2778-79; A2785. At the time of the claimed invention, robotic motor-driven cleaners were criticized by pool companies (including Zodiac's predecessor—seller of the *Henkin* device) as potentially dangerous because they used many electric-powered components in water. A2778.

B. The Patented Invention

1. The ’183 Patent Discloses a Superior Pool Cleaner that Achieves Controlled Directional Movement Without the Use of a Computerized Drive Motor

The ’183 patent discloses an automated pool cleaner that filters pool water while being propelled by an internal pump that discharges filtered water from a “discharge conduit.” A79-80 at 10:41-11:30; A2786. The cleaner draws in the unfiltered water from underneath the device. A78 at 8:58-61.





A63.

The ’183 patent’s innovation of using the internal pump for cleaning, for maintaining contact with the pool surface, and for propulsion was a major improvement over the methods used by previous pressure-side cleaners (which used external pumps for propulsion) and robotic motor-driven cleaners (which used electric drive motors for propulsion). A2786. The cleaner disclosed in the ’183 patent was the first pool cleaner in the industry to achieve *controlled*

directional motion using an internal pump and a filtered-water jet drive, as opposed to a computerized drive motor as in the prior art. *Id.*

The cleaner disclosed in the ’183 patent has axially-mounted wheels or supports positioned to allow for controlled directional movement of the robot across the bottom of the pool. A83 at 18:11-20. The types of patterns achievable using this method of controlled directional movement are illustrated in Figures 35A and 35B:

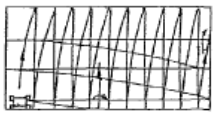


FIG. 35A

FIG. 35B

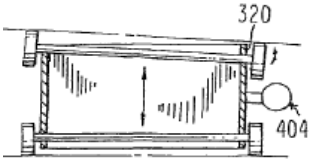


FIG. 37

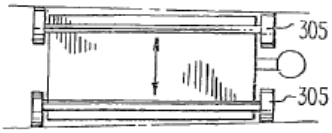
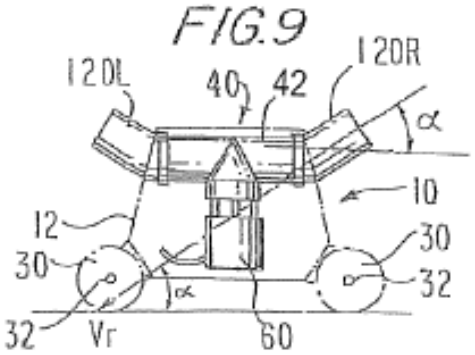


FIG. 38

A71. These are comparable to the patterns previously achievable only by computer-controlled motorized cleaners. *See* A70, Figs. 31B, 32B. These controlled-movement patterns clean the pool faster than, and are thus preferred over, the random-movement patterns used by suction-side cleaners and pressure-side cleaners in the prior art. *See supra* § III.A.

The controlled-movement pattern is made possible, in part, by the orientation of the discharge conduit (i.e., the water jet). The jet is positioned such that it produces a force vector V_r directed to a point at or behind the axis of the cleaner's front wheels, as shown in Figure 9 below. A79-80 at 10:41-11:3; A2786.



A63.

A jet positioned in this manner propels the cleaner forward and provides sufficient force for efficient cleaning, while keeping the wheels in operative contact with the pool surface. A79-80 at 10:41-11:3. Put differently, the downward force supplied by the jet, arranged as claimed in the '183 patent, allows the cleaner to move and clean with stability. *Id.* The cleaner described in the '183 patent also does not incur the same wear and tear as typical pressure-side cleaners, which were designed to turn around by randomly spinning and/or falling off walls. *See supra* § III.A.2.

When viewed together, the features in the '183 patent—e.g., using an internal pump to propel the device with filtered water discharged from a jet,

angling the jet to provide stability, and using axially-mounted wheels positioned for controlled directional movement—combine to provide a robotic pool cleaner that is a significant improvement over any cleaner that came before it. Among other things, the patented device combines the controlled-directional-movement feature of the more expensive, maintenance-intensive motor-driven robots with the cost efficiency of water-jet propulsion. A79-80 at 10:41-11:3; A83 at 18:11-20; A2778-79. The result is a cheaper, easier-to-maintain pool-cleaning robot that achieves *controlled* directional propulsion rather than relying on random or erratic motion like most comparable devices in the prior art. A79-80 at 10:41-11:3; A83 at 18:11-20; A2786.

2. The Revolutionary Technology in the ’183 Patent Has Enjoyed Significant Commercial Success

Aqua incorporated the ’183 patent’s technology into its POOL ROVER robotic cleaner, released in 2001. A2790. When compared to Aqua’s previous pool-cleaning products, the technology in the ’183 patent lowered production costs and decreased repair and maintenance costs. A2790-91. The POOL ROVER also consumed less power than previous products and exhibited the stability described in the ’183 patent. *Id.* Moreover, the POOL ROVER’s controlled movement patterns saved time and energy and decreased wear and tear on the robot, compared to random-motion cleaners. A2791. The number of customer inquiries and complaints on operational issues that Aqua received for the POOL ROVER

was 90% less than those for its AQUABOT device, a previously released robotic motor-driven cleaner. *Id.*

Over the past ten years, Aqua has sold over 100,000 pool cleaners with the technology from the '183 patent. *Id.* Sales have increased every year since 2002. *Id.* Annual sales of the POOL ROVER reached 10,000 within approximately four years of the product's release. A2791-92. POOL ROVER sales currently represent more than two-thirds of all robotic pool cleaner sales for Aqua. A2792.

3. Zodiac Expressed Interest in the '183 Patent's Technology Before Copying It

In 2002, shortly after Aqua released the POOL ROVER, Zodiac expressed interest in purchasing Aqua's jet-drive technology (i.e., the technology covered by the '183 patent). *Id.* The two companies participated in exploratory discussions at Aqua's headquarters in New Jersey. *Id.* Zodiac's Chief Operating Officer and its President both toured Aqua's facilities, observing products and manufacturing operations. *Id.* As part of these discussions, Aqua provided detailed technical specifications of its jet-drive technology to Zodiac. *Id.* Zodiac (marketer of the *Henkin* device) acknowledged that it had never considered commercializing a controlled-movement jet-drive pool cleaner like the one claimed in the '183 patent. *Id.*

After pausing the negotiations for several years, the parties reengaged in 2008, with Zodiac reaffirming its interest in the jet-drive technology covered by

the ’183 patent. *Id.* As part of these renewed discussions, Aqua sent several jet-drive robotic pool cleaners to Zodiac for evaluation. A2792-93. After testing these products, Zodiac expressed interest in entering into a joint venture with Aqua. A2793. Later in 2008, Aqua’s President met with Zodiac’s top business and technical personnel to discuss the patented jet-drive technology. A2774; A2793. At some point after the meeting, however, Zodiac decided it did not want to enter into the joint venture, citing the current state of the economy as the reason. A2793.

A few months later in 2009, Zodiac introduced its new POLARIS line of robotic pool cleaners *fully equipped with Aqua’s jet-drive technology*. A2794. This included the angled jet drive with a resultant force vector directed just as the ’183 patent describes—rearward of the axis of rotation of the front wheels or supports. *Id.* Zodiac continued using Aqua’s patented jet-drive technology in subsequent models of its POLARIS product (e.g., the POLARIS 9100, 9300, and 9400). *Id.* The POLARIS product and Aqua’s POOL ROVER pool cleaner now constitute the majority of robotic pool-cleaner sales in the United States. *Id.*

C. The Amended Claims at Issue in This Appeal

Claims 22-24 of the ’183 patent are at issue in this appeal. These are substitute, amended claims introduced by motion during the *inter partes* review

underlying this appeal. A2280-83. Claims 22-24 are reproduced below in annotation form to show the amendments[2]:

> 22. (Proposed substitute for original claim 1) A self-propelled cleaning apparatus for cleaning a submerged surface of a pool or tank, comprising:
>
> a housing having a front portion as defined by the direction of movement of the apparatus when propelled by a water jet, an opposing rear portion and adjoining side portions defining the periphery of the apparatus, and a baseplate with at least one water inlet;
>
> rotationally-mounted supports axially mounted transverse to a longitudinal axis of said apparatus and coupled proximate the front and rear portions of the housing to ~~enable~~ control the directional movement of said apparatus over the submerged surface;
>
> a water pump mounted in the interior of said housing, said water pump being configured to draw water and debris from the pool or tank through the at least one water inlet for filtering; and
>
> a stationary directional discharge conduit in fluid communication with the water pump and having at least one discharge opening through which a pressurized stream of water forming the water jet is directionally discharged at a predetermined angle that is acute with respect [to] the surface over which the apparatus is moving,
>
> wherein said predetermined angle is inclined upwardly with respect to the surface beneath the apparatus to produce a resultant force vector that is directed to a position that is proximate to and rearwardly displaced from a line passing through the transverse axial mountings of the front rotationally-mounted supports.
>
> 23. (Proposed substitute for original claim 8) The apparatus of claim ~~7~~ 22, wherein the rotationally-mounted supports comprise first

[2] Newly-added text is shown in underline, and deleted language is shown in strikethrough.

and second pairs of axially mounted wheels respectively positioned proximate to the front and rear portions of the housing, wherein a portion of the discharge conduit terminating in the at least one discharge opening is angled upward with respect to an adjacent portion of the discharge conduit to produce a resultant force vector in the water jet discharged from said at least one discharge opening that is directed to pass ~~through~~ proximately to and rearwardly of the plane of the axis of rotation of the pair of wheels at the front portion of the apparatus.

24. (Proposed substitute for original claim 20) A self-propelled cleaning apparatus for cleaning a submerged surface of a pool or tank, said apparatus having a longitudinal axis and being propelled by the discharge of a water jet, the apparatus comprising:

a housing including a baseplate with at least one water inlet, a front portion, a rear portion and opposing side portions defining the periphery of the apparatus, said front portion being defined with respect to the forward directional movement of the apparatus when propelled by the water jet;

~~rotationally-mounted supports~~ at least a front pair of wheels, each wheel axially mounted transverse to the longitudinal axis and coupled to the housing to ~~enable~~ control the directional movement of said apparatus over the submerged surface;

a water pump mounted in the interior of said housing, said water pump configured to draw water and debris from the pool or tank through the at least one water inlet for filtering, and a pump discharge outlet for emitting a pressurized stream of filtered water;

a stationary directional discharge conduit in fluid communication with the pump discharge outlet, the discharge conduit having at least one discharge opening through which the filtered water jet is directionally discharged from the apparatus at a predetermined angle that is less than normal with respect to the surface beneath the apparatus,

wherein said predetermined angle is inclined upwardly with respect to the surface beneath the apparatus to produce a resultant

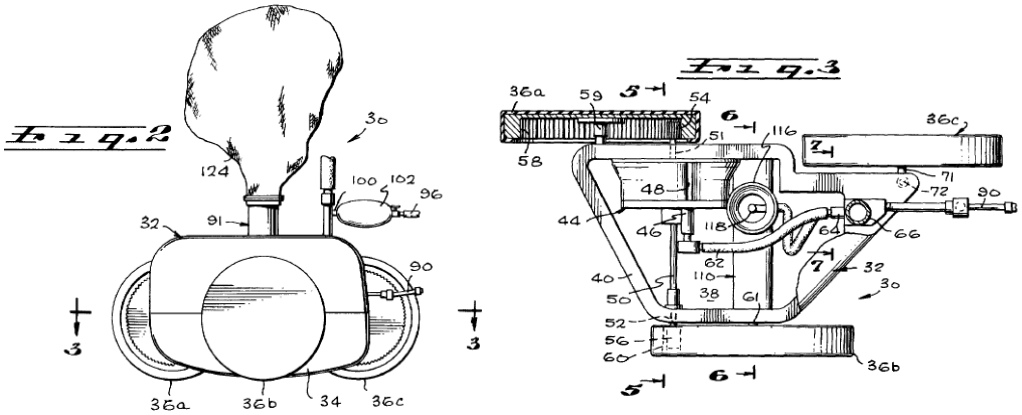
> force vector that is directed to a position that is proximate to and rearwardly displaced from a line passing through the transverse axial mountings of the front pair of wheels.

Id.

D. Description of the Two References Relied Upon by the PTAB to Deny Aqua's Motion to Substitute Claims 22-24

1. Henkin (U.S. Patent No. 3,936,899)

Henkin discloses a pressure-side pool cleaner that moves randomly around the bottom of the pool. *See supra* § III.A.2; A2520 at 1:46-49. The random movement in *Henkin* is facilitated by a three-wheel design where the wheels (36a, 36b, 36c) rotate around axes that are "offset with respect to one another." A2521 at 4:42-57. In addition, rear wheel 36c is pivotally mounted to permit random movement similar to that of a caster wheel. A2520 at 2:22-26; A2523 at 7:45-65.



A2516; A2517.

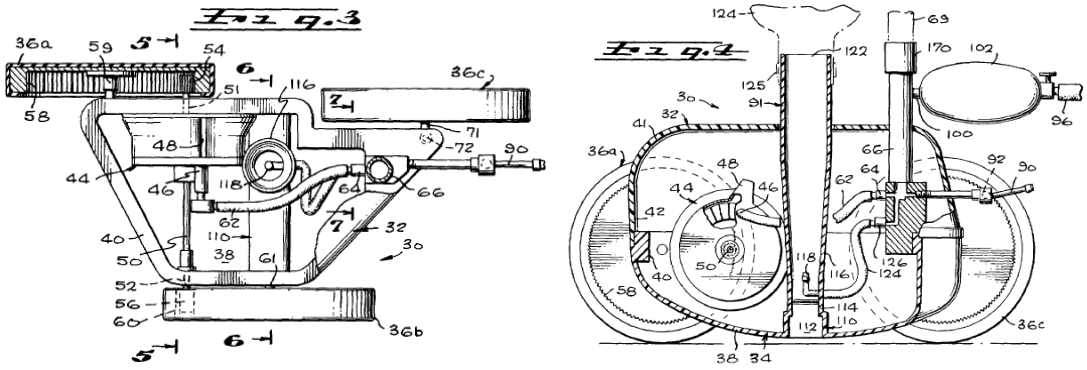
The "skewed" relationship between the wheels prevents the cleaner from "getting stuck against vertical walls or barriers." A2521 at 4:42-49. "That is, in its

random travel along the pool vessel surface, even if the wheels 36a and 36b simultaneously engage a large obstacle such as the vertical wall of a step, the skewed relationship of the wheels . . . will produce a force component extending parallel to the vertical wall to thus enable the car to spin off and . . . avoid getting stuck in a position from which it cannot emerge." *Id.* at 4:49-57. Thus, the use of three offset wheels (as opposed to four aligned wheels) is very important to the proper functioning of the *Henkin* design.

In addition to "spinning" off walls, *Henkin* can change direction by climbing vertical surfaces and then falling off to "reestablish . . . travel along another path." A2522 at 5:6-14, 5:34-51. *Henkin* teaches that the weight distribution in the cleaner and the low center of gravity allow the cleaner to land "correct side up" after the fall. *Id.* at 5:34-51.

In *Henkin*, the primary source of movement is provided by wheels driven by pressurized water flow from an external booster pump that sends water down a supply hose and into the device. A2521 at 4:35-41. *Henkin* also discloses an auxiliary water jet that aids in propulsion and provides the extra force that enables the cleaner to make its random and erratic turns—i.e., "a forward [force] component which aids in propelling the car and facilitates the car climbing vertical surfaces and working itself out of corners." A2522 at 5:19-24; *see also id.* at 5:34-

40. In *Henkin*, the water jet is referred to as a "directionally adjustable nozzle 90," shown below in Figures 3 and 4. *Id.* at 5:6-10.



A2517.

The nozzle 90 is adjustable, with the angle "selected to yield both a downward thrust component (i.e. normal to the vessel surface) for providing traction and a forward component which aids in propelling the car and facilitates the car climbing vertical surfaces and working itself out of corners." *Id.* at 5:15-27. *Henkin* does not describe the limits of adjustability for the nozzle, but the position of the nozzle would logically be confined to a range that allows the *Henkin* cleaner to operate properly. For instance, angling the thrust component too far downward would press the wheels of the *Henkin* device to the floor and inhibit the device from operating as intended, which is to move, slip, and turn randomly about the pool. *See supra* § III.A.2. Angling the thrust component too far downward would also compromise the forward thrust component, which the

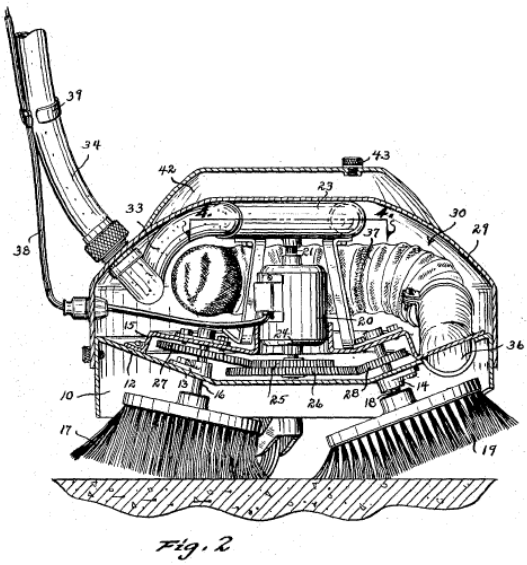
Henkin cleaner relies on to gain traction against vertical walls for performing its climb-and-fall maneuver. A2522 at 5:6-14, 5:34-40.

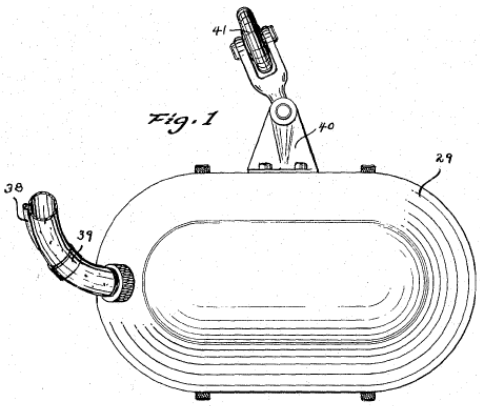
The random movement described in *Henkin* is not an accident—this type of movement is necessary for the device to clean the pool as intended. *Henkin* discloses a flexible "sweep hose" 96, shown above in Figure 4, that stirs up debris by whipping back and forth along the bottom of the pool. *Id.* at 5:52-68. This debris is intended to be collected by the pool's "standard filtration system," not the cleaner itself. *Id.* at 5:60-63.

The *Henkin* cleaner also performs some filtering on its own. As the cleaner moves along the bottom of the pool, it pulls debris in from underneath the device through a "suction opening" 112, shown in Figure 4 above. *Id.* at 6:6-52. Suction is created by an orifice 118 that discharges water received from the external booster pump 70. *Id.* The suction force provided by the orifice causes the debris to progress up the device to a mesh filter bag 124, which catches the debris while letting filtered water back out into the pool. *Id.* Notably, whereas the water leaving the filter bag is filtered by the device, the water discharged back into the pool from nozzle 90 and sweep hose 96 is not filtered by the device. *Id.* at 5:6-14, 5:52-68, 6:6-34, Fig. 4.

2. Myers (U.S. Patent No. 3,321,787)

Myers describes a pool-cleaning device "that is erratically self-propelled over the bottom surface of the swimming pool." A2510 at 1:8-11; *see also id.* at 2:47-48. The *Myers* device has two differently angled, vertically mounted rotary brushes 17, 19 powered either by an internal electric motor 20 or an internal rotary pump 23. *Id.* at 1:47-2:5; A2511 at 3:41-46. Water enters the device from underneath, after which it can be filtered by a "pocket-type noncollapsible filter 37." A2510 at 2:22-33.





A2508.

A "powered suction" element outside of the pool such as a "motorized pump" can connect to the device through a "rubber-like hose" 34 for water removal. *Id.* at 2:5-21. The hose can be detached to provide a jet force that will help move the unit. A2511 at 3:6-12. The random, erratic movement in *Myers* is

necessary because the device "must, without attention of the user, be able to engage a wall of the pool, change its course of direction, and proceed intermittently to other locations." A2510 at 1:8-11, 2:47-51. Also, the "erratic movement will eventually cause the scrubbing elements to contact all the bottom surface of the pool." *Id.* at 2:51-53.

Myers uses "several methods for causing . . . erratic movement." *Id.* at 2:53-55; *see also* A2510-11 at 2:55-3:25. These methods involve differentiating the position, bristle length, speed of rotation, and direction of rotation of the scrub brushes to ensure that the traction between each brush and the pool surface varies. A2510-11 at 2:59-3:5. *Myers* also teaches that the water discharged from the flexible conduit 33 when the rubber-like hose 34 is detached contributes to erratic movement. *Id.* at 2:54-56, 3:6-12 (identifying jet discharge as one of "several methods for causing this erratic movement of the unit").

Notably, *Myers* mentions nothing about using the jet to stabilize the pool cleaner and instead relies on other components for stabilization such as "a horizontal arm 40 carrying a caster wheel 41" and a compartment that can be filled with sand or water to weigh down the device. A2510 at 2:34-46.

E. The PTAB's *Inter Partes* Review of the '183 Patent

1. Proceedings Before Institution

Zodiac filed a petition for *inter partes* review of the '183 patent on February 25, 2013, seeking to invalidate claims 1-14, 16, and 19-21. A2005-07. In its petition, Zodiac alleged that claims 1-4, 13, 14, 16, and 19-21 were anticipated by *Myers* and that claims 1-12 and 19-21 were obvious based on various combinations of *Myers* and three additional references: *Henkin*; *Pansini* (U.S. Patent No. 4,100,641); and *Altschul* (U.S. Patent No. 4,429,429). *Id.*

Zodiac's challenge to claims 10-12 failed. A90; A121. These claims include a unique combination of features that Zodiac was unable to demonstrate would have been obvious at the time of the invention. For example, claim 10 requires four wheels with each pair being "mounted on an axle extending transversely across the housing of the apparatus." A87 at 25:4-6. Claim 11 requires that the jet discharge be angled such that it "produce[s] a resultant force vector . . . directed to a position that is proximate to, and rearwardly displaced from the axle of the front pair of wheels." *Id.* at 25:7-13. Claim 12 requires that the resultant force vector "intersect the axle of the front pair of wheels." *Id.* at 25:14-19.

Zodiac alleged that claims 10-12 were obvious over a combination of *Altschul* and *Myers*. A2007. But the PTAB rejected this argument because

Altschul describes a cleaning device "for cleaning the sidewalls of a swimming pool at the waterline region, within a few inches above and below the waterline." A119-20 (quoting A2549 at 1:8-9). The modifications that Zodiac proposed would have compromised *Altschul*'s buoyancy properties and thus conflicted with the purpose of the device, which is to float near the waterline. A120. Accordingly, the PTAB denied institution for claims 10-12. A90; A121. The PTAB did, however, institute *inter partes* review for claims 1-9, 13, 14, 16, and 19-21. A121.

2. Proceedings After Institution

a. Aqua's Motion to Amend Claims

After institution, Aqua moved pursuant to 35 U.S.C. § 316(d) to amend claims 1, 8, and 20 of the '183 patent, substituting them with claims 22, 23, and 24, respectively. A2276-95. Claims 22-24 include features of the invention that distinguish Aqua's pool cleaner from the prior art. These include the controlled-directional-movement feature requiring *controlled* movement of the device along the bottom of the pool, as opposed to random or erratic movement (claims 22-24); the rearwardly-displaced-vector feature, which produces a downward force sufficient to keep the cleaner stable during its controlled movement (claims 22-24); and the filtered-water-jet feature requiring the propulsion jet to discharge filtered water (claim 24). Moreover, claim 23 requires *four wheels* axially mounted transverse to the longitudinal axis, in contrast to the three-wheeled offset design of

Henkin or the *Myers* design, which has two non-axially-mounted scrubbers and a caster wheel.

In support of its motion to amend, Aqua explained how the '183 patent's specification discloses the subject matter necessary to support these amendments and how none of the amendments broaden the issued claims. A2283-85; A2395-99. Aqua also explained that claims 22-24 were patentable over the various obviousness combinations relied upon by the PTAB in its institution decision. A2285-93; A2400-02; A2803-06.

b. Final Written Decision

The PTAB issued a final written decision on August 22, 2014, which addressed, inter alia, Aqua's motion to enter amended claims 22-24. The PTAB found that Aqua had complied with 37 C.F.R. § 42.121(a)(2)(ii) because the amendments were not broadening, did not introduce unsupported subject matter, and did not render the claims indefinite. A39-46. Thus, the PTAB found no *statutory* defects in the amended claims. *See* 35 U.S.C. § 316(d) (giving patent owners the right to file one motion to amend during *inter partes* review, provided the amendments do not broaden the claims or add new matter). The PTAB then proceeded to evaluate the patentability of these claims.

Ultimately, the PTAB found that Aqua "fail[ed] to demonstrate that the substitute claims [22-24] are patentable over Henkin and Myers." A52. The

PTAB did not explain exactly how or why a person skilled in the art would integrate the *Henkin* and *Myers* designs to arrive at all the limitations in claims 22-24. It instead referred to the earlier analysis of *Henkin* and *Myers* that it had performed under the original claims. A51-52. There, the PTAB had agreed with Zodiac that *Henkin* discloses "substantially all" of the limitations in claims 1-5 and 19-21 of the '183 patent. A27. The PTAB had further agreed with Zodiac that a person skilled in the art would rely on *Myers* to replace *Henkin*'s external pump with an internal pump. *Id*. Notably, however, claims 1-5 and 19-21 do not include the controlled-directional-movement limitation (claims 22-24), the rearwardly-displaced-vector limitation (claims 22-24), or the four-wheels limitation (claim 23). These limitations were never addressed in the PTAB's initial obviousness analysis based on *Henkin* and *Myers*.

After referring back to its initial analysis, the PTAB addressed just one limitation in amended claims 22-24—the rearwardly-displaced-vector limitation. A50-52. The PTAB rejected Aqua's evidence that this limitation is not disclosed by *Myers* or *Henkin* with a conclusory statement that "Henkin describes using the downward resultant force for a substantially similar purpose to the '183 Patent." A50-51. The PTAB ignored that using the jet position recited in claims 22-24 with the *Henkin* cleaner would inhibit the device from operating as intended, which is to move, slip, and turn randomly about the pool, often climbing and spinning off

walls to do so. *See supra* § III.D.1. The two techniques are not compatible. The positioning of the force vector in claims 22-24 is designed for stability, whereas *Henkin* requires *instability* to accomplish random turning when encountering a sidewall. A2784; A2789.

After addressing the rearwardly-displaced-vector limitation, the PTAB's analysis essentially stopped. The PTAB never addressed or even acknowledged the controlled-directional-movement limitation in claims 22-24, which is not met by either *Henkin* or *Myers*. As Aqua explained in its motion to amend, this limitation was specifically added to distinguish prior-art references such as *Henkin* and *Myers* that rely on "totally random movement." A2285; *see also* A2289 (noting that *Myers* "only intends uncontrolled and erratic movement"); A2396 (noting that "control" is a "[n]arrowing [l]imitation" that distinguishes *Myers*); A2803; A2805. Likewise, the PTAB never addressed the filtered-water-jet limitation in claim 24, which Aqua argued cannot be met by the combined *Henkin/Myers* device hypothesized by the PTAB. A2479 ("Directional discharge conduit [in *Henkin*] does not discharge filtered water."); A1033 at 34:21-22. The PTAB also never addressed the four-wheels limitation of claim 23, which clearly is not satisfied by either *Henkin* or *Myers* and would not be met by the PTAB's hypothetical *Henkin/Myers* combination. *See* A2401 (noting that "Henkin is a three-wheeled outrigger device"); *see also* A1055 at 56:13-24 (PTAB inquiring

about the four-wheels limitation and Zodiac's counsel admitting that "Myers doesn't disclose two sets of wheels" and "Henkin doesn't disclose two sets of wheels").

Rather than address these limitations, the PTAB issued a conclusory, one-sentence statement that "we find that with respect to the additional limitations recited in the substitute claims, there are a finite number of predictable solutions and that the subject matter of the substitute claims is not the product of innovation, but of ordinary skill and common sense." A51-52. The PTAB cited no *evidence* to support this conclusion—for instance, it cited no testimony from a person of ordinary skill in the art. *Id.* It is Aqua's contention that this one-sentence, ipsis dixit dismissal of all the remaining limitations in the claims was improper and not in keeping with this Court's obviousness jurisprudence or the record-making requirements of the APA.

IV. SUMMARY OF THE ARGUMENT

The PTAB erred in ruling that Aqua failed to show that claims 22-24 are distinguishable over the combination of *Henkin* and *Myers*. Specifically, the PTAB failed to perform a limitation-by-limitation analysis of these claims as required by this Court's obviousness jurisprudence and the APA. As a result of its truncated and conclusory analysis, the PTAB overlooked at least three limitations

recited in claims 22-24 that are clearly not present in the hypothetical combination of *Henkin* and *Myers* proposed by the PTAB.

First, claims 22-24 each require at least one pair of rotationally-mounted supports or wheels "axially mounted transverse to the longitudinal axis" of the apparatus "to *control* the directional movement of said apparatus over the submerged surface." A2280-83 (emphasis added). In contrast, neither *Henkin* nor *Myers* discloses *controlled* directional movement. Instead, both references expressly teach only *random* or *erratic* movement, which is the antithesis of controlled directional movement.

Second, dependent claim 23 requires *four* axially-mounted wheels for controlling directional movement. In contrast, neither *Henkin* nor *Myers* discloses or suggests the use of four axially-mounted wheels. *Myers* discloses only two non-axially-mounted scrubbing elements and a single caster wheel. *Henkin* discloses only *three* offset wheels mounted on three "spaced axes" to help the apparatus "avoid getting stuck against vertical walls or barriers" during its random travel around the pool. A2520 at 2:11039; A2521 at 4:42-57. The use of two pairs of axially-mounted wheels in *Henkin* would destroy this important "spin off" feature, rendering the device inoperable for its intended purpose.

Third, claim 24 requires a "discharge opening through which the *filtered* water jet [from the filter pump discharge outlet] is directionally discharged."

A2282 (emphasis added). In contrast, the combination of *Henkin* and *Myers* proposed by the PTAB—i.e., where *Henkin*'s external pump is replaced with the internal pump of *Myers*—would not discharge filtered pool water through its directional jet. Instead, the only filtered water that is discharged in the *Henkin* design is the water dispersed through the filter bag at the top of the device. The hypothetical *Henkin/Myers* device proposed by the PTAB would therefore discharge only *unfiltered* water through the propulsion jet.

It is important to note that Aqua added each of these limitations to the amended claims to distinguish the cited prior art. In summarily concluding that claims 22-24 would have been obvious, the PTAB ignored these added claim limitations and failed to show how they would be met by the same hypothetical combination of *Henkin* and *Myers* that was used to invalidate claims 1-5 and 19-21, *which do not contain all of these limitations*.

In fact, the PTAB's obviousness analysis for claims 22-24 focused on just a single limitation—the rearwardly-displaced-vector limitation. And there, the PTAB simply got it wrong. Nothing in *Henken* suggests adjusting the angle of the discharge nozzle such that the resultant vector is directed *behind* the front wheels (or supports) of the device. In fact, doing so would inhibit the *Henkin* device from operating as intended, which is to move, slip, and turn randomly about the pool, often climbing and spinning off walls to do so.

The PTAB also erred by not properly analyzing the objective indicia of nonobviousness, which include substantial evidence of commercial success, long-felt need, and copying by Zodiac.

Finally, the PTAB erred as a matter of law in interpreting 37 C.F.R. § 42.121(a)(2)(i) as placing a burden on the patentee to prove that amended claims proposed under 35 U.S.C. § 316(d) are *not* invalid. There is no such requirement in the governing statute. To the contrary, 35 U.S.C. § 316(e) makes clear that *petitioners* bear "the burden of proving a proposition of unpatentability by a preponderance of the evidence," and this makes no distinction between original or amended claims.

V. APPLICABLE LEGAL PRINCIPLES

A. Standard of Review

This Court reviews legal determinations by the PTAB without deference and factual findings for substantial evidence. *In re Zurko*, 258 F.3d 1379, 1384 (Fed. Cir. 2001). The substantial evidence standard allows this Court to use its "comparative expertise" to "understand the basis for the [PTAB's] finding of fact" and "assur[e] proper review." *Id.* (quoting *Dickinson v. Zurko*, 527 U.S. 150, 162-63 (1999)).

B. Legal Standards Applicable to Motions to Substitute Claims During *Inter Partes* Review

35 U.S.C. § 316(d)(1) gives patent owners the right in an *inter partes* review to request amendment of the challenged claims. Specifically, "[d]uring an inter partes review . . . , the patent owner may file 1 motion to amend the patent in 1 or more the following ways: . . . (B) For each challenged claim, propose a reasonable number of substitute claims." 35 U.S.C. § 316(d)(1). The only restriction on this right is that "[a]n amendment under this subsection may not enlarge the scope of the claims of the patent or introduce new matter." 35 U.S.C. § 316(d)(3). The same section of the statute makes clear that, "[i]n an inter partes review . . . , the petitioner shall have the burden of proving a proposition of unpatentability by a preponderance of the evidence." 35 U.S.C. § 316(e). Notably, this burden of proof is irrespective of the type of claim that is being challenged (i.e., original or amended); the statute places the burden of proving *any* "proposition of unpatentability" squarely on the petitioner. *Id.*

The PTO implemented 37 C.F.R. § 42.121 ("Amendment of the patent") to administer the statutory right of a patent owner to petition for amendment. That rule states that "[a] patent owner may file one motion to amend a patent, but only after conferring with the Board." 37 C.F.R. § 42.121(a). It further establishes the criteria for denial of such a motion as follows:

> A motion to amend may be denied where:
>
> (i) The amendment does not respond to a ground of unpatentability involved in the trial; or
>
> (ii) The amendment seeks to enlarge the scope of the claims of the patent or introduce new subject matter.

37 C.F.R. § 42.121(a)(2).[3]

Notably, the requirement in Rule 42.121(a)(2)(i) that a motion to substitute claims must "respond to a ground of unpatentability involved in the trial" does not actually appear in the statute. Instead, the PTO added this requirement during implementation of the statute. *See* 35 U.S.C. § 316(d) (containing no such requirement). Accordingly, this additional requirement can only carry statutory authority to the extent it (1) "give[s] effect to the unambiguously expressed intent of Congress," or (2) fills a gap left by Congress and "is based on a permissible construction of the statute." *Chevron, U.S.A., Inc. v. Natural Res. Def. Council, Inc.*, 467 U.S. 837, 842-43 (1984); *accord In re Cuozzo Speed Techs., LLC*, No. 2014-1301, slip op. at 16-19 (Fed. Cir. Feb. 4, 2015) (addressing the PTO's rulemaking authority under the America Invents Act).

In other cases, the PTAB has interpreted Rule 42.121(a)(2)(i) as negating the statutory burden of proof on the petitioner as set forth in 35 U.S.C. § 316(e), and

[3] A "ground of unpatentability" in subsection (i) most logically refers to the prior-art references or combinations upon which the original petition for *inter partes* review was based. *See* 37 C.F.R. § 42.104(b)(2) (requiring a petition to identify "[t]he *specific statutory grounds* under 35 U.S.C. 102 or 103 on which the challenge to the claim is based and the *patents or printed publications relied upon for each ground*" (emphases added)).

instead has placed that burden on the patent owner for amended claims. *See, e.g.*, *Idle Free Sys., Inc. v. Bergstrom, Inc.*, IPR2012-00027, Paper 26 at 7 (PTAB June 11, 2013) ("The burden is not on the petitioner to show unpatentability [of amended claims], but on the patent owner to show patentable distinction over the prior art of record and also prior art known to the patent owner."). In the present case, the PTAB likewise placed the burden of proving patentability on Aqua and required nothing of Zodiac. A46-47 ("In a motion to amend claims, the patent owner, as the movant, bears the burden of establishing the patentability of the proposed substitute claims over the prior art of record and also other prior art known to Patent Owner."); *see also* A52.

Aqua disagrees that 37 C.F.R. § 42.121(a)(2)(i) places a burden on the patent owner to prove patentability of substitute claims over the asserted prior art. First, there is no requirement in the authorizing statute—35 U.S.C. § 316(d)—that a proposed amendment must "respond to a ground of unpatentability involved in the trial." That requirement appears only in the PTO's regulations. Although it is not improper per se for the PTO to include such an extraneous requirement in the implementing regulations, it is improper for the agency to interpret this requirement in a way that conflicts with the statute. The authorizing statute clearly states that "the *petitioner* shall have the burden of proving a proposition of unpatentability by a preponderance of the evidence." 35 U.S.C. § 316(e)

(emphasis added). This statutory language is not limited to any type of claim, and it makes no distinction as to whether a "proposition of unpatentability" is asserted against an original claim or a substitute claim. A "proposition of unpatentability" is a broad phrase that covers both situations. Accordingly, it would be flatly contrary to the statute for the PTO to interpret 37 C.F.R. § 42.121(a)(2)(i)—a provision that appears *nowhere* in the statute—as shifting the statutory burden of proof from the petitioner to the patent owner for substitute claims. *Chevron*, 467 U.S. at 843-44 (agency interpretations cannot be upheld if they are "manifestly contrary to the statute").

Moreover, even taking the PTO's regulatory language at face value, a patent owner need only show that a proposed amendment "respond[s] to a ground of unpatentability involved in the trial." 37 C.F.R. § 42.121(a)(2)(i). This is a far cry from having to *prove patentability*. For instance, if a proposed amendment adds limitations to a challenged claim, and the patent owner makes a good-faith argument as to how those added limitations distinguish the asserted prior art, then he has "*respond[ed]* to a ground of unpatentability involved in the trial." (Emphasis added.) To wit, "respond[ing]" to an argument is not the same as "prevailing" over the argument. Moreover, the regulation only requires responding to "*a* [i.e., one] ground of unpatentability involved in the trial," so it does not even require a comprehensive response to *all* grounds asserted against a particular

claim. If the PTO had truly wanted to place the burden on patent owners to prove the patentability of substitute claims, it would have drafted Rule 42.121(a)(2)(i) to require patent owners to "respond to *and overcome all* grounds of unpatentability asserted against the original claims." But, of course, this would have been flatly contrary to 35 U.S.C. § 316(e), which places the burden of proving invalidity on the petitioner. *See Microsoft Corp. v. i4i Ltd. P'ship*, 131 S. Ct. 2238, 2244 (2011) ("Where Congress has prescribed the governing standard of proof, its choice controls absent 'countervailing constitutional constraints.'" (quoting *Steadman v. SEC*, 450 U.S. 91, 95 (1981))).

Finally, the concept of placing a burden on the patent holder to prove a negative, i.e., that an amended claim is *not* invalid, finds no precedent and is contrary to decades of established law. *Cf. Rambus Inc. v. Rea*, 731 F.3d 1248, 1255 (Fed. Cir. 2013) ("The Board erroneously placed the burden on [the patent holder] to prove that its claims were not obvious. In reexamination proceedings, 'a preponderance of the evidence must show nonpatentability before the PTO may reject the claims of a patent application.'" (quoting *Ethicon, Inc. v. Quigg*, 849 F.2d 1422, 1427 (Fed. Cir. 1988))); *Velander v. Garner*, 348 F.3d 1359, 1369-70 (Fed. Cir. 2003) (requiring the party challenging validity in an interference proceeding to "establish by a preponderance of the evidence that the claims of the . . . application were unpatentable").

Notwithstanding all of this, it may not be necessary for this Court to reach the issue of statutory or regulatory interpretation. In this case, the PTAB found that Aqua's proposed amendments satisfied *all* of the statutory requirements of 35 U.S.C. § 316(d), i.e., they did not broaden the original claims or introduce new subject matter. A39-46; *see also* A2283-85; A2395-99. As for the extrastatutory requirements of "respond[ing] to a ground of unpatentability involved in the trial," the PTAB found that Aqua "fail[ed] to demonstrate that the substitute claims are patentable over Henkin and Myers." A52. Yet the PTAB itself failed to address all the limitations in the substitute claims and therefore failed to establish a record that can support this decision, even assuming arguendo that Aqua had a burden to establish the patentability of these claims. In short, regardless of which party had the burden to show unpatentability or patentability, the PTAB's truncated analysis, which focused on just a *single* claim limitation, is insufficient to support either conclusion.

C. Legal Standards Relating to Obviousness

1. An Obviousness Analysis Must Consider the Claimed Invention as a Whole and Therefore Must Consider All of the Claimed Limitations

A patent claim can only be rejected for obviousness "if the differences between the subject matter sought to be patented and the prior art are such that the subject matter *as a whole* would have been obvious at the time the invention was

made to a person having ordinary skill in the art." 35 U.S.C. § 103(a) (2006) (emphasis added). Thus, "[f]ocusing on the obviousness of substitutions and differences, instead of on the invention as a whole, is a legally improper way to simplify the often difficult determination of obviousness." *Gillette Co. v. S.C. Johnson & Son, Inc.*, 919 F.2d 720, 724 (Fed. Cir. 1990); *see also Sanofi-Synthelabo v. Apotex, Inc.*, 550 F.3d 1075, 1086 (Fed. Cir. 2008) ("The determination of obviousness is made with respect to the subject matter as a whole, not separate pieces of the claim.").

It follows that an obviousness analysis must address *all* the limitations of a claim, not just some of them. In other words, although 35 U.S.C. § 103 does not require that all limitations be found in a single prior-art reference, it does require that all limitations be found in a distinct combination or modification of the prior art that would have been obvious to a person of ordinary skill in the art. *See, e.g.*, *CFMT, Inc. v. Yieldup Int'l Corp.*, 349 F.3d 1333, 1342 (Fed. Cir. 2003) (citing *In re Royka*, 490 F.2d 981, 985 (CCPA 1974) ("[O]bviousness requires a suggestion of all limitations in a claim.")); *Orthopedic Equip. Co., Inc. v. United States*, 702 F.2d 1005, 1013 (Fed. Cir. 1983) ("What matters in the § 103 nonobviousness determination is whether a person of ordinary skill in the art, having all of the teachings of the references before him, is able to produce *the structure defined by the claim*." (emphasis added)).

Moreover, "a patent composed of several elements is not proved obvious merely by demonstrating that each of its elements was, independently, known in the prior art." *KSR Int'l Co. v. Teleflex Inc.*, 550 U.S. 398, 418 (2007); *see also In re Kotzab*, 217 F.3d 1365, 1371 (Fed. Cir. 2000) ("[A] rejection cannot be predicated on the mere identification in [the prior art] of individual components of claimed limitations."). Instead, there must be a "motivation to combine teachings from separate references." *Cheese Sys., Inc. v. Tetra Pak Cheese & Powder Sys., Inc.*, 725 F.3d 1341, 1352 (Fed. Cir. 2013) (citing *KSR*, 550 U.S. at 421-22). An obviousness finding "cannot be sustained by mere conclusory statements; instead, there must be some *articulated reasoning* with some *rational underpinning* to support the legal conclusion of obviousness." *KSR*, 550 U.S. at 418 (emphases added) (quoting *In re Kahn*, 441 F.3d 977, 988 (Fed. Cir. 2006)).

2. A Prima Facie Case of Obviousness Must Explicitly Show that Each Claim Limitation Would Have Been Satisfied by the Asserted Combination or Modification of the Prior Art

When judging the patentability of a claim against the prior art, the PTO must consider "all words in [the] claim." MPEP § 2143.03 (quoting *In re Wilson*, 424 F.2d 1382, 1385 (CCPA 1970)). A PTO decision that fails to discuss a claim's "unique limitations" and instead offers only a "very general and broad conclusion of obviousness" is "inadequate." *In re Thrift*, 298 F.3d 1357, 1366 (Fed. Cir. 2002). Likewise, an obviousness analysis that fails to address *all* of the claimed

limitations cannot, as a matter of law, constitute a prima facie case of obviousness. *See CFMT*, 349 F.3d at 1342; *Orthopedic Equip.*, 702 F.2d at 1013. In such a situation, a ruling vacating the PTO's decision and remanding the case is appropriate. *In re Thrift*, 298 F.3d at 1366-67.

3. Objective Indicia of Nonobviousness Must Be Duly Considered When Presented

An obviousness analysis under § 103 must consider any objective evidence of nonobviousness presented by the patentee. *Mintz v. Dietz & Watson, Inc.*, 679 F.3d 1372, 1375 (Fed. Cir. 2012). Such evidence "may often be the most probative and cogent evidence of nonobviousness in the record," *id.* at 1378 (quoting *Ortho-McNeil Pharm., Inc. v. Mylan Labs., Inc.*, 520 F.3d 1358, 1365 (Fed. Cir. 2008)), and "may often establish that an invention appearing to have been obvious in light of the prior art was not," *id.* (quoting *Simmons Fastener Corp. v. Ill. Tool Works, Inc.*, 739 F.2d 1573, 1575 (Fed. Cir. 1984)). Examples of objective indicia of nonobviousness are "commercial success, long felt but unsolved needs, [and] failure of others." *KSR*, 550 U.S. at 399 (quoting *Graham v. John Deere Co.*, 383 U.S. 1, 17-18 (1966)).

VI. ARGUMENT

A. The PTAB Failed to Address All Limitations in Claims 22-24, Which Renders Its Obviousness Analysis Per Se Inadequate

In its obviousness analysis, the PTAB was required to analyze *all* claim limitations in claims 22-24, including the new limitations added by amendment. *In re Thrift*, 298 F.3d at 1366; *In re Wilson*, 424 F.2d at 1385. In failing to do so, the PTAB erred as a matter of law, necessitating vacatur and remand of its obviousness determination.

This Court's decision in *In re Thrift* is instructive. There, the PTO rejected claims 1-10 in a patent application where two prior-art references disclosed all limitations in those claims. *In re Thrift*, 298 F.3d at 1363-65. This Court affirmed, finding that the PTO's ruling was supported by substantial evidence. *Id.* at 1365. But the application had other claims with additional limitations relating to "grammar-creation capability features" that were not in claims 1-10. *Id.* For these claims, the examiner "generally affirmed his initial conclusion as to obviousness" (i.e., the conclusion for claims 1-10) "without specifically discussing the grammar features." *Id.* Instead, the examiner "summarily rejected" the grammar limitations, stating that "[t]he use of grammar is old and well known in the art of speech recognition as a means of optimization which is highly desirable." *Id.* (alteration in original) (citation omitted).

On appeal, this Court held that the examiner's obviousness rejection was "simply inadequate on its face." *Id.* at 1366. While the PTO's analysis "generally addresse[d] the use of grammar," it did not address each "unique" grammar limitation in the claim. *Id.* Accordingly, the PTO's rejection of the claims with the grammar limitations was vacated and remanded. *Id.* at 1366-67.

Here, as in *In re Thrift*, the PTAB failed to meaningfully address three distinct claim limitations in claims 22-24: (1) the controlled-directional-movement limitation in claims 22-24; (2) the four-wheels limitation in claim 23; and (3) the filtered-water-jet limitation in claim 24. Instead, the PTAB simply issued a blanket, one-sentence ruling under *KSR*, stating that "we find that with respect to the additional limitations recited in the substitute claims, there are a finite number of predictable solutions and that the subject matter of the substitute claims is not the product of innovation, but of ordinary skill and common sense." A51-52. As a matter of law, this sweeping statement cannot establish a prima facie case of obviousness where the PTAB failed to separately analyze each of the limitations of the claims. *In re Thrift*, 298 F.3d at 1363-65; *see also KSR*, 550 U.S. at 418 ("[T]here must be some *articulated reasoning* with some *rational underpinning* to support the legal conclusion of obviousness." (emphases added) (quoting *In re Kahn*, 441 F.3d at 988)). Accordingly, the PTAB's finding that claims 22-24 are obvious should be vacated and remanded for this reason alone. On remand, the

PTAB should be instructed to address *each* limitation in claims 22-24, including the new limitations that were specifically added to distinguish the asserted prior art.

B. The PTAB's Conclusory Ruling Violates the Administrative Procedure Act

The PTO is an agency subject to the APA, which allows for deferential review of agency action. *Zurko*, 527 U.S. at 152-54. But "[d]eferential judicial review under the Administrative Procedure Act does not relieve the agency of its obligation to develop an evidentiary basis for its findings." *In re Sang-Su Lee*, 277 F.3d 1338, 1344 (Fed. Cir. 2002). An agency action can only be upheld under the APA if the agency "articulate[d] a satisfactory explanation for its action including a 'rational connection between the facts found and the choice made.'" *Motor Vehicle Mfrs. Ass'n of United States, Inc. v. State Farm Mut. Auto. Ins. Co.*, 463 U.S. 29, 43 (1983) (quoting *Burlington Truck Lines, Inc. v. United States*, 371 U.S. 156, 168 (1962)). This Court has vacated and remanded PTO actions that failed to comply with the APA. *See In re Sang-Su Lee*, 277 F.3d at 1345 (vacating and remanding Board decision for failing to comply with the APA, stating that "[t]he board cannot rely on conclusory statements when dealing with particular combinations of prior art and specific claims, but must set forth the rationale on which it relies").

Here, the PTAB's failure to meaningfully address the controlled-directional-movement limitation in claims 22-24, the four-wheels limitation in claim 23, and the filtered-water-jet limitation in claim 24 violates the APA, which independently warrants vacatur and remand of the Board's decision.

C. In Addition to Its Conclusory Analysis, the PTAB's Ruling Is Flawed Because Its Proposed Combination of *Henkin* and *Myers* Does Not Include All the Limitations of Claims 22-24

1. The Proposed *Henkin/Myers* Combination Does Not Include the Controlled-Directional-Movement Limitation of Claims 22-24

Claim 22 requires "rotationally-mounted supports axially mounted transverse to a longitudinal axis of said apparatus and coupled proximate the front and rear portions of the housing to *control the directional movement* of said apparatus over the submerged surface." A2280 (emphasis added). Dependent claim 23 incorporates this limitation and further requires that the rotationally-mounted supports be "first and second pairs of axially mounted wheels." A2281. And claim 24 requires wheels "axially mounted transverse to the longitudinal axis and coupled to the housing to *control the directional movement* of said apparatus over the submerged surface." A2282 (emphasis added).

The controlled-directional-movement limitation was added to differentiate these claims from prior-art devices that moved randomly, such as the *Myers* and *Henkin* devices that the PTAB had relied upon to reject claims 1-5 and 19-21.

A2289; A2396; A2401; A2803-05.[4] Confining the claims to cleaners that move in a controlled directional manner around the pool is significant because devices that employ controlled-movement patterns clean pools faster than those with random-movement patterns. *See supra* § III.A. Thus, not only is the controlled-directional-movement limitation undisclosed in the *Henkin/Myers* combination, it is a significant improvement over that combination.

Despite the importance of this limitation in claims 22-24, the PTAB never even addressed it. A50-52. Instead, the PTAB merely stated that there are a "finite number of predictable solutions" for the "additional limitations recited in the substitute claims." A51-52. This statement mentions nothing about the controlled-directional-movement limitation and cannot qualify as an adequate analysis under this Court's vast obviousness jurisprudence or the APA. *See In re Thrift*, 298 F.3d at 1366-67; *In re Sang-Su Lee*, 277 F.3d at 1345.

The record is devoid of *any* factual support for the PTAB's blanket, one-sentence assertion that this limitation (along with all the others) would be satisfied by the combination of *Henkin* and *Myers*. Indeed, the evidence strongly suggests the opposite. *Henkin* is specifically designed to move in a random fashion, not in a

[4] Before the amendments in claims 22-24, the claims only required the supports to "enable movement." *See, e.g.*, A86 at 24:13-15; A87 at 26:11-13, 33-35. The amendments narrowed the claims to cover supports (and wheels in claim 23) that "*control* the directional movement." A2280-83 (emphasis added). Thus, claims 22-24 no longer cover devices that move randomly, i.e., in an *uncontrolled* fashion.

controlled directional fashion. Indeed, the very first sentence of *Henkin*'s Abstract states that the device is "adapted to travel underwater along a *random* path on the pool vessel surface." A2515 at Abstract (emphasis added); *see also* A2523 at 7:45-47 (stating that the pool cleaner "should travel in a *highly random* manner" "[i]n order . . . to function effectively" (emphasis added)). Likewise, *Myers* is unquestionably designed to be "erratically self-propelled over the bottom surface of the swimming pool." A2510 at 1:8-11. How can combining two erratic/random pool cleaners result in a cleaning robot that achieves *controlled* directional movement? The PTAB never explained how, and this Court should not be left attempting to answer this question on a blank record. *See Rambus*, 731 F.3d at 1258 ("We decline to make these fact findings for the first time on appeal.") (remanding to the PTO to reevaluate its obviousness determination).

2. The Proposed *Henkin/Myers* Combination Does Not Satisfy the Four-Wheels Limitation of Claim 23

Dependent claim 23 requires "first and second pairs of axially mounted wheels respectively positioned proximate to the front and rear portions of the housing." A2281. Thus, this claim specifically requires *four* axially-mounted wheels for controlling directional movement. Neither *Henkin* nor *Myers* discloses or suggests the use of four axially-mounted wheels. *See* A1055 at 56:19-21 (Zodiac's counsel admitting that "Myers doesn't disclose two sets of wheels" and "Henkin doesn't disclose two sets of wheels"). *Myers* discloses only two, non-

axially-mounted scrubbing elements and a single caster wheel. A2510-11 at 1:47-2:5, 2:34-46, 3:41-46. *Henkin* discloses only *three* offset wheels mounted on three "spaced axes" to help the apparatus "avoid getting stuck against vertical walls or barriers" during its random travel around the pool. A2520 at 2:11-30; A2521 at 4:42-57. Indeed, adding two pairs of axially-mounted wheels in *Henkin* would undermine that device's ability to turn randomly by spinning off walls. A2521 at 4:42-57.

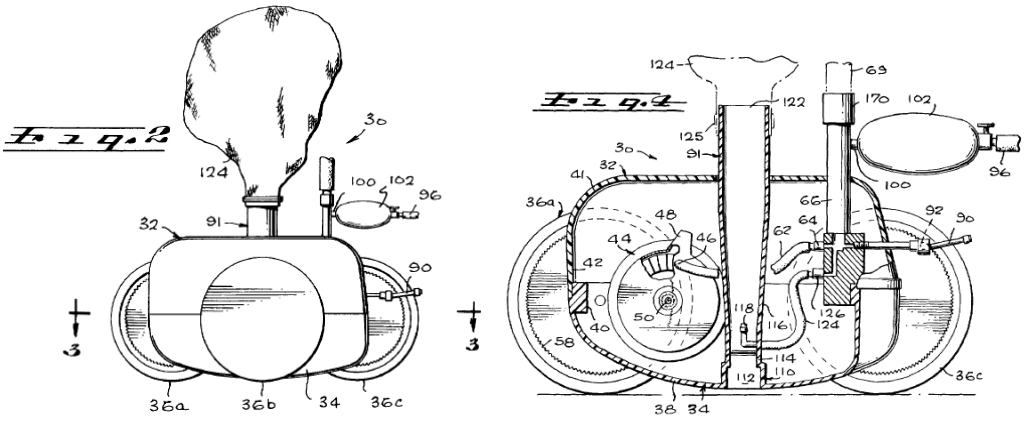
Once again, the PTAB failed to address this limitation specifically. Instead, it issued a one-sentence, blanket statement that *all* the remaining limitations of claims 22-24 are obvious under *KSR* because there are allegedly only a finite number of predictable solutions. A51-52 (citing *KSR*, 550 U.S. at 421). For the same reasons discussed in Section VI.C.1, the PTAB's inadequate (indeed nonexistent) analysis of the four-wheels limitation provides independent grounds for vacating the rejection of claim 23 and remanding the case.

3. The Proposed *Henkin/Myers* Combination Does Not Disclose the Filtered-Water-Jet Limitation of Claim 24

Claim 24 requires a "discharge opening through which the *filtered* water jet [from the filter pump discharge outlet] is directionally discharged." A2282. In contrast, the combination of *Henkin* and *Myers* proposed by the PTAB—i.e., where *Henkin*'s external pump is replaced with the internal pump of *Myers*—would not

discharge filtered water through its directional jet. Instead, it would discharge *unfiltered* water through the jet.

Specifically, for the *Myers* pump to work in *Henkin*, it would have to perform the same function as the *Henkin* pump. One such function is to provide pumped water to the orifice 118 so that it can create the suction necessary to pull debris into the device. A2522 at 6:6-41 (explaining that the orifice 118 discharges water received from the external booster pump 70).



A2516; A2517.

The suction force provided by the orifice causes the debris to progress up the venturi tube 116 to a mesh filter bag 124. A2522 at 6:6-41 This bag filters the water immediately before it leaves the device and is returned to the pool. *Id.* Because any filtered water in the proposed *Henkin/Myers* combination would immediately exit the device through the filter bag, no filtered water can be discharged from the jet nozzle 90. Indeed, Figure 4 (above) shows that the water

discharged from nozzle 90 comes directly from the pump *without* passing through a filter first.

Like the other limitations mentioned above, the filtered-water-jet limitation is important—it goes to the very purpose of the patented technology, which is to clean pools. And it is a significant improvement over the PTAB's proposed *Henkin/Myers* combination, which would discharge unfiltered water back into the pool, increasing cleaning time and decreasing energy efficiency.

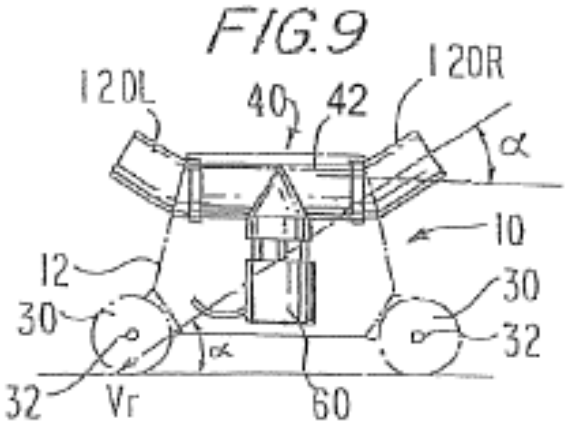
Despite the importance of the filtered-water-jet limitation, the PTAB failed to address it—relying once more on its blanket *KSR* statement on the finite number of predictable solutions. A51-52. Thus, for the same reasons discussed above, the PTAB's inadequate analysis provides independent grounds for vacating the rejection of claim 24 and remanding the case.

D. The PTAB's Finding that the Proposed *Henkin/Myers* Combination Would Satisfy the Rearwardly-Displaced-Vector Limitation of Claims 22-24 Lacks Substantial Evidence

Claims 22 and 24 require a "stationary directional discharge conduit" discharging a "water jet" to be positioned such that it produces "a resultant force vector . . . directed to a position that is proximate to and rearwardly displaced from a line passing through the transverse axial mountings" of the "front rotationally-mounted supports" (claim 22 (A2280-81)) or the "front pair of wheels" (claim 24 (A2282-83)). Claim 23 depends from claim 22 and recites a discharge conduit

angled to "produce a resultant force vector in the water jet discharged from said at least one discharge opening that is directed to pass proximately to and rearwardly of the plane of the axis of rotation of the pair of wheels at the front portion of the apparatus." A2281.

In short, these limitations require the force vector (*see* V_r in Figure 9 below) resulting from the discharge conduit to always be directed downwardly enough to point behind an axle (or imaginary axle) running between the front wheels.



A63.

The inventors found that such a force vector will keep the wheels of the cleaner pressed to the pool floor. A79-80 at 10:41-11:3. Put differently, the downward force supplied by the jet creates sufficient traction between the cleaner's wheels (or supports) and the bottom of the pool to keep the cleaner stable. *Id.* The traction provided by the downward force component also enhances the controlled

directional movement of the cleaner when maneuvering in all areas of the pool. A2804-05.

Neither *Myers* nor *Henkin* discloses the rearwardly-displaced-vector limitation of claims 22-24. A2789-90; A2804-05. Moreover, this limitation cannot be found obvious over *Myers* and *Henkin* because the very purpose of the limitation (i.e., to promote stability during controlled movement) *directly opposes* the purpose of the jets in *Myers* and *Henkin* (to promote random movement). For example, *Myers* states that its erratic movement is made possible by its scrub brushes *and its jet*. A2510-11 at 2:47-3:12. And the jet in *Henkin* is specifically used to provide a sufficient "forward" force to allow the cleaner to randomly change directions by climbing walls or working itself out of corners. A2521-22 at 4:58-5:51. This conflict in purposes between the rearwardly-displaced-vector limitation in claims 22-24 and the prior art cannot square with the PTAB's conclusory finding that "Henkin describes using the downward resultant force for a substantially similar purpose to the '183 Patent." A50-51. In fact, the evidence shows that the water jet in *Henkin* is used for the *opposite* purpose, namely, to facilitate random movement—not controlled movement. A2520 at 2:11-30; A2522 at 5:6-51.

Accordingly, the PTAB's conclusion that there were a "finite number of predictable solutions" for the vector limitation (A51-52) is flawed. The "solution"

relied on by the PTAB (i.e., adjusting the nozzle in *Henkin* such that the resultant force vector points behind the axis of the front wheels) would inhibit the hypothetical *Henkin/Myers* device from operating as designed, i.e., with random movement. *See, e.g.*, A2520 at 1:45-51.

E. Because the PTAB's Proposed *Henkin/Myers* Combination Fails to Disclose All the Limitations of Claims 22-24, the PTAB's Obviousness Finding Cannot Be Sustained

In sum, the device resulting from the combination of *Henkin* and *Myers* proposed by the PTAB fails to disclose at least four claim limitations: (1) the controlled-directional-movement limitation in claims 22-24; (2) the four-wheels limitation in claim 23; (3) the filtered-water-jet limitation in claim 24; and (4) the rearwardly-displaced-vector limitation in claims 22-24. This Court has reversed obviousness rulings when the asserted prior-art combination failed to disclose all of the recited claim limitations. *See, e.g.*, *Crocs, Inc. v. Int'l Trade Comm'n*, 598 F.3d 1294, 1308-11 (Fed. Cir. 2010) (reversing obviousness ruling where prior art failed to disclose a foam strap on a shoe); *Source Search Techs., LLC v. LendingTree, LLC*, 588 F.3d 1063, 1072-73 (Fed. Cir. 2009) (vacating district court obviousness finding where none of the prior-art references disclosed a claim limitation that addressed a problem for which the "solution may not have been a straightforward step").

F. The PTAB Failed to Give Proper Consideration to the Objective Indicia of Nonobviousness

Although the PTAB considered the objective indicia of nonobviousness for original claim 21, it did not perform any separate secondary-factors analysis for amended claims 22-24. Instead, it simply stated in a footnote that "we were not persuaded by Patent Owner's arguments regarding secondary considerations with respect to the [original] challenged claims." A52 n.9. This cursory statement, however, is insufficient as a matter of law because amended claims 22-24 contain different limitations than the original claims, and Aqua presented secondary-factors evidence that pertained specifically to the amended claims.

Although some of the PTAB's secondary-factors analysis for claim 21 is arguably relevant to claims 22-24, other evidence pertaining to the newly-added limitations in the amended claims was overlooked. For example, Zodiac argued that the controlled-movement feature that Aqua contended met a long-felt need was "not claimed, as Claim 21 does not require or even describe controlled movement or surface stability." A35-36. The PTAB, relying on this argument, concluded that "to the extent that Patent Owner may have shown . . . a long-felt need, Patent Owner fails to show a nexus between that need and limitations recited in the challenged claims of the '183 Patent." A36.

But controlled directional movement is at the *core* of amended claims 22-24, and Aqua submitted specific evidence showing that this feature in the amended

claims satisfied a long-felt need and contributed to commercial success. A2790-91 ("[T]he *efficient movement of the cleaner* saved time, energy and wear of the cleaner at a much lower cost than other commercially available robotic motor driven cleaners." (emphasis added)); A2780 (stating that "Aqua Products' jet drive provided a less expensive, reliable and less complex robotic cleaner that would *clean the entire pool in a much faster and more thorough way* than any other robotic cleaner" (emphasis added)). This evidence was provided in a declaration submitted "in support of Patent Owner's Replacement Corrected Motion *to Amend Claims* and Patent Owner's Response to the Petition for *Inter Partes* review" (A2772 (emphasis added)); thus, there is no question it was submitted in support of amended claims 22-24.

Accordingly, the PTAB erred by overlooking this secondary evidence of nonobviousness, which was individualized and targeted specifically to amended claims 22-24. *See Rambus*, 731 F.3d at 1256-57 (vacating and remanding because the PTO failed to consider evidence of long-felt need and industry praise that related to certain claimed features); *see also Apple Inc. v. Int'l Trade Comm'n*, 725 F.3d 1356, 1365-66 (Fed. Cir. 2013) (secondary considerations such as long-felt need "must be considered before determining whether the claimed invention would have been obvious"). The PTAB's obviousness decision should therefore be vacated and remanded for this additional, independent reason.

G. The PTAB Erred in Shifting the Petitioner's Statutory Burden to the Patent Owner to Prove that the Proposed Amended Claims Are Not Invalid

As explained above, the PTAB found that amended claims 22-24 satisfied the *statutory* requirements for amending claims, i.e., they neither broadened the original claims nor added new matter. A39-46. At that point, the burden should have shifted to Zodiac to prove by a preponderance of the evidence that the amended claims are invalid. *See* 35 U.S.C. § 316(e) ("In an inter partes review . . . , the petitioner shall have the burden of proving a proposition of unpatentability by a preponderance of the evidence."). But the PTAB interpreted 37 C.F.R. § 42.121(a)(2)(i) as placing an evidentiary burden on Aqua to prove that the amended claims are *not* invalid. A46-47; A52. This is erroneous because it contradicts the unambiguous language of the governing statute. *See supra* § V.B.

Moreover, shifting the burden to the patentee to prove validity creates an absurd result; it forces the patentee to have to address the universe of prior art and attempt to negate every conceivable invalidity theory, all in the fifteen pages allotted by the PTO for motions to amend. *See* 37 C.F.R. § 42.24; *cf. Medtronic, Inc. v. Mirowski Family Ventures, LLC*, 134 S. Ct. 843, 850 (2014) (refusing to place burden on accused infringer to show noninfringement after reasoning that doing so could result in the accused infringer having to "work in the dark . . . to negate every conceivable infringement theory"). The analysis in this section, as

well as the analysis in Section V.B above, provides yet another independent basis for vacating and remanding the PTAB's decision rejecting claims 22-24.

VII. CONCLUSION

For these reasons, this Court should vacate the PTAB's decision finding substitute claims 22-24 of the '183 patent unpatentable and remand the case back to the PTAB for a proper analysis.

Date: March 16, 2015

Respectfully submitted,

/s/ James R. Barney
James R. Barney
Timothy P. McAnulty
David K. Mroz
FINNEGAN, HENDERSON, FARABOW, GARRETT & DUNNER, LLP
901 New York Avenue, NW
Washington, DC 20001-4413
(202) 408-4000

Attorneys for Appellant Aqua Products, Inc.

ADDENDUM

Trials@uspto.gov
571.272.7822

Paper 71
Entered: August 22, 2014

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

ZODIAC POOL SYSTEMS, INC.,
Petitioner,

v.

AQUA PRODUCTS, INC.,
Patent Owner.

Case IPR2013-00159
Patent 8,273,183 B2

Before BRIAN J. McNAMARA, RAMA G. ELLURU, and JAMES B. ARPIN, *Administrative Patent Judges.*

ARPIN, *Administrative Patent Judge*.

FINAL WRITTEN DECISION
35 U.S.C. § 318(a) and 37 C.F.R. § 42.73

I. BACKGROUND

Zodiac Pool Systems, Inc. ("Petitioner") filed a Petition to institute an *inter partes* review (Paper 5) of claims 1–14, 16, and 19–21 of U.S. Patent No. 8,273,183 B2 (Ex. 1006; "the '183 Patent") pursuant to 35 U.S.C. §§ 311–312 and 37 C.F.R. §§ 42.100–42.106. Pursuant to 35 U.S.C. § 314,

we instituted an *inter partes* review, on August 23, 2013, as to claims 1–9, 13, 14, 16, and 19–21 of the '183 Patent, but not with respect to claims 10–12. Paper 18.

After institution, Patent Owner filed a Response to Petition (Paper 28) and a contingent, Replacement Corrected Motion to Amend Claims (Paper 42).[1] Petitioner filed a Reply to Patent Owner's Response to Petition (Paper 44) and an Opposition to Patent Owner's Replacement Corrected Motion to Amend Claims (Paper 45). Patent Owner further filed a Corrected Reply in Support of Motion to Amend Claims (Paper 55) and a Corrected Sur-Reply in Support of Opposition to Petition (Paper 56).

In addition, Patent Owner filed a Motion to Exclude Evidence. Paper 58. Petitioner filed an Opposition to Patent Owner's Motion to Exclude Evidence (Paper 61), and Patent Owner filed a Reply Memorandum in Support of its Motion to Exclude Evidence (Paper 62). The Motion to Exclude Evidence seeks to exclude certain portions of the declaration of Petitioner's declarant, Mr. Keith McQueen, (Ex. 1009) and the entire declaration of Petitioner's declarant, Dr. Homayoon Kazerooni, (Ex. 1010). Paper 58, 1–5.

An oral hearing was held on May 20, 2014, a transcript of which appears in the record. Paper 70.

We have jurisdiction under 35 U.S.C. § 6(c). This final written decision is entered pursuant to 35 U.S.C. § 318(a).

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[1] Patent Owner initially filed a Motion to Amend Claims (Paper 27) on Nov. 25, 2013, and a Corrected Motion to Amend Claims (Paper 39) on Feb. 18, 2014. Because we required Patent Owner to refile the Corrected Motion to Amend Claims, the motion under consideration in this case was filed on Mar. 3, 2014.

For the reasons that follow, we determine that Petitioner has shown by a preponderance of the evidence that challenged claims 1-9, 13, 14, 16, and 19–21 are *unpatentable*. Further, for the reasons that follow, we *deny* the Replacement Corrected Motion to Amend Claims requesting entry of substitute claims 22–24.

Patent Owner's Motion to Exclude Evidence is *granted-in-part* and *denied-in-part*.

A. Related Proceedings

In addition to this proceeding, the '183 Patent is involved in concurrent district court litigation captioned *Aqua Products, Inc. v. Zodiac Pool Systems, Inc.*, 1:12-cv-09342-TPG (S.D.N.Y.). *See* Paper 5, 1.

B. The '183 Patent

The '183 Patent relates to self-propelled apparatus and methods for controlling such apparatus for cleaning a submerged surface of a pool or tank. Ex. 1006, col. 1, ll. 22–26. Although such apparatus are propelled by a water jet, the '183 Patent states that the movement of such apparatus is random. *Id.* at col. 2, ll. 57–59. The '183 Patent describes methods for controlling the scanning and traversing patterns of the cleaning apparatus with respect to the bottom and sidewalls of the pool or tank. *Id.* at col. 1, ll. 22–26. In the '183 Patent, "[r]eferences to the front or forward end of the cleaner will be relative to its then-direction of movement." *Id.* at col. 4, ll. 11–12.

An apparatus, as recited in the claims and suitable for control according to the recited methods, is illustrated in Figure 1 of the '183 Patent,

reproduced below:

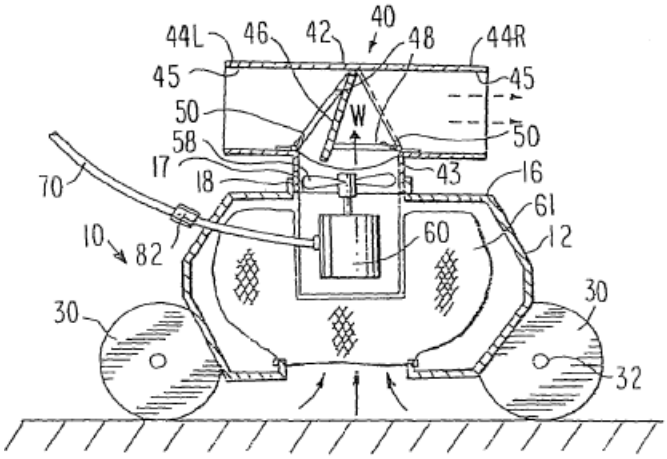

FIG. 1

Figure 1 depicts "a side elevation, partly in cross-section, of a pool cleaner illustrating one embodiment of the directional water jet of the invention." Ex. 1006, col. 7, ll. 1–3.

Figure 1, a schematic illustration of a cross-sectional, side view of pool or tank cleaner apparatus 10, depicts an embodiment of the directional water jet, or discharge conduit, recited in claims 1 and 20. Ex. 1006, col. 7, ll. 1–3. A water inlet (not numbered) is disposed through housing 12 and below motor-driven water pump motor 60, whereby pump motor 60 draws water and pool or tank debris through the water inlet for filtering. *Id.* at col. 8, ll. 58–61. Water drawn through the water inlet may pass through filter 61, and pool or tank debris may be entrained by filter 61. *Id.* Pool cleaner 10 further comprises valve assembly 40 forming a pump outlet that is mounted above pump motor 60. *Id.* at col. 9, ll. 4-12. Pool cleaner 10 uses impeller 58 to drive water "W" through housing aperture 17 and into valve assembly 40. *Id.* at col. 9, ll. 4–8.

As depicted in the embodiment of Figure 1 of the '183 Patent, "valve

assembly 40 comprises a generally T-shaped valve housing 42 with depending leg 43 having a first end that is secured to cleaner housing flange 18, and a second end that is in fluid communication with discharge conduits 44R and 44L." *Id.* at col. 9, ll. 8–12. In Figure 1, the angle formed between the surface over which pool cleaner 10 is moving and discharge conduits 44R and 44L is equal to or is substantially equal to zero, *i.e.*, discharge conduits 44R and 44L are substantially parallel to the surface of movement. Thus, discharge conduits 44R and 44L are at acute angles, *i.e.*, angles less than 90º (*see* claim 1) or less than normal (*see* claim 20) with respect to the surface of movement. *Id.* at col. 9, ll. 7–11. Pool cleaner 10 is propelled by the water jet created by the selective ejection of water from pump motor 60 directed by flap assembly 46 through one of discharge conduits 44R and 44L. *Id.* at col. 9, ll. 24–53; Figs. 1–3.

Alternatively, an apparatus, as recited in the claims and suitable for control according to the recited methods, is illustrated in Figure 9 of the '183 Patent, reproduced below:

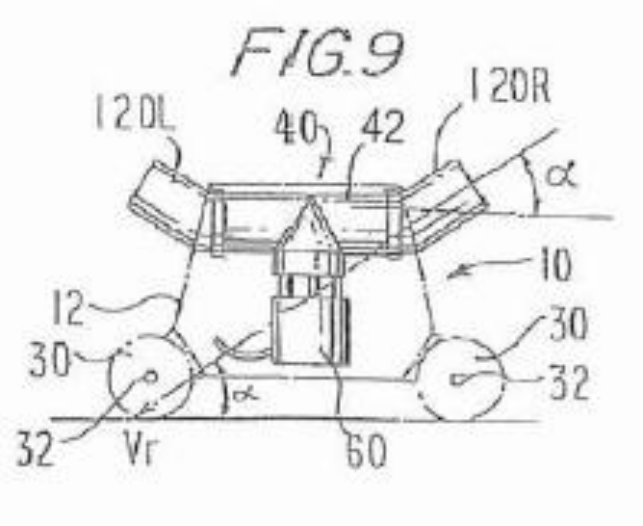

Figure 9 depicts a side elevation of embodiment illustrated in relation to a pool cleaner. Ex. 1006, col. 7, ll. 20–21.

In Figure 9, a preferred embodiment of pool cleaner 10 is depicted having valve assembly 40 in which discharge conduits 44R and 44L through their associated elbows 120R and 120L project through the sidewalls of a pool cleaner housing 12 at angle α that is less than 90º and greater than 0º, i.e., is acute or less than normal, with respect to the surface of movement of pool cleaner 10. *Id.* at col. 10, ll. 47–48, 60–64; *see id.* at col. 24, ll. 6–25; col. 26, ll. 1–24 (Claims 1 and 20). Thus, the direction of movement may change depending upon which conduit ejects the water. *Id.* In the alternative embodiment depicted in Figure 9, elbows 120R and 120L cause a resultant force vector component generated by the water jet to move housing 12 in a direction away from the discharged water jet and another resultant force vector component to urge housing 12 downward against the pool or tank surface over which pool cleaner 10 moves. *Id.* at col. 10, ll. 47–51; Fig. 8. Pool cleaner 10 further comprises rotationally-mounted supports, i.e., wheels 30 mounted on a pair of axles 32. *Id.* at col. 10, ll. 47–66. Each of axles 32 is disposed proximate to one of a front and an opposing rear end of pool cleaner 10, as defined by the direction of movement. *Id.* at col. 10, l. 64–col. 11, l. 3; *see also id.* at col. 5, ll. 9–12 ("[R]eferences to the front and rear of the cleaning apparatus or its housing will be with respect to the direction of its movement.").

C. Claims Under Review

1. Challenged Claims.

Of the challenged claims, claims 1, 20, and 21 are independent. Independent claims 1 and 20 recite similar limitations describing embodiments of a self-propelled cleaning apparatus for cleaning a

submerged surface of a pool or tank. Ex. 1006, col. 24, ll. 6–7; col. 26, ll. 1–2. Independent claim 21 recites "[a] method for cleaning a submerged surface of a pool or tank." *Id.* at col. 26, ll. 25–26. As to the dependent claims, challenged claims 2-9, 13, 14, 16, and 19 depend from claim 1.

Independent claim 21 of the '183 Patent is illustrative of the claims at issue:

> 21. A method for cleaning a submerged surface of a pool or tank, comprising the steps of:
>
> providing a self-propelled cleaning apparatus, said cleaning apparatus including a housing having a baseplate with at least one water inlet, and further including a front portion as defined by the direction of movement of the cleaning apparatus when propelled by a water jet, an opposing rear portion and adjoining side portions defining the periphery of the apparatus, rotationally-mounted supports coupled to the housing to enable movement of said apparatus over the submerged surface, a water pump mounted in the interior of said housing, and a directional discharge conduit in fluid communication with the water pump and having at least one discharge opening;
>
> activating the water pump to draw water and debris from the pool or tank through the at least one water inlet; filtering the water drawn into the housing;
>
> discharging the filtered water through the directional discharge conduit at an acute angle with respect to the surface over which the apparatus is moving, said discharged filtered water forming a water jet having a resultant force vector acutely angled towards the surface beneath the apparatus; and
>
> propelling the apparatus in a forward direction of movement.

2. Proposed Substitute Claims

In its Replacement Corrected Motion to Amend Claims, Patent Owner proposes claims 22–24, as substitute claims for original claims

1, 8, and 20, respectively. Paper 42, 2. The substitute claims are reproduced below, with underlined material indicating language added to the corresponding original claims and struck-through indicating language removed from the corresponding original claims:

22. (Proposed substitute for original claim 1) A self-propelled cleaning apparatus for cleaning a submerged surface of a pool or tank, comprising:

a housing having a front portion as defined by the direction of movement of the apparatus when propelled by a water jet, an opposing rear portion and adjoining side portions defining the periphery of the apparatus, and a baseplate with at least one water inlet;

rotationally-mounted supports axially mounted transverse to a longitudinal axis of said apparatus and coupled proximate the front and rear portions of the housing to ~~enable~~ control the directional movement of said apparatus over the submerged surface;

a water pump mounted in the interior of said housing, said water pump being configured to draw water and debris from the pool or tank through the at least one water inlet for filtering; and

a stationary directional discharge conduit in fluid communication with the water pump and having at least one discharge opening through which a pressurized stream of water forming the water jet is directionally discharged at a predetermined angle that is acute with respect the surface over which the apparatus is moving,

wherein said predetermined angle is inclined upwardly with respect to the surface beneath the apparatus to produce a resultant force vector that is directed to a position that is proximate to and rearwardly displaced from a line passing through the transverse axial mountings of the front rotationally-mounted supports.

23. (Proposed substitute for original claim 8) The apparatus of claim [[7]] 22, wherein the rotationally-mounted

supports comprise first and second pairs of axially mounted wheels respectively positioned proximate to the front and rear portions of the housing, wherein a portion of the discharge conduit terminating in the at least one discharge opening is angled upward with respect to an adjacent portion of the discharge conduit to produce a resultant force vector in the water jet discharged from said at least one discharge opening that is directed to pass ~~through~~ proximately to and rearwardly of the plane of the axis of rotation of the pair of wheels at the front portion of the apparatus.

24. (Proposed substitute for original claim 20) A self-propelled cleaning apparatus for cleaning a submerged surface of a pool or tank, said apparatus having a longitudinal axis and being propelled by the discharge of a water jet, the apparatus comprising:

a housing including a baseplate with at least one water inlet, a front portion, a rear portion and opposing side portions defining the periphery of the apparatus, said front portion being defined with respect to the forward directional movement of the apparatus when propelled by the water jet;

~~rotationally-mounted supports~~ at least a front pair of wheels, each wheel axially mounted transverse to the longitudinal axis and coupled to the housing to ~~enable~~ control the directional movement of said apparatus over the submerged surface;

a water pump mounted in the interior of said housing, said water pump configured to draw water and debris from the pool or tank through the at least one water inlet for filtering, and a pump discharge outlet for emitting a pressurized stream of filtered water;

a stationary directional discharge conduit in fluid communication with the pump discharge outlet, the discharge conduit having at least one discharge opening through which the filtered water jet is directionally discharged from the apparatus at a predetermined angle

> that is less than normal with respect to the surface beneath the apparatus, wherein said predetermined angle is inclined upwardly with respect to the surface beneath the apparatus to produce a resultant force vector that is directed to a position that is proximate to and rearwardly displaced from a line passing through the transverse axial mountings of the front pair of wheels.

Id. at 2-5.

D. Grounds of Unpatentability

Petitioner relies upon the following prior art references and declarations to support the grounds upon which we instituted an *inter partes* review:

Exhibit No.	References and Declarations
1001	U.S. Patent No. 3,321,787 to R.R. Myers ("Myers"), issued May 30, 1967
1002	U.S. Patent No. 3,936,899 to Henkin et al. ("Henkin"), issued Feb. 10, 1976
1003	U.S. Patent No. 4,100,641 to Pansini ("Pansini"), issued July 18, 1978
1009	Declaration of Mr. Keith McQueen in Support of Petitioner's Reply to Patent Owner's Response to Petition (Mar. 10, 2014) ("Declaration of Mr. McQueen")
1010	Declaration of Homayoon Kazerooni, Ph.D. in support of Petitioner's Reply to Patent Owner's Response to Petition and Petitioner's Opposition to Patent Owner's Replacement Corrected Motion to Amend Claims (Mar. 10, 2014) ("Declaration of Dr. Kazerooni")

We instituted *inter partes* review of the '183 Patent based upon the following asserted grounds of unpatentability:

Claims	Statutory Basis	Applied Reference(s)
1, 2, 13, 14, 16, and 19–21	35 U.S.C. § 102(b)	Myers
1–5 and 19–21	35 U.S.C. § 103(a)	Henkin and Myers
1–9 and 19–21	35 U.S.C. § 103(a)	Pansini and Myers

Paper 18, 34.

II. DISCUSSION

In the Response to Petition, Patent Owner only addresses claim 21 and does not address expressly claims 1-9, 13, 14, 16, 19, and 20. Paper 28, 1–2. Nevertheless, although Patent Owner waived argument on all of the claims other than claim 21 and then filed the Replacement Corrected Motion to Amend Claims on other claims, Patent Owner does not concede that the original claims, other than claim 21, would not be patentable. Paper 70, 22:7–24; *see* Paper 42, 2, n.2. We have reviewed the evidence presented by Petitioner regarding the claims upon which we instituted *inter partes* review and determine that, for the reasons set forth below, Petitioner has shown by a preponderance of the evidence that claims 1-9, 13, 14, 16, and 19–21 are unpatentable.

A. Claim Construction

Consistent with the statute and legislative history of the Leahy-Smith America Invents Act, Pub. L. No. 112-29, 125 Stat. 284 (2011) ("AIA"), the Patent Trial and Appeal Board ("the Board") interprets claims using the broadest reasonable construction in light of the specification of the patent in which they appear. 37 C.F.R. § 42.100(b); *see also* Office Patent Trial Practice Guide, 77 Fed. Reg. 48,756, 48,766 (Aug. 14, 2012). Under the broadest reasonable construction standard, claim terms are given their ordinary and customary meaning as would be understood by one of ordinary skill in the art in the context of the specification. *In re Translogic Tech., Inc.*, 504 F.3d 1249, 1257 (Fed. Cir. 2007) (quoting *Phillips v. AWH Corp.*, 415 F.3d 1303, 1312 (Fed. Cir. 2005) (en banc)). Any special definition for a claim term must be set forth in the specification with "reasonable clarity, deliberateness, and precision." *In re Paulsen*, 30 F.3d 1475, 1480 (Fed. Cir. 1994). We are careful, however, not to read a particular embodiment appearing in the written description into the claim if the claim language is broader than the embodiment. *In re Van Geuns*, 988 F.2d 1181, 1184 (Fed. Cir. 1993). Our analysis requires the construction of the following claim terms.

1. a stationary directional discharge conduit

As noted in our Decision to institute *inter partes* review, claim 1 limits the apparatus to "*a* stationary directional discharge conduit," and independent claims 20 and 21 recite "*a* directional discharge conduit." Ex. 1006, col. 24, l. 20; col. 26, ll. 19, 36-37 (emphases added). Further, we note that Patent Owner includes this limitation of claim 1 in substitute claims 22–24. Paper 42, 2–5. Referring to the language of claim 1 and to

the Specification, we found no definition for a stationary directional discharge conduit. Although the Specification describes various embodiments of such discharge conduits, e.g., discharge conduits 44R and 44L (Ex. 1006, col. 9, ll. 8–12), we do not limit the interpretation of this term to such embodiments. *Van Geuns*, 988 F.2d at 1184.

Considering the language of claim 1, a relevant definition of the term "stationary" is "not moving or not movable; fixed or still." WEBSTER'S NEW WORLD DICTIONARY, 1309 (3rd College ed. 1988) (Ex. 3002). Moreover, a relevant definition of the term "directional" is "of, aimed at, or indicating (a specific) direction." *Id.* at 389. Petitioner noted that, during prosecution, Patent Owner argued in overcoming the Examiner's proposed Restriction Requirement that

> [A] pool cleaner apparatus [that] employs *at least one* discharge opening through which the water jet is directionally discharged from the cleaning apparatus at a predetermined angle that is less than normal with respect to the surface beneath the apparatus. *At least one* angled discharge outlet 120R and/or 120L extends from the jet valve assembly 40, as described in paragraphs 0091 through 0094 and shown in Figs. 8 and 9 of the present application.

Paper 5, 6 (quoting Response to Restriction/Election Requirement (Ex. 1005) 2 (emphases added)).

Neither Patent Owner nor Petitioner contests this construction. We further note that claim 6, which depends directly from claim 1, recites that "the discharge conduit has *at least two* discharge openings, each of which discharge openings is located at opposite ends of the discharge conduit" (Ex. 1006, col. 24, ll. 44–46 (emphasis added)). Thus, "a stationary directional discharge conduit" of claim 1 broadly includes conduits with one

or more discharge openings, and we also apply this interpretation to the use of this term in the substitute claims.[2] Therefore, consistent with the language of claim 1, the description in the Specification, and the prosecution history of the '183 Patent, we conclude that the broadest reasonable interpretation of "*a* stationary directional discharge conduit" is one or more discharge conduits, each of which is stationary and is oriented in a particular direction, e.g., that does not move and is aligned relative to a given axis of the apparatus. *See KCJ Corp. v. Kinetic Concepts, Inc.*, 223 F.3d 1351, 1356 (Fed. Cir. 2000) ("an indefinite article 'a' or 'an' in patent parlance carries the meaning of 'one or more' in open-ended claims containing the transitional phrase 'comprising'") (citations omitted).

2. a front portion as defined by the direction of movement of the apparatus when propelled by a water jet

Independent claim 1 recites, and claim 21 similarly recites, that a housing has "a front portion *as defined by the direction of movement of the apparatus when propelled by a water jet*." Ex. 1006, col. 24, ll. 8–10; col. 26, ll. 29–31 (emphasis added). Patent Owner includes this limitation in substitute claims 22 and 23. Independent claim 20 and substitute claim 24 similarly recite that "said front portion *being defined with respect to the forward directional movement* of the apparatus when propelled by the water jet." Ex. 1006, col. 26 ll. 7–10; Paper 42, 2 (emphasis added).[3] As used in

[2] Other claims can be valuable sources in determining the meaning of a claim term. *See Vitronics Corp. v. Conceptronic, Inc.*, 90 F.3d 1576, 1582 (Fed. Cir. 1996). Because claim terms normally are used consistently throughout the claims, the usage of a term in one claim can illuminate the meaning of the same or similar terms in other claims. *See Rexnord Corp. v. Laitram Corp.*, 274 F.3d 1336, 1342 (Fed. Cir. 2001); *CVI/Beta Ventures, Inc. v. Tura LP*, 112 F.3d 1146, 1159 (Fed. Cir. 1997).

[3] *See supra* n.2.

each of these claims, this language describes the front portion based on (1) the direction of movement of the apparatus, and (2) the time, e.g., "when" the apparatus is propelled "by a water jet."

As we explained in our Decision to institute *inter partes* review, with respect to the first basis for describing the "front portion," the Specification states that the movement of the apparatus is random. Paper 18, 10–11 (citing Ex. 1006, col. 2, ll. 57–59; col. 5, ll. 4–9). The Specification further explains that the "[r]eference to the front or forward end of the cleaner will be *relative* to its *then*-direction of movement." *Id.* at col. 4, ll. 11–12 (emphases added); *see id*. at col. 5, ll. 9–12. Thus, we concluded that the "front portion" of the housing may change with time, and no single portion of the housing may be identified exclusively as the "front portion."

Similarly, with respect to the second basis for describing the "front portion," i.e., "when" the apparatus is propelled by a water jet, the Specification states that "the invention comprehends a method of propelling a pool or tank cleaner by means of a water jet that is discharged [from a discharge conduit] in *at least* a first and a second direction that result in opposite translational directions." *Id.* at col. 4, ll. 50–54 (emphasis added). Nevertheless, we do not interpret the language of claim 1 as limited to such an embodiment. The scope of this limitation is determined by the number and direction of orientation of the discharge conduits.

First, claim 1, as well as substitute claims 22–24, recites that the apparatus comprises "*a* stationary directional discharge conduit." *Id.* at col. 24, l. 20; Paper 42, 3, 4 (emphasis added). As noted above, under the broadest reasonable interpretation, this limitation describes one or more such conduits. Second, although embodiments of the invention are depicted as

having opposing discharge conduits, e.g., discharge conduits 44R and 44L, as noted above, we do not read a particular embodiment appearing in the Specification into the claim, especially if, as here, the claim language is broader than the particular embodiment. *Van Geuns*, 988 F.2d at 1184; *see* Ex. 1006, Figs. 1, 9 (depicting discharge conduits 44R and 44L). Third, during prosecution, Applicants argued that the claimed apparatus employ "*at least one* discharge opening through which the water jet is directionally discharged." Paper 5, 6 (quoting Response to Restriction/Election Requirement (Ex. 1005) 2 (emphasis added)). This argument is consistent with the language of claims 1 and 6, as discussed above in Section II.A.1.

Patent Owner argues that the "front" of the recited apparatus "remains constant in terms of the direction of movement" and, in particular, "[t]he front portion of Patent Owner's cleaner remains *in constant alignment with the water jet* which is propelling the cleaner in '**a forward** direction'" (emphasis added). Paper 28, 4–5 (citing the language of claim 21). Petitioner disagrees. Paper 44, 2–4.

Patent Owner does not identify support in the claim language or in the Specification for its argument regarding the "constant alignment" of the front of the apparatus with the water jet. Patent Owner relies instead on a dictionary definition of the indefinite article "a" (Ex. 2014) and on Mr. Giora Erlich's declaration (Ex. 2016 ¶¶ 55–56). Paper 28, 5. With respect to the dictionary definition, Mr. Erlich's interpretation of the indefinite article "a" is inconsistent with the recitation in claim 6 of an apparatus having multiple conduit openings. Further, Mr. Erlich bases his opinion on the depiction of the apparatus in Figure 1A of the '183 Patent to demonstrate that "a single 'front portion' . . . remains in constant alignment with the

water jet." Ex. 2016 ¶ 56.

On this evidence, however, we are not persuaded to read the limitations of this depicted embodiment of the Specification into the claims. *Van Geuns*, 988 F.2d at 1184. Consistent with the language of the claims, the disclosure of the Specification, and the prosecution history, we interpret this limitation as providing that the location of the front portion on the apparatus varies with the movement of the apparatus, both over time and depending upon the number and direction of orientation of one or more discharge conduits through which the water jet is discharged.

3. an opposing rear portion and *adjoining side portions*

Independent claims 1 and 21 recite that the front portion, together with "an opposing rear portion and adjoining side portions" define the periphery of the apparatus. Ex. 1006, col. 24, l. 10; col. 26, ll. 31-33; Abstract. Patent Owner includes this limitation in proposed substitute claims 22 and 23. Paper 42, 2–3. Independent claim 20 and proposed substitute claim 24 similarly recite "a front portion, a rear portion and opposing side portions defining the periphery of the apparatus." Ex. 1006, col. 26, ll. 6–7; Paper 42, 4. The Specification states that "references to the front *and rear* of the cleaning apparatus or its housing will be with respect to the direction of its movement." Ex. 1006, col. 5, ll. 10–12 (emphasis added). Consistent with the broadest reasonable interpretation of the "front portion," as set forth above, the "rear portion" is opposite to the "front portion" of the apparatus and, like the front portion, the location of the rear portion on the apparatus varies with the movement of the apparatus, both over time and depending upon the number and direction of orientation of one or more discharge conduits through which the water jet is discharged.

Because the side portions adjoin the front and rear portions, as with the front and rear portions, we interpret the location of the side portions on the apparatus to vary with the movement of the apparatus, both over time and depending upon the number and direction of orientation of one or more discharge conduits through which the water jet is discharged. Therefore, the rear and side portions are defined relative to the varying front portion.

4. rotationally-mounted supports coupled proximate the front and rear portions of the housing

Independent claim 1 recites "rotationally-mounted supports coupled proximate the front and rear portions of the housing." Ex. 1006, col. 24, ll. 13–14. Claim 21 similar recites "rotationally-mounted supports coupled to the housing." *Id.* at col. 26, ll. 33–34. We find no express definition, in the Specification or agreed upon by the parties, for rotationally-mounted supports. Patent Owner includes this limitation in substitute claims 22 and 23. The Specification, however, describes that

> [A] further object of the invention is to provide an improved apparatus and method for varying the position of one or more of *the wheels or other support means* of the cleaner in order to vary the directional movement and scanning patterns of the apparatus with respect to the bottom surface of the pool or tank being cleaned.

Ex. 1006, col. 3, ll. 35–40 (emphasis added). The Specification also describes that the cleaner may move "on *supporting wheels, rollers or tracks* that are aligned with the longitudinal axis of the cleaner body when it moves in a straight line." *Id.* at col. 4, ll. 8–11 (emphasis added). Referring, for example, to Figure 1, wheels 30 mounted on axles 32 are depicted as disposed at either end of pool cleaner 10.

A definition of the verb "to support" is "to carry or bear (a specific weight, strain, pressure, etc.)," and a definition of the noun "support" is "a person or thing that supports, esp. financially." WEBSTER'S NEW WORLD DICTIONARY (Ex. 3002) at 1345. A definition of the noun "rotation" is "rotating or being rotated." *Id.* at 1168. Thus, we interpret the term "rotationally-mounted supports" to recite two or more things (including, but not limited to wheels, rollers, and tracks) that carry or bear the housing of the apparatus and which are mounted to the housing, so that the supports may rotate or turn, for example, on an axis.[4] Nevertheless, because the front and rear of the apparatus are determined by its direction of movement at any particular point in time, whether the rotationally-mounted supports are "coupled proximate to the front and rear portions of the housing" depends upon the direction of movement of the apparatus at a given time.

5. towards the surface beneath the apparatus

Independent claim 21 recites "said discharged filtered water forming a water jet having a resultant force vector acutely angled *towards the surface beneath the apparatus*." Ex. 1006, col. 26, ll. 45– 48 (emphasis added). Independent claim 20 recites a limitation similar to that of claim 21. Independent claim 1, however, recites that "a pressurized stream of water forming the water jet is directionally discharged at a predetermined angle that is acute *with respect the surface over which the apparatus is moving*." *Id.* at col. 26, ll. 22– 25 (emphasis added). Each of these limitations

[4] Substitute claim 23 recites that "the rotationally-mounted supports *comprise* first and second pairs of axially mounted wheels respectively positioned proximate to the front and rear portions of the housing." Paper 42, 3 (emphasis added). Differences among claims can be a useful in understanding the meaning of particular claim terms. *See Laitram Corp. v. Rexnord, Inc.*, 939 F.2d 1533, 1538 (Fed. Cir. 1991).

describes the force or the direction of the water jet with respect to the "surface," rather than with respect to the apparatus. In proposed substitute claims 22 and 24, Patent Owner further limits the recitations of original claims 1 and 20, respectively, such that the angles of the force and of the direction of the water jet are described relative to the front rotationally-mounted supports or pairs of wheels.

With respect to the recitations of claims 20 and 21, a relevant definition of the preposition "towards" is "in the direction of," and a relevant definition of the preposition "beneath" is "below; lower than." WEBSTER'S NEW WORLD DICTIONARY (Ex. 3002) at 129, 1414-15. Thus, we conclude that these limitations describe the surface beneath the apparatus, but are not limited to the relative dispositions of the rotationally-mounted supports. With respect to claim 1, however, the corresponding limitation refers more broadly to the surface "over which the apparatus is moving." Consequently, with respect to claim 1, the predetermined angle may be acute with regard to any portion of that surface, regardless whether or not it lies *beneath* the apparatus. *See* Paper 42, 10–11 (quoting the deposition of Mr. Erlich regarding the criticality of the angle with respect to the apparatus and the surface). We construe the corresponding limitations of substitute claims 22–24 more narrowly that original claims 1, 8, or 20 in view of the added recitations describing the angles relative to the positions of the front, rotationally-mounted supports or pairs of wheels. *Cf., e.g.*, Ex. 1006, col. 24, ll. 28–34, 38–43 (Claims 3, 5).

6. Remaining Claim Terms or Phrases

All remaining claim terms and phrases recited in the challenged or substitute claims are given their ordinary and customary meanings,

consistent with the Specification, as would be understood by one with ordinary skill in the art, and need not be construed explicitly here.

B. Grounds for Review

1. Anticipation by Myers

"A claim is anticipated only if each and every element as set forth in the claim is found, either expressly or inherently described, in a single prior art reference." *Verdegaal Bros., Inc. v. Union Oil Co. of Cal.*, 814 F.2d 628, 631 (Fed. Cir. 1987) (citations omitted). Petitioner argues that Myers discloses, expressly or inherently, each and every element of claims 1, 2, 13, 14, 16, and 19–21. Paper 5, 8–11, 21–23, 26–27, 40–42, 45–47, 52–53.

Figures 1 and 2 of Myers are reproduced below, including Petitioner's annotations. *See* Paper 5, 8 (depicting annotated versions of Myers's Figs. 1 and 2).

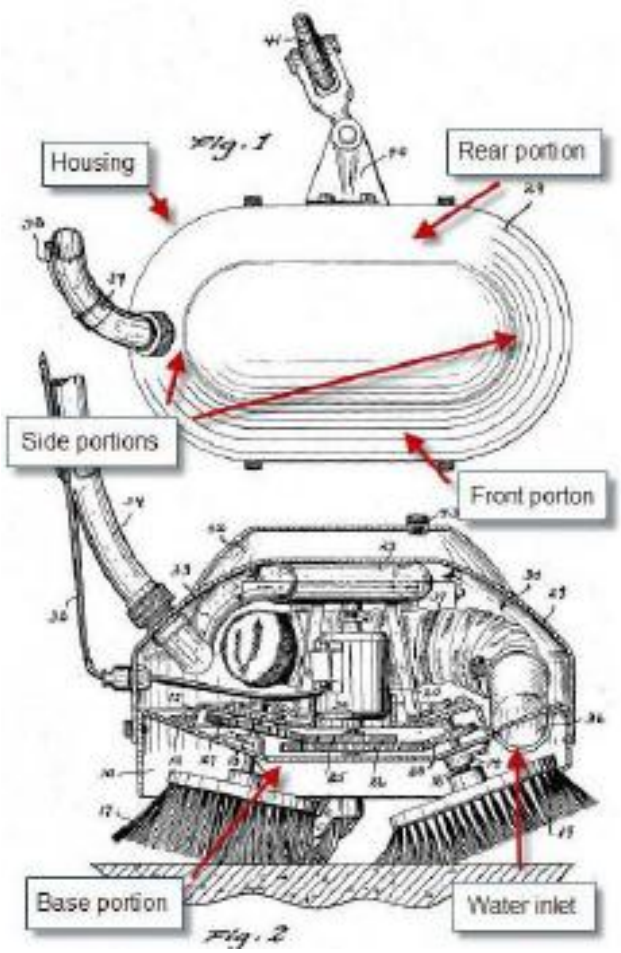

Figure 1 depicts a top plan view of a swimming pool cleaning means according to Myers's invention, and Figure 2 depicts a cross-sectional view of the swimming pool cleaning means, as depicted in Myers's Figure 1. Ex.1001, col. 1, ll. 42–43.

Petitioner annotated these figures to identify elements of Myers's device corresponding to the housing, including front, rear, and side portions; the base portion, e.g., the baseplate; and the water inlet. In view of our claim interpretation, the identifications of the front, rear, and side portions in Petitioner's annotated Figure 2 are merely illustrative of those portions at a point in time.

Referring to Figures 1 and 2, Petitioner argues that Myers depicts "a

self-propelled cleaning apparatus for cleaning a submerged surface of a pool or tank." Paper 5, 8; *see* Ex. 1006, Claim 21 (preamble). In particular, Myers indicates that the disclosed "invention relates to a swimming pool cleaning device and more particularly to a cleaning means that is erratically self-propelled over the bottom surface of the swimming pool." Paper 5, 8 (quoting Ex. 1001, col. 1, ll. 8–11). Moreover, Petitioner argues that Myers's device includes the claimed "housing," i.e., hood 29, having front, opposing rear, and adjoining side portions, which define the periphery of the device. Paper 5, 8. Further, Petitioner argues that Myers's device includes a baseplate, i.e., outer area 12, through which a water inlet, i.e., passageway 36, communicates with the outside of the device. *Id.*; *see* Ex. 1001, col. 1, 50–52; col. 2, ll. 22–24.

Referring to Figure 2, Myers depicts "a surface engaging element such as a brush or like 17" which is "rotatably mounted" on shafts at either end of hood 29. Ex. 1001, col. 1, ll. 55-61. Petitioner argues that surface engaging elements 17 correspond to the rotationally-mounted supports, as recited in claim 1. Paper 5, 8.

Finally, referring to Figure 2, Myers discloses that flexible conduit 33 may be connected to outlet opening 32 of rotary pump 13 and may pass through and terminate just beyond hood 29. Ex. 1001, col. 2, ll. 8–13. An elongated, flexible conduit, e.g., hose 34, may be attached *detachably* to the outlet portion of conduit 33 and may extend to a point outside the swimming pool. *Id.* at col. 2, ll. 13–18. Myers further explains that:

> [I]f the electric motor is operated as a motor, and the conduit 33 is detached [from conduit 34], *the water exiting from the unit and into the pool will provide a jet force to move the unit*. Also due to the gear wheel sizes and other placed elements more weight will be borne on by one brush than the other brush. This

> is particularly true if the conduit 33 is attached.

Id. at col. 3, ll. 6–12 (emphasis added). Thus, Petitioner argues that Myers discloses the directional discharge conduit, as recited in claim 21, as well as the stationary directional discharge conduit, as recited in claim 1. Paper 5, 10–11.

Patent Owner disagrees (1) with our claim construction regarding the recitation in claim 21 of "a front portion as defined by the direction of movement of the cleaning apparatus when propelled by a water jet" (*see supra* Section II.A.2) and (2) with Petitioner's reading of Myers's disclosure on the language of claim 21. Paper 28, 3–7. First, Patent Owner contends that "even if the 'front' changes on reversal of movement, the 'front' nonetheless remains constant in terms of the direction of movement." *Id.* at 4. Thus, Patent Owner contends that we erred in concluding that "the front portion of the housing may change with time, and no single portion of the housing may be identified exclusively as the front portion." Paper 18, 11. Consequently, Patent Owner contends that "[t]he front portion of Patent Owner's cleaner remains in constant alignment with the water jet which is propelling the cleaner in 'a forward direction.'" Paper 28, 5. As we noted above, the challenged claims simply do not include any recitation regarding a "constant alignment" between the front portion of the apparatus and the water jet.

Patent Owner further argues that

> the water jet of the Myers' cleaner provides an ancillary force vector that contributes to the intended erratic, and not necessarily forward, movement of the cleaner. [Ex. 2016 ¶¶ 57, 60.] This ancillary force vector works in conjunction with the single projecting swivel wheel and the pair of brushes that are

> axially mounted at an acute angle displaced slightly from the vertical to create erratic movement. *Id.* at 60[.]

Paper 28, 5. Nevertheless, as we have discussed, the front of the apparatus is determined by the direction of movement. Even accepting that Myers's apparatus may engage in erratic movement, such movement still may define a front portion at any given time. Further, erratic movement is not necessarily inconsistent with "propelling the apparatus *in a forward direction* of movement," as recited in claim 21. Ex. 1006, col. 26, ll. 49–50 (emphasis added); *compare* Paper 70, 23:23–24:2 ("[T]he fact is that once that front starts, once there is a correlation, once there is a movement, there is a front, the direction of motion are related. Therefore, structurally there has to be sometimes both a front and a direction -- forward direction of movement"), *with id.* at 9:3–9:6 ("There's nothing to – there's nothing in this claim that would exclude not only forward directions of movement but sideways directions of movement, components of movement that are caused by not only the jet drive but also the configuration of the apparatus."). Patent Owner's apparatus is not limited solely to movement in a forward direction. Ex. 1006, col. 5, ll. 4–9 ("The invention comprehends methods and apparatus for controlling the movement of robotic tank and swimming pool cleaners that can be characterized as systematic scanning patterns, scalloped or curvilinear patterns *and controlled random motions with respect to the bottom surface of the pool or tank*." (emphasis added)); *see also* Paper 70, 6:14-24 (discussing curvilinear movement depicted in Ex. 1006, Fig. 35). We agree with Patent Owner that Myers describes that its device moves "erratically" across the bottom surface of the pool. *See* Ex. 1001, col. 1, ll. 8–11, 22–24; col. 2, l. 34–col. 3, l. 5. We determine, however, that Myers's

device has an identifiable, if varying, "front portion" consistent with our interpretation of the limitation recited in claim 21.

In addition, although the movement of Myers's device may be influenced by the rotation of surface engaging elements 17 (Ex. 1001, col. 2, l. 55–col. 3, l. 5), such additional influences are not precluded by the language of claim 21. Further, we note that the "propelling limitation" of claim 21 does not limit the form of propulsion and, in particular, does not recite that the apparatus is propelled in a forward direction only by the water jet. Thus, like Myers, the movement of the recited apparatus also may be the result of the contributions of separate elements. Paper 44, 2–4; *see* Paper 70, 49:4–20. Therefore, we are not persuaded by Patent Owner's arguments that Myers fails to disclose any of the recited elements of claim 21.

Patent Owner contends that the reasons discussed above for distinguishing the claimed invention over Myers over claim 21, apply to remaining challenged claims, claims 1, 2, 13, 14, 16, 19, and 20, as well. Paper 70, 22:7–17. We conclude that Petitioner has demonstrated by a preponderance of the evidence that claims 1, 2, 13, 14, 16, and 19–21 of the '183 Patent are anticipated by Myers.

2. Henkin and Myers

A patent claim is unpatentable under 35 U.S.C. § 103(a) if the differences between the claimed subject matter and the prior art are "such that the subject matter, as a whole, would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains." *KSR Int'l Co. v. Teleflex Inc*., 550 U.S. 398, 406 (2007). The question of obviousness is resolved on the basis of underlying factual determinations, including: (1) the scope and content of the prior art;

(2) any differences between the claimed subject matter and the prior art; (3) the level of skill in the art; and (4) objective evidence of nonobviousness, i.e., secondary considerations. *Graham v. John Deere Co.*, 383 U.S. 1, 17–18 (1966).

Petitioner argues that Henkin discloses substantially all of the limitations of challenged claims 1-5 and 19–21, except that Henkin discloses the use of an external pump, rather than an internal pump. *See* Paper 5, 13 (Claim 1), 48 (Claim 20), 54 (Claim 21). Like Myers, Henkin discloses an apparatus for cleaning submerged surfaces of a pool. Ex. 1002, col. 1, ll. 46–59. Myers, however, teaches the use of an internal pump, e.g., ordinary rotary pump 23. *See* Paper 5, 13 (Claim 1), 48 (Claim 20), 54 (Claim 21). Petitioner argues that a person of ordinary skill in the relevant art would have had a reason to modify the teachings of Henkin to replace the external pump with an internally-mounted pump to eliminate (1) the need for an external source of pressurized water and supply hose and (2) the need to manage the supply hose to prevent entanglement. *Id*. We agree.

Patent Owner argues that the method recited in claim 21 is distinguishable over Henkin and Myers for at least two reasons. Paper 28, 7–10. First, Patent Owner notes that claim 21 recites "said discharged filtered water forming a water jet having *a resultant force vector acutely angled towards the surface beneath the apparatus*." *Id.* at 7 (citing Ex. 1006, col. 26, ll. 45– 48 (emphasis added)). Patent Owner contends, however, that Henkin fails to teach or suggest this limitation. *Id.*; *see also* Paper 5, 27 (depicting a resultant force vector aligned with Henkin's nozzle 90 angled acutely towards the surface over which Henkin's apparatus moves). Second, Patent Owner contends that neither Henkin nor Myers

provides a person of ordinary skill in the art with a reason to combine the teachings of these references to achieve the invention recited in the challenged claims. Paper 28, 9.

Patent Owner correctly notes that Henkin's Figure 2 depicts nozzle 90 oriented at an acute angle to the surface over which Henkin's apparatus moves. *Id.* at 8. Further, as depicted in Henkin's Figure 2, water ejected from nozzle 90 would produce a resultant force directed ahead of, rather than beneath, Henkin's apparatus. *Id.* at 8. Nevertheless, Henkin teaches that nozzle 90 is adjustable. Paper 44, 6 (quoting Ex. 1002, col. 5, ll. 15–16 (describing set means for holding nozzle 90 at a selected angle)). Moreover, Henkin teaches that "[t]he angle or the nozzle 90 is selected to yield both a downward thrust component (i.e. normal to the vessel surface) for providing traction and a forward component which aids in propelling the car and facilitates the car climbing vertical surfaces and working itself out of corners." Ex. 1002, col. 5, ll. 19–23; *see* Paper 5, 55 (claim chart for Claim 21). Thus, Henkin teaches that the angle of nozzle 90 may be adjusted and that, if an appropriate angle was selected, such an adjustment could result in a resultant force vector directed *beneath* Henkin's apparatus. Paper 70, 15:17–19; 36:6–37:19. Further, Myers depicts that a resultant force vector produced by a water jet directed *beneath* Myer's apparatus. Paper 5, 55; Paper 70, 15:11–16.

Patent Owner also contends that "neither Henkin nor Myers, provide[s] a person of ordinary skill in the art with any purpose or reason to direct the 'discharge filtered water forming a water jet having a resultant force vector acutely angled towards the surface beneath the apparatus,' as required by challenged claim 21." Paper 28, 9 (citation omitted). As

discussed above, Myers depicts that a resultant force vector produced by a water jet may be directed beneath Myer's apparatus. Paper 42, 8; Paper 5, 55. Petitioner argues that:

> [b]oth Myers and Henkin teach propelling a cleaner using a water jet force. Accordingly, one of ordinary skill in the art would be motivated to combine the direction of the resultant force vector of Myers which provides stability with the Henkin cleaner to further increase the downward thrust component for providing traction in the Henkin cleaner in order to further increase the stability of the Henkin cleaner.

Paper 44, 8 (citations omitted). Further, as noted above, Henkin describes using the downward resultant force for a substantially similar purpose to the '183 Patent. Paper 70, 15:20–16:2; *compare* Ex. 1006, col. 10, ll. 60–64, *with* Ex. 1002, col. 5, ll. 19–23. As the U.S. Supreme Court has explained,

> When there is a design need or market pressure to solve a problem and there are a finite number of identified, predictable solutions, a person of ordinary skill has good reason to pursue the known options within his or her technical grasp. If this leads to the anticipated success, it is likely the product not of innovation but of ordinary skill and common sense. In that instance the fact that a combination was obvious to try might show that it was obvious under § 103.

KSR, 550 U.S. at 421. We agree with Petitioner that Henkin provides a reason for combining its teachings with those of Myers and that the combination of the teachings of Henkin and Myers was "neither unpredictable nor beyond the person of ordinary skill." *See* Paper 70, 16:22–24.

3. Pansini and Myers

Petitioner argues that Pansini discloses substantially all of the limitations of challenged claims 1–9 and 19–21, except that Pansini

discloses the use of an external pump, rather than an internal pump. *See* Paper 5, 16 (Claim 1), 49 (Claim 20), 55–56 (Claim 21). Like Myers, Pansini discloses an apparatus for cleaning submerged surfaces of a pool. Pansini, Abstract. Myers, however, teaches the use of an internal pump, e.g., ordinary rotary pump 23. Paper 5, 16. Petitioner argues that a person of ordinary skill in the relevant art would have had a reason to modify the teachings of Pansini to replace the external pump with an internally-mounted pump to eliminate (1) the need for an external source of pressurized water and supply hose, and (2) the need to manage the supply hose to prevent entanglement. *Id.* We agree.

Patent Owner contends that (1) Pansini does not teach that the angle of its jet nozzles 20 and 22, as depicted in Pansini's Figure 3, creates a resultant force vector directed *beneath* the cleaning apparatus (Paper 28, 10); (2) Pansini does not teach that the water pump is mounted in the interior of the housing (*id.* at 12); and (3) the combination of Pansini and Myers fails to teach these missing limitations of Pansini (*id.* at 14). For the reasons set forth below, we are not persuaded by Patent Owner's contentions.

First, Patent Owner contends that Pansini does not disclose that the angle of its jet nozzles 20 and 22, as depicted in Pansini's Figure 3, creates a resultant force vector directed beneath the cleaning apparatus. *Id.* at 10. Although Patent Owner is correct, Petitioner relies on Myers, rather than Pansini, to teach this particular limitation of claim 21. Petitioner argues that, although "Pansini by itself does not disclose a resultant force vector directed beneath the apparatus, Myers does disclose such a force vector, and Patent Owner does not dispute this fact." Paper 44, 9. As Patent Owner acknowledges, Myers teaches a resultant force vector having a horizontal

component and a vertical component and that "Myers only generally discloses that 'the outlet of said pump [is] capable of serving to jet a stream of water for propelling said chassis over the floor of a swimming pool.'" Paper 28, 11 (quoting Ex. 1001, col. 7, ll. 46–48). The horizontal component may assist in propelling the apparatus, and the vertical component may assist in maintaining the apparatus in contact with the surface beneath it. *Id.* Patent Owner contends, however, that "[t]hese were not attributes even considered by Pansini or Myers." *Id.* (citing Ex. 2016 ¶ 72). Therefore, Patent Owner contends that a person of ordinary skill in the art would not have combined the teachings of Pansini and Myers to achieve this limitation. *Id.* at 14.

Petitioner disagrees and argues that

> [O]ne of ordinary skill in the art would be motivated to combine the direction of the resultant force vector of Myers (directed at the surface beneath the cleaner) which provides stability with the Pansini cleaner to further increase the hold-down force of the Pansini cleaner to further increase the stability of the Pansini cleaner.

Paper 44, 9; *see* Ex. 1010 ¶ 22 (citing Ex. 1003, col. 3, l. 66–col. 4, l. 2); Paper 70, 17:1–8, 52:23–53:9. As we noted above, the U.S. Supreme Court has explained, that "[w]hen there is a design need or market pressure to solve a problem and there are a finite number of identified, predictable solutions, a person of ordinary skill has good reason to pursue the known options within his or her technical grasp." *KSR*, 550 U.S. at 421. Therefore, we are persuaded that Petitioner demonstrates that the combined teachings of Pansini and Myers teach a resultant vector force that may be angled beneath the apparatus, and that a person of ordinary skill in the art would

have reason to combine their teachings to achieve this limitation.

Second, Patent Owner argues that Pansini does not teach that the water pump is mounted in the interior of the housing, and that a person of ordinary skill in the relevant art would be discouraged from combining the teachings of Pansini and Myers to achieve that configuration. Paper 28, 12. In particular, Patent Owner argues that "Pansini was principally concerned with the fact that a cleaning apparatus fed by the pool's circulation system would be highly susceptible to being tipped over by the drag force of the hose which provided the water source to propel the cleaning device." *Id.* In support of this argument, Patent Owner cites a claim that was cancelled during Pansini's prosecution, reciting that "said hose applying a drag force to said carrier tending to tip it over in a direction opposite to its direction of movement under the influence of the drive jet from said nozzle." Ex. 2013, 25 (quoting cancelled claim 19). From this portion of the prosecution history, Patent Owner argues that "Pansini's invention related to solving the problem of using an external pump, not eliminating it." Paper 28, 12 (citing Ex. 2016 ¶ 70). We are not persuaded by Patent Owner's arguments.

As noted in our Decision to institute *inter partes* review, we were not persuaded that Pansini's teachings would discourage persons of ordinary skill in the relevant art from incorporating a pump within the housing of the cleaner described in Pansini. Paper 18, 24–25. The evidence presented in Patent Owner's response to the petition does not now persuade us otherwise. *See* Paper 28, 12–14. Although Pansini may have been concerned that "a cleaning apparatus *fed by the pool's circulation system* would be highly susceptible to being tipped over by the drag force of the hose which provided the water source to propel the cleaning device" (*id.* at 12 (emphasis

added)), Patent Owner fails to demonstrate that Pansini's teachings are limited to such cleaner configurations. Further, although Pansini's cancelled application claim 19 recited that "said hose applying a drag force to said carrier tending to tip it over in a direction opposite to its direction of movement under the influence of the drive jet from said nozzle" (Ex. 2013, 25 (quoting cancelled claim 19)), Patent Owner does not demonstrate that Pansini's teachings are so limited. *See id.* at 13; *see also* Paper 44, 8–9 (describing Pansini's claim 1).

Finally, Patent Owner notes the purported dangers of using electrically powered pool cleaners as a reason against combining the teachings of Pansini and Myers as proposed by Petitioner. Paper 28, 14 (citing Ex. 2016 ¶¶ 19 ("In 1999, these companies (including Polaris, now owned by Zodiac) criticized and described electrically powered robotic pool cleaners as being dangerous because of the use of electrically powered components in water."), 69, 72 (describing problems with cable entanglement). As we noted in our Decision to institute *inter partes* review, the apparatus recited in the independent claims is not limited to use in swimming pools, but also is suitable for use in tanks. Paper 18, 24; *see* Ex. 1006, col. 26, ll. 25-26 (Claim 21) ("for cleaning a submerged surface of a pool *or tank*" (emphasis added)).

In addition, although the Specification of the '183 Patent may describe embodiments of the internal pump including electric motors, claim 21 merely recites a "water pump" and does not require that the recited pump be driven by an electric motor. *See* Paper 18, 25. Similarly, we addressed the issue of power supply cable entanglement in our Decision to institute and suggested that, for example, the use of a battery might resolve this issue. *Id.*

at 26. Although Patent Owner's declarant states that the use of a battery may have been undesirable and may have caused other difficulties, the declarant does not state that this option was unavailable. *See* Ex. 2016 ¶ 20. Therefore, we are not persuaded that Pansini teaches away from the Petitioner's proposed combination of Pansini and Myers, nor do we find that Pansini's teachings are limited the use of external or internal pumps.

4. Secondary Considerations

Factual inquiries for an obviousness determination include secondary considerations based on evaluation and crediting of objective evidence of nonobviousness. *Graham*, 383 U.S. at 17. Notwithstanding what the teachings of the prior art would have suggested to one with ordinary skill in the art at the time of the '183 Patent's invention, the totality of the evidence submitted, including objective evidence of nonobviousness, may lead to a conclusion that the challenged claims would not have been obvious to one with ordinary skill in the art. *In re Piasecki*, 745 F.2d 1468, 1471–72 (Fed. Cir. 1984). Secondary considerations may include any of the following: long-felt but unsolved needs, failure of others, unexpected results, commercial success, copying, licensing, and praise. *See Graham*, 383 U.S. at 17; *Leapfrog Enters., Inc. v. Fisher–Price, Inc.*, 485 F.3d 1157, 1162 (Fed. Cir. 2007).

To be of relevance, evidence of nonobviousness must be commensurate in scope with the claimed invention. *In re Kao*, 639 F.3d 1057, 1068 (Fed. Cir. 2011) (citing *In re Tiffin*, 448 F.2d 791, 792 (CCPA 1971)); *In re Hiniker Co.*, 150 F.3d 1362, 1369 (Fed. Cir. 1998). In that regard, in order to be accorded substantial weight, there must be a nexus between the merits of the claimed invention and the evidence of secondary

considerations. *In re GPAC Inc*., 57 F.3d 1573, 1580 (Fed. Cir. 1995). "Nexus" is a legally and factually sufficient connection between the objective evidence and the claimed invention, such that the objective evidence should be considered in determining nonobviousness. *Demaco Corp. v. F. Von Langsdorff Licensing Ltd.*, 851 F.2d 1387, 1392 (Fed. Cir. 1988). The burden of showing that there is a nexus lies with the patent owner. *Id*.; *see Paulsen*, 30 F.3d at 1482.

a. Long-Felt Need

Here, Patent Owner argues that, prior to 1999, there was a long-felt need to provide efficient, automated cleaning devices, as recited in the challenged claims. Paper 28, 15-19. In particular, Patent Owner contends that three approaches were developed separately at the time of the invention and that the third approach was embodied in the claims of the '183 Patent, namely, "a truly robotic cleaner driven by electrical power *that requires controlled movements*." *Id.* at 15-16 (citing Ex. 2016 ¶ 22) (emphasis added). Consequently, Patent Owner argues that, because of the long-felt need for its products embodying the claimed invention, the subject matter of the challenged claims would not have been obvious over the combination of Henkin and Myers or Pansini and Myers. *Id.* at 17. As support, Patent Owner proffers the declaration of Mr. Erlich (Ex. 2016), who is an inventor of the '183 Patent. *Id.* at 3, 15–19.

Patent Owner argues that "[c]ontrolling the movement of the cleaner was critical to avoiding the twisting of the electric cable which would seriously impede the cleaner's operation." *Id.* at 17 (citing Ex. 2016 ¶ 28). Petitioner responds that "Patent Owner's argument is flawed because the purported 'solution' to the alleged 'long felt need' is not claimed, as Claim

21 does not require or even describe controlled movement or surface stability." Paper 44, 9. Similarly, Patent Owner fails to demonstrate that the recitations of the challenged claims solve the other problems which Patent Owner contends are the subject of long-felt need, namely, susceptibility of parts to wear and breakdown and elimination of power supply cables. Paper 28, 16–19; *see* Paper 44, 10–11. Consequently, to the extent that Patent Owner may have shown that these problems represent a long-felt need, Patent Owner fails to show a nexus between that need and limitations recited in the challenged claims of the '183 Patent. Paper 28, 13–14. Thus, we determine that Patent Owner's objective evidence does not support a conclusion of nonobviousness, because the evidence before us does not demonstrate adequately that the challenged claims represent a solution to the alleged long-felt need.[5]

b. Failure of Others and Commercial Success

Patent Owner further argues that its products were commercially successful and that others had failed to develop corresponding products. Paper 28, 19–20. To substantiate its argument that Patent Owner's products were commercially successful, Patent Owner states that

> Customers responded [to the introduction of its products] by purchasing more than 100,000 units in the first ten years since introduction. Sales have increased every year since 2002.

[5] Patent Owner further argues that our Decision to institute *inter partes* review "implicitly recognized that the prior art did not anticipate or render obvious this angular/vector force in deciding that claims 10–12 of the '183 Patent are not subject to these proceedings." Paper 28, 19. However, our Decision merely found that, by its arguments and supporting evidence, Petitioner had failed to establish a reasonable likelihood of prevailing in demonstrating the unpatentability of those claims over Exhibits 1001 and 1004. Paper 18, 31–33.

> Within about four years from introduction annual sales of Pool Rover exceeded ten thousand units. Today, sales of jet drive products account for more than 2/3 of all Aqua Products' sales of pool cleaners.

Id. at 20 n.4 (citing Ex. 2016 ¶ 40). The cited portion of Mr. Erlich's declaration (Ex. 2016), however, identifies no evidence in support of these statements. Further, Patent Owner contends that Petitioner developed a product based on Patent Owner's product and that Petitioner's product also embodies the challenged claims. *Id.* at 20–21. Moreover, Patent Owner contends that, when Patent Owner's and Petitioner's products, which both allegedly embody the challenged claims, are considered together, the combined sales "represent by far the majority of sales in the United States of robotic pool cleaners." *Id.* at 22. Patent Owner, however, points to no other evidence supporting these contentions.

In addition, as Petitioner correctly points out, "information solely on numbers of units sold is insufficient to establish commercial success." Paper 44, 11 (citing *In re Baxter Travenol Labs*, 952 F.2d 388, 392 (Fed. Cir. 1991) ("Information solely on numbers of units sold is insufficient to establish commercial success.")). Petitioner also correctly notes that "Patent Owner makes no showing that these alleged sales figures are significant in the pool cleaner industry." *Id.* at 11–12 (citing *In re Huang*, 100 F.3d 135, 140 (Fed. Cir. 1996) ("Declining to find evidence of commercial success because '[a]though [the inventor's] affidavit certainly indicates that many units have been sold, it provides no indication of whether this represents a substantial quantity in this market.'"). Accordingly, we find unpersuasive Patent Owner's proffered evidence of commercial success. *See Cable Elec. Prods., Inc. v. Genmark, Inc.*, 770 F.2d 1015, 1026–27 (Fed. Cir. 1985)

(finding that sales of five (5) million units represent a minimal showing of commercial success because "[w]ithout further economic evidence . . . it would be improper to infer that the reported sales represent a substantial share of any definable market").

Patent Owner also argues that "failure of others" was evidence of secondary considerations, which may lead to a conclusion that the challenged claims would not have been obvious to one with ordinary skill in the art. Paper 28, 19. Patent Owner presents insufficient evidence for us to determine whether others had attempted and failed in developing the subject matter of the challenged claims. Other than perhaps Petitioner's failure to develop the subject matter of the challenged claims before Patent Owner,[6] as Petitioner notes, "no failure of any other company's pool cleaners is discussed in the section." Paper 44, 15. Further, "Patent Owner does not describe any other company's attempt to produce a cleaner that would infringe Claim 21, nor does Patent Owner describe how any other company failed in their 'attempts.'" *Id.*

In its Sur-Reply in support of its response, Patent Owner alters it asserted secondary considerations from the failure of others to copying. Paper 56, 1. Nevertheless, Petitioner previously asserted that it began development of its own product over a year before meeting with Patent Owner to discuss working together. Paper 44, 14 (citing Ex. 2016 ¶¶ 23, 24). In its Sur-Reply, Patent Owner only asserts that "[t]he adoption of Jet

[6] Patent Owner asserts that, prior to being informed of Patent Owner's products specifications, "[Petitioner's] representatives acknowledged that they had not previously contemplated a commercial product incorporating controlled movement jet drive." Paper 28, 20.

Drive by Zodiac *is consistent with* copying after Zodiac saw Aqua Products' Jet Drive, assessed consumer preferences and confirmed the pump flow design." Paper 56, 4 (emphasis added). We do not determine infringement in *inter partes* review, and the evidence presented by Patent Owner is insufficient to show that Petitioner copied Patent Owner's products.

After weighing the evidence of obviousness and nonobviousness of record, on balance, we conclude that the strong evidence of obviousness outweighs the weak evidence of nonobviousness.

Therefore, in view of the foregoing discussion of claim 21 and accepting Patent Owner's definition of a person of ordinary skill in the relevant art (Ex. 2016 ¶ 17), we are persuaded that Petitioner has demonstrated by a preponderance of the evidence that claims 1–5 and 19–21 of the '183 Patent are unpatentable over Henkin and Myers and that claims 1–9 and 19–21 of the '183 Patent are unpatentable over Pansini and Myers.

C. Motion to Amend Claims

As noted above, Patent Owner filed a contingent, Replacement Corrected Motion to Amend Claims under 37 C.F.R. § 42.121. Paper 42. Petitioner filed an Opposition to Patent Owner's Replacement Corrected Motion to Amend Claims (Paper 45), and Patent Owner filed a Corrected Reply in Support of Motion to Amend Claims (Paper 55). Because we conclude that Petitioner has shown the challenged claims to be unpatentable, we now consider the Replacement Corrected Motion to Amend Claims.

1. Scope of Motion to Amend Claims

Pursuant to 37 C.F.R. § 42.121(a)(2), a motion to amend claims may be denied if: (1) the amendments "seek[] to enlarge the scope of the claims

of the patent"; (2) the amendments "introduce new subject matter"; or (3) the amendments do not "respond to a ground of unpatentability," upon which trial was instituted. As discussed below, we determine that substitute claims 22 and 24 presented in Patent Owner's Replacement Corrected Motion to Amend Claims are definite and narrow the scope of the original claims, and do not introduce new subject matter. Although Patent Owner's Replacement Corrected Motion to Amend Claims attempts to respond to grounds of unpatentability, upon which trial was instituted, for the reasons set forth below, we deny Patent Owner's Replacement Corrected Motion to Amend Claims.

a. Narrowing Amendments

In substitute claim 22, Patent Owner proposes to replace the phrase "to *enable* movement of said apparatus" in claim 1 with the phrase "to *control* the directional movement of the apparatus." Paper 42, 1 (emphasis added). Petitioner argues that replacing "enable" with "control" impermissibly broadens claim 22. Paper 45, 4. In particular, Petitioner argues that "'[e]nable' has a well-known ordinary and customary meaning of 'to provide with the means or opportunity' and 'to make possible, practical, or easy.' In contrast, 'control' has a well-known ordinary and customary meaning of 'to exercise restraining or directing influence over.'" *Id.* at 4–5 (citations omitted). Thus, Petitioner contends that enable and control have different meanings and that the meaning of "control" is not contained within the meaning of "enable." *Id.* at 5. Patent Owner responds that "'[e]nable' subsumes both controlled or uncontrolled enabled movement. 'Control' restricts that which is 'enabled.'" Paper 55, 2.

We are not persuaded that the term "enable" *subsumes* the term "control." Although, as both parties acknowledge, to "enable" may mean "to make possible, practical or easy," (*see* Paper 55, 2 (citing Paper 45, 4)), this definition does not imply the power to control. Nevertheless, we are persuaded that, in order to "control" movement, movement first must be "enabled" or that the term "control" *subsumes* the term "enable." Thus, within the context of this substitute claim and as suggested by Petitioner, we construe the phrase "to control the directional movement" as "to *enable and* control the directional movement." *See* Paper 55, 4. As such, we conclude that this proposed amendment to substitute is narrowing.

In substitute claims 23 and 24, Patent Owner further proposes to amend each claims 8 and 20, respectively, to recite that "said predetermined angle is inclined upwardly with respect to the surface beneath the apparatus to produce a resultant force vector that is directed to a position that is proximate to and rearwardly displaced from a line passing through the transverse axial mountings of the front rotationally-mounted supports [or of the front pair of wheels]." Paper 42, 3, 4–5. We find this limitation narrows each of these substitute claims by requiring a narrower range of acute angles for the discharge conduit, such that the resultant force vector not only is directed to the surface beneath the apparatus, but to a specific area with respect to the recited transverse axial mountings.

Petitioner contends that, because substitute claim 23 recites that "a resultant force vector 'is directed to pass proximately to and rearwardly of the plane of the axis of rotation of the pair of wheels at the front portion of the apparatus,' rather than 'through' the plane, as recited in original claim 8," the substitute claim fails to narrow the original claim that it would

replace. Paper 45, 6. In particular, Petitioner contends that, in order to narrow the original claim, the substitute claim must recite that the resultant force vector "is directed to pass *through and* proximately to and rearwardly of the plane of the axis of rotation of the pair of wheels at the front portion of the apparatus." *Id.* (emphasis added). Patent Owner argues that Petitioner's contention ignores the dependency of substitute claim 23, from substitute claim 22. Paper 55, 4. We agree with Patent Owner's argument. Because we determine that substitute claim 22 properly narrows the subject matter of original claim 1, we are persuaded that substitute claim 23 also properly narrows the subject matter of original claim 8.

Patent Owner contends that the remaining limitations added to substitute claims 22–24 are narrowing limitations. Paper 55, 1. Petitioner does not contest that the remaining limitations are narrowing. Paper 45, 4–7. We agree that the remaining limitations are narrowing. Therefore, for the foregoing reasons, we determine that Patent Owner's proposed substitute claims 22–24 comply with 37 C.F.R. § 42.121(a)(2).

b. Definiteness of Substitute Claims

Under 35 U.S.C. § 112, ¶ 2, "[t]he specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention." The U.S. Supreme Court read "§112, ¶ 2 to require that a patent's claims, viewed in light of the specification and prosecution history, inform those skilled in the art about the scope of the invention with reasonable certainty." *Nautilus, Inc. v. BioSig Instruments, Inc.*, 134 S.Ct. 2120, 2129 (2014). We apply this standard in the context of our use of the broadest reasonable interpretation standard for claim construction (37 C.F.R. § 42.100(b)) and, given that the

challenged claim terms were introduced in a motion to amend claims, in the absence of prosecution history with respect to the language of the proposed substitute claims.[7] Petitioner argues that the substitute claims are indefinite. Paper 45, 7–9. We disagree.

Petitioner contends that, because substitute claim 24 only refers to "at least a front pair of wheels, each wheel axially mounted transverse to the longitudinal axis" of said apparatus, this claim fails to provide proper antecedent basis in the claim for the term "*the* transverse axial mountings." *Id.* at 7 (emphasis added). Claim 22 similarly recites that "rotationally-mounted supports [are] axially mounted transverse to a longitudinal axis of said apparatus." In particular, Petitioner contends that "[i]t is unclear from the claim what is meant by the term 'transverse axial mountings' (i.e., whether the mountings are part of, connected to, or entirely separate from supports or wheels)." *Id.* Petitioner, however, confuses the requirement for antecedent basis with the construction of the term. Here, we are persuaded that the description of the supports or wheels as "axially mounted transverse to a longitudinal axis" provides sufficient antecedent basis for the later reference to "the transverse axial mountings." *See* Paper 55, 3.

Petitioner further contends that, because substitute claims 22 and 24 refer to "a longitudinal axis" and because the term "longitudinal axis" is undefined, these claims are indefinite. Paper 45, 8 (citation omitted). In particular, Petitioner contends that "it is unclear *when* the supports of claim

[7] *See In re Packard*, 751 F.3d 1307, 1325 (Fed. Cir. 2014) (Plager, J., concurring) ("[U]nlike courts which have a full prosecution record to consider, the prosecution record before the USPTO is in development and not fixed during examination, and the USPTO does not rely on it for interpreting claims.").

22 or the wheels of claim 24 are transverse to the longitudinal axis." *Id.* (emphasis added). Patent Owner argues that the "longitudinal axis" is described in the Specification. Paper 55, 3 (citing, e.g., Ex. 1006, Figs. 33–36 (depicting double headed arrow)); *see also* Ex. 1006, col. 4, ll. 8–11 (the cleaner may move "on supporting wheels, rollers or tracks that are aligned *with the longitudinal axis* of the cleaner body when it moves in a straight line" (emphasis added)). Further, as Patent Owner correctly notes, the supports (claim 22) or the wheels (claim 24) are axially mounted transverse to the longitudinal axis, but the supports or wheels themselves are not recited as "transverse to the longitudinal axis." Paper 55 3–4; *see* Paper 45, 8. Thus, substitute claims 22 and 24 are not indefinite for the reasons proposed by Petitioner.

Petitioner contends that substitute claim 23 is indefinite (1) because the claim recites "a force vector" and it is not clear whether this is the same as or a different "force vector" from that recited in its base claim, claim 22; and (2) because the claim recites "the plane" without providing antecedent basis for the "plane." Paper 45, 8–9. In particular, Petitioner contends that "many force vectors can potentially be 'directed to pass proximately to and rearwardly of the plane.'" *Id.* at 9 (citing Ex. 1010 ¶ 26). As with original claims 7 and 8, we construe the term "a force vector" of substitute claim 23 to refer to the force vector in its base claim. With respect to the recitation of "the plane," there are only a limited number of planes which may contain the transverse axial mounting and be oriented, such that the force vector is directed to pass "proximately to and rearwardly of the plane." In particular, the plane may be parallel to the direction of the vector, but if the plane is angled toward the vector, the degree of offset is limited by the length, i.e.,

the magnitude, of the resultant force vector. Thus, Patent Owner's claim may be broad in scope, but the breadth of a claim is not to be equated with indefiniteness. *See e.g., In re Miller*, 441 F.2d 689, 693 (CCPA 1971). Thus, substitute claim 23 is not indefinite for the reasons proposed by Petitioner.

c. Written Description for Substitute Claims

37 C.F.R. § 42.121(b)(1) requires the patent owner to set forth in a motion to amend "the support in the original disclosure of the patent for each claim that is added or amended." *See Nichia Corporation v. Emcore Corporation*, IPR2012-00005, slip op. 3 (PTAB June 3, 2013) (Paper 27). Substitute claim 23 recites that "a resultant force vector in the water jet discharged from said at least one discharge opening that is directed to pass proximately to and rearwardly of the plane of the axis of rotation of the pair of wheels at the front portion of the apparatus." Paper 42, 3. Petitioner contends that "Patent Owner has failed to identify where this language is recited *in haec verba* and further failed to explain why one of ordinary skill in the art would have recognized that the inventor possessed the claimed subject matter." Paper 45, 10. As the U.S. Court of Appeals for the Federal Circuit explains, however,

> The test for determining compliance with the written description requirement is whether the disclosure of the application as originally filed reasonably conveys to the artisan that the inventor had possession at that time of the later claimed subject matter, *rather than the presence or absence of literal support in the specification for the claim language* . . . The content of the drawings may also be considered in determining compliance with the written description requirement.

In re Kaslow, 707 F.2d 1366, 1375 (Fed. Cir. 1983) (emphasis added) (citations omitted). Consequently, Patent Owner is not required to identify where this language is recited *in haec verba* in order to satisfy the written description requirement.

Patent Owner argues that the recitations of substitute claim 23 conforms the language of that claim to the language proposed in substitute claim 22. Paper 45, 6–7. We agree. Substitute claim 22 recites that "a resultant force vector that is directed to *a position that is proximate to and rearwardly displaced from a line passing through the transverse axial mountings* of the front rotationally-mounted supports." Paper 42, 3 (emphasis added). Original claims 7 and 8 described the rotationally-mounted supports as a pair of wheels and the resultant force vector as passing *through* the plane of the axis of rotation of the pair of wheels. Ex. 1006, col. 24, ll. 52–63. Further, the orientation of the plane of the axis of rotation of the pair of wheels is implicit in the drawings, given the angle of the resultant force vector. *E.g., id.* Fig. 9; *see Enzo Biochem, Inc. v. Gen-Probe Inc.*, 323 F.3d 956, 969 (Fed. Cir. 2002) ("the written description requirement is satisfied by the patentee's disclosure of 'such descriptive means as words, structures, figures, diagrams, formulas, etc., that fully set forth the claimed invention.'" (citation omitted)). Therefore, we determine that substitute claim 23 satisfies the written description requirement.

2. Patentability Over the Prior Art

An *inter partes* review is neither a patent examination proceeding nor a patent reexamination proceeding. In a motion to amend claims, the patent owner, as the movant, bears the burden of establishing the patentability of the proposed substitute claims over the prior art of record and also other

prior art known to Patent Owner. *Idle Free Systems, Inc. Bergstrom, Inc.*, IPR2012-00027, slip op. 7 (PTAB June 11, 2013) (Paper 26) (informative). We deny the Replacement Corrected Motion to Amend Claims because, for the reasons below, we are not persuaded that Patent Owner has demonstrated the patentability of the proposed substitute claims over a ground of unpatentability involving Henkin and Myers.

a. Construction of Substitute Claims

Initially, we note that Patent Owner does not propose a construction for the claim terms added to original claims 1, 8, and 20 by substitute claims 22–24, respectively. Paper 55, 4–5. Patent Owner again addresses the definition of "a front portion" and "a forward direction" in the substitute claims and asserts that "[t]he proposed amendments require that the 'front' is not variable." *Id.* at 4. We disagree.

As with original claim 1, substitute claim 22 continues to define the "front portion as defined by the direction of movement of the apparatus when propelled by a water jet." Paper 42, 2. Claim 24 adopts a similar recitation from original claim 20. *Id.* at 4. Consequently, we again construe the front portion as variable with the direction of movement "when propelled by a water jet."

Substitute claim 22 recites that rotationally-mounted supports are "axially mounted transverse to a longitudinal axis of said apparatus."[8] *Id.* at 2. Substitute claim 24 recites a similar limitation in which the supports are pairs of wheels. *Id.* at 4. Patent Owner proposes that we construe longitudinal axis as an axis which extends along the length of the apparatus

[8] Substitute claim 23 depends from substitute claim 22 and recites that the supports are pairs of wheels. Paper 42, 3.

in the direction of movement. Paper 55, 3-4. Patent Owner also proposes that "the 'longitudinal axis' is a real or imaginary straight line running or placed lengthwise around which the parts of the apparatus are symmetrically arranged." Paper 55, 3. Because the apparatus may move in any direction (*see* Ex. 1006, col. 5, ll. 4–9 (apparatus with "controlled random motions with respect to the bottom surface of the pool or tank")), this construction means that the orientation of the longitudinal axis is variable. Petitioner does not contest this construction (*see* Paper 45, 8), and we adopt this construction of the term "longitudinal axis."

Patent Owner does not propose a construction for "transverse axial mountings." Nevertheless, Patent Owner proposes that

> A line defined as extending transversely between the transverse axial mountings of the front pair of wheels is present either for wheels that have a common axle 32 which extends transversely across the longitudinal axis of the cleaning apparatus ('183 Patent, Figs. 9, 10) or are individually mounted to an independent axle that does not extend completely across the cleaning apparatus. *Id.*, Figs. 33–36, 39–44.

Paper 42, 6. A relevant definition of "transverse" is "lying, situated, placed, etc. across; crossing from side to side; opposed to LONGITUDINAL." WEBSTER'S NEW WORLD DICTIONARY (Ex. 3002) at 1422. Petitioner does not propose a construction for this term. Therefore, we construe the term "transverse axial mountings" as devices for mounting rotationally-mounted supports or wheels on opposite sides of a longitudinal axis. Because both the front portion and the longitudinal axis may vary with the direction of movement, a transverse line across the longitudinal axis or between supports or wheels also may vary with the direction of movement.

Further, substitute claim 22 recites that "rotationally-mounted supports axially mounted transverse to a longitudinal axis of said apparatus and coupled proximate the front and rear portions of the housing *to control* the directional movement of said apparatus over the submerged surface." Paper 42, 2 (emphasis added). Thus, substitute claim 22 recites that the supports *control* the directional movement although the apparatus may be *propelled* by a water jet. Substitute claim 24 recites that such control is supplied by wheels, rather than supports.

Although each of substitute claims 22–24 recites that the apparatus comprises "a stationary directional discharge conduit," this limitation appears in original claim 1. We construe this limitation in the same manner that we construed it with respect to the original claims. *See supra* Section II.A.1. Consequently, we remain unpersuaded that the front portion is not variable, e.g., is in constant alignment with the water jet which is propelling the apparatus in a forward direction. *See* Paper 28, 5.

Finally, substitute claim 22 recites that "said predetermined angle is inclined upwardly with respect to the surface beneath the apparatus to produce a resultant force vector that is directed to a position that is proximate to and rearwardly displaced from a line passing through the transverse axial mountings of the front rotationally-mounted supports." Paper 42, 2. Substitute claim 24 recites a similar limitation referring to pairs of wheels, instead of supports. *Id.* at 4–5. Consistent with the constructions set forth above, we construe the line passing through the transverse axial mountings as varying with the direction of movement. Hence, as the apparatus changes direction, each of the front portion, the longitudinal axis,

and the line passing through the transverse axial mountings "of the *front* rotationally-mounted supports" will vary.

b. Obviousness over Henkin and Myers

Patent Owner argues that substitute claims 22–24 are patentable over Henkin and Myers. Paper 42, 11–13. In particular, Patent Owner argues that "[n]either Henkin nor Myers suggest an apparatus with the 'resultant force vector that is directed to a position that is proximate to and rearwardly displaced from a line passing through the transverse axial mountings of the front rotationally-mounted supports' (claim 22) or the 'front pair of wheels' (claim 24)." Paper 42, 11–12 (citing Ex. 2016 ¶ 77) (emphasis omitted).

Patent Owner argues that the Specification of the '183 Patent discloses that the resultant force vector enables the apparatus to maintain consistent traction with the pool surface, advances the cleaner in a forward direction, and allows the apparatus to maintain proper orientation when contacting a vertical wall that is normal to the horizontal bottom surface beneath the cleaner. Paper 42, 12 (citing Ex. 1006, col. 10, l. 60–col. 11, l. 3; col. 10, ll. 47–51; col. 25, ll. 10–13; Ex. 2016 ¶ 78). In particular, Patent Owner argues that:

> When the apparatus comes into contact with a vertical surface normal to the horizontal bottom surface, the angle and direction, i.e., positioning of the resultant force vector Vr, ensures that the apparatus does not flip up and disrupt the cleaning pattern. Paper 42, 12 (citing Ex. 2016 ¶ 78). If the resultant force vector is directed forward of the transverse axial line of the front rotationally-mounted supports, the rear end of the apparatus can be impelled to flip upwards and rotate forward towards the vertical sidewall, thereby displacing and hindering the forward ascent of the apparatus up the sidewall. *Id.* ¶¶ 36, 79.

Paper 42, 12.

As Petitioner notes, "Henkin discloses a resultant force vector having th[e] very same purpose" that Patent Owner attributes to the structure of the substitute claims. Paper 45, 13. Patent Owner states that "[t]he angle [of adjustable nozzle 90] is selected to yield both a downward thrust component, *i.e.*, normal to the vessel surface, for providing traction and a forward component which aids in propelling the apparatus. Set means can be provided for holding the selected angle of the nozzle and valve means for varying the flow rate through the nozzle, 90." Paper 28, 8 (citing Ex. 2016 ¶ 64 (citing Ex. 1002, col. 5, ll. 15–27)). Henkin specifically teaches that the selected angle of nozzle 90 also "facilitates the car *climbing vertical surfaces* and working itself out of corners." Ex. 1002, col. 5, ll. 22–24 (emphasis added).

Patent Owner argues Henkin and Myers did not recognize or try to solve the problem it identified. Paper 42, 13 (citing Ex. 2016 ¶ 80). Patent Owner argues that "[n]either Henkin nor Myers suggest or otherwise provide a person of ordinary skill in the art with any reason to direct the resultant force vector proximate to and rearwardly displaced from a line passing through the transverse axial mountings of the front rotationally-mounted supports (e.g., a front pair of wheels), as recited in proposed substitute claim 22 or 24." Paper 42, 12–13 (citing Ex. 2016 ¶¶ 63, 79). As discussed above with respect to the original claims, we disagree. Henkin describes using the downward resultant force for a substantially similar purpose to the '183 Patent. Paper 70, 15:20–16:2; *compare* Ex. 1006, col. 10, ll. 60–64, *with* Ex. 1002, col. 5, ll. 19–23. Consequently, we find that with respect to the additional limitations recited in the substitute claims, there are a finite

number of predictable solutions and that the subject matter of the substitute claims is not the product of innovation, but of ordinary skill and common sense. *See KSR*, 550 U.S. at 421; *see also* Paper 70, 16:22–24 ("The patent owner has not put forward any reason that this particular technology area is so specialized that [the combinations of the teachings of Henkin and Myers] were neither predictable or beyond the person of ordinary skill.").

Consequently, Patent Owner's Replacement Corrected Motion to Amend Claims requesting entry of substitute claims 22–24 is *denied* for failing to demonstrate that the substitute claims are patentable over Henkin and Myers.[9]

D. Motion to Exclude Evidence

In Patent Owner's Motion to Exclude Evidence, Patent Owner moves to exclude (1) certain paragraphs of the declaration of Petitioner's declarant, Mr. McQueen (*i.e.*, Ex. 1009 ¶¶ 16–21, 23, 26); and (2) the declaration of Petitioner's declarant, Dr. Homayoon Kazerooni (Ex. 1010). Paper 58, 1. As noted above, Petitioner filed an Opposition to Patent Owner's Motion to Exclude Evidence (Paper 61), and Patent Owner filed a Reply Memorandum in Support of its Motion to Exclude Evidence (Paper 62). The motion is *granted-in-part* and *denied-in-part*.

[9] Petitioner notes that "Patent Owner did not identify or assert any secondary considerations of non-obviousness with respect to substitute claims 22-24." Paper 45, 15. Nevertheless, we were not persuaded by Patent Owner's arguments regarding secondary considerations with respect to the challenged claims.

1. Declaration of Mr. McQueen

With regard to the Declaration of Mr. McQueen, Patent Owner requests that we exclude (1) paragraphs 23 and 26 because these paragraphs rely on information that was not produced or for which English-language translations were not provided; (2) paragraphs 16–18 because these paragraphs rely on information concerning meetings which Mr. McQueen did not attend; and (3) paragraphs 19–21 because these paragraphs respond to Mr. Erlich's comments concerning a meeting (Ex. 2016 ¶ 49) that Mr. McQueen did not attend. Paper 58, 3–8. Regarding the Declaration of McQueen, Petitioner contends that Patent Owner's objections were insufficient or untimely. Paper 61, 2–3. In addition, regarding paragraph 26, Petitioner contends that Mr. McQueen's statements concerning certain unproduced user-studies relate to his recollection of the studies, rather than the studies themselves. *Id.* at 4. Further, Petitioner acknowledges that it could not locate and produce the studies. *Id.* at 5. Petitioner maintains, however, that Mr. McQueen's testimony is admissible without the supporting documents. *Id.* (citing F.R.E. 602).

Patent Owner states that it first objected to the Declaration of Mr. McQueen on March 16, 2014, four business days after service of the declaration. Paper 58, 3; Paper 62, 1. Further, Petitioner's production and filing of documents in this case was piecemeal and ultimately incomplete. *See* Paper 61, 5; Paper 62, 1–2. Given the Petitioner's actions in this case, we determine that Petitioner was adequately and timely informed of Patent Owner's objections to the Declaration of Mr. McQueen. *See* 37 C.F.R. § 42.5(a).

With respect to paragraph 26 of the Declaration of Mr. McQueen, we determine that Patent Owner's objections go to the weight that we accord to Mr. McQueen's testimony, rather than the admissibility of this paragraph of the Declaration of Mr. McQueen. We are capable of according the appropriate weight to testimony, for which Petitioner is unable to provide support. Therefore, we deny Patent Owner's request to exclude paragraph 26 of the Declaration of Mr. McQueen.

With respect to paragraph 23 of the Declaration of Mr. McQueen, Mr. McQueen refers to an engineering study, including a flow analysis, in the Spring and Summer of 2007 by a third party engineering company; three Enveloppe Soleau filed with the French National Industrial Property Institute on August 20, 2007; and nine French patent applications filed in December 2007. Ex. 1009 ¶ 23. Of these documents, Patent Owner states that only one of the three Enveloppe Soleau was produced (Ex. 1014B). Paper 58, 4. Nevertheless, this exhibit was not filed with the Board. Further, although Petitioner appears to have produced certain supporting documents (e.g., Exhibits 1014A, 1014B, 1015A, and 1015B) to Patent Owner, Patent Owner asserts that these documents were produced in French, without accompanying English-language translations. *Id.* at 5–6.

In acknowledgment of the deficiencies in its production of documents to the Patent Owner and in its filing of documents with the Board, Petitioner offers to strike portions of paragraph 23 of the Declaration of Mr. McQueen. Paper 61, 4–5. Petitioner's offer is insufficient. Petitioner's declarant states that "Zodiac had a third party engineering company *conduct an engineering study, including a flow analysis on the inverted pump design and engineering drawings*. This analysis took place in the spring and summer of

2007." Ex. 1009 ¶ 23 (emphasis added). Contrary to Petitioner's assertion, these sentences relate to the content of cited documents, rather than solely to "facts that occurred." Paper 61, 5. Therefore, we grant-in-part Patent Owner's motion to exclude paragraph 23 of the Declaration of Mr. McQueen and exclude all of paragraph 23 of Mr. McQueen's declaration, except for the first sentence: "Zodiac's development of the Polaris 9300/9400 line began in January 2007." We accord the appropriate weight to this statement in the Declaration of Mr. McQueen.

With respect to paragraphs 16–21of the Declaration of Mr. McQueen, Patent Owner objects that Mr. McQueen's testimony is based on his general, rather than specific, knowledge of meetings and conversations, in which he was not a participant. Paper 58, 6–8; Paper 62, 3–4. Petitioner does not dispute that Mr. McQueen did not participate in these meetings or conversations. *See* Paper 61, 7–9. Further, Petitioner contends that "Patent Owner has not introduced anything to contradict Mr. McQueen's statement that the facts stated are within his personal knowledge." *Id.* at 8. With respect to paragraphs 16–21 of the Declaration of Mr. McQueen, we determine that Patent Owner's objections go to the weight that we accord to Mr. McQueen's testimony, rather than the admissibility of these paragraphs of the Declaration of Mr. McQueen. We are capable of according the appropriate weight to this testimony. Therefore, we deny Patent Owner's request to exclude paragraphs 16–21 of the Declaration of Mr. McQueen.

2. Declaration of Dr. Kazerooni

Dr. Kazerooni's and Mr. McQueen's declarations were filed on the same date, March 10, 2014. Petitioner contends that Patent Owner did not object to the Declaration of Dr. Kazerooni until twenty-one (21) days after

the filing of the declaration. Paper 61, 11; *see* 37 C.F.R. § 42.64(b)(1) ("[A]ny objection must be served within five business days of service of evidence to which the objection is directed."). Patent Owner does not dispute that it failed to object in a timely manner to the Declaration of Dr. Kazerooni. *See* Paper 58, 3; Paper 61, 4–5. Because we determine that the objections to the Declaration of Dr. Kazerooni were untimely, we deny the request to exclude his declaration.

III. CONCLUSION

We conclude that Petitioner has demonstrated by a preponderance of the evidence that (1) claims 1, 2, 13, 14, 16, and 19–21 are anticipated under 35 U.S.C. § 102(b) by Myers; (2) claims 1–5 and 19–21 are rendered obvious under 35 U.S.C. § 103(a) by Henkin and Myers; and (3) claims 1–9 and 19–21 are rendered obvious under 35 U.S.C. § 103(a) by Pansini and Myers. Further, Patent Owner's Replacement Corrected Motion to Amend Claims is *denied*, and Patent Owner's Motion to Exclude Evidence is *granted-in-part* and *denied-in-part*.

This is a final written decision of the Board under 35 U.S.C. § 318(a). Parties to the proceeding seeking judicial review of this decision must comply with the notice and service requirements of 37 C.F.R. § 90.2.

IV. ORDER

Accordingly, it is hereby:

ORDERED that claims 1–9, 14, 16, and 19–21 of the '183 Patent are held *unpatentable*;

FURTHER ORDERED that Patent Owner's Replacement Corrected Motion to Amend Claims is *denied*;

FURTHER ORDERED that Patent Owner's Motion to Exclude Evidence is *granted-in-part* with respect to paragraph 23 of the Declaration of Mr. McQueen and *denied-in-part* with respect to the remaining challenged paragraphs of the Declaration of Mr. McQueen and with respect to the Declaration Dr. Kazerooni; and

FURTHER ORDERED that parties to the proceeding seeking judicial review of this Final Written Decision must comply with the notice and service requirements of 37 C.F.R. § 90.2.

PETITIONER:

Christopher Bright
Gregory Yoder
Mark Bentley
McDERMOTT, WILL & EMERY LLP
cbright@mwe.com
gyoder@mwe.com
mbentley@mwe.com

PATENT OWNER:

Jeffrey A. Schwab
Anthony Coppola
ABELMAN, FRAYNE & SCHWAB
jaschwab@lawabel.com
aacoppola@lawabel.com

EXHIBIT
1006

US008273183B2

(12) **United States Patent**
Erlich et al.

(10) **Patent No.: US 8,273,183 B2**
(45) **Date of Patent: Sep. 25, 2012**

(54) **AUTOMATED SWIMMING POOL CLEANER HAVING AN ANGLED JET DRIVE PROPULSION SYSTEM**

(75) Inventors: **Giora Erlich**, North Caldwell, NJ (US); **Zibor Horvath**, Springfield, NJ (US)

(73) Assignee: **Aqua Products, Inc.**, Cedar Grove, NJ (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: **13/135,684**

(22) Filed: **Jul. 12, 2011**

(65) **Prior Publication Data**

US 2011/0271983 A1 Nov. 10, 2011

Related U.S. Application Data

(60) Continuation of application No. 12/924,554, filed on Sep. 28, 2010, which is a division of application No. 11/606,809, filed on Nov. 29, 2006, now Pat. No. 7,827,643, which is a division of application No. 10/793,447, filed on Mar. 3, 2004, now Pat. No. 7,165,284, which is a division of application No. 10/109,689, filed on Mar. 29, 2002, now Pat. No. 6,742,613, which is a division of application No. 09/237,301, filed on Jan. 25, 1999, now Pat. No. 6,412,133.

(51) **Int. Cl.**
E04H 4/16 (2006.01)
B08B 5/00 (2006.01)

(52) **U.S. Cl.** **134/6**; 15/1.7

(58) **Field of Classification Search** 15/1.7; 134/6

See application file for complete search history.

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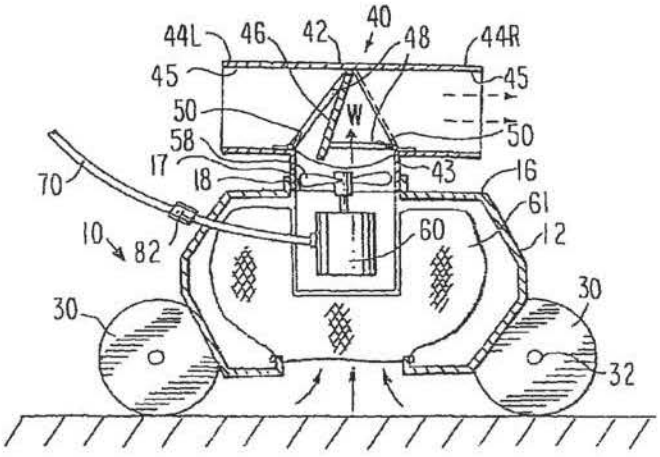
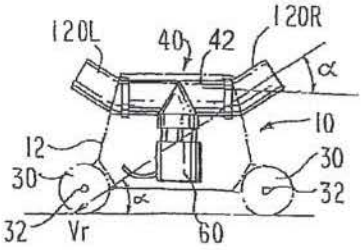
Primary Examiner — Randall Chin
(74) *Attorney, Agent, or Firm* — Abelman, Frayne & Schwab

(57) **ABSTRACT**

A self-propelled cleaning apparatus for cleaning a submerged surface of a pool or tank includes a housing having a front portion as defined by the direction of movement of the apparatus when propelled by a water jet, an opposing rear portion and adjoining side portions defining the periphery of the apparatus, and a baseplate with at least one water inlet. Rotationally-mounted supports are coupled proximate the front and rear portions of the housing to enable movement of the apparatus over the submerged surface. A water pump is configured to draw water and debris from the pool through the inlet for filtering. A stationary directional discharge conduit is in fluid communication with the pump and has at least one discharge opening through which a pressurized stream of water forming the water jet is directionally discharged at an acute angle with respect to the surface over which the apparatus is moving.

21 Claims, 15 Drawing Sheets





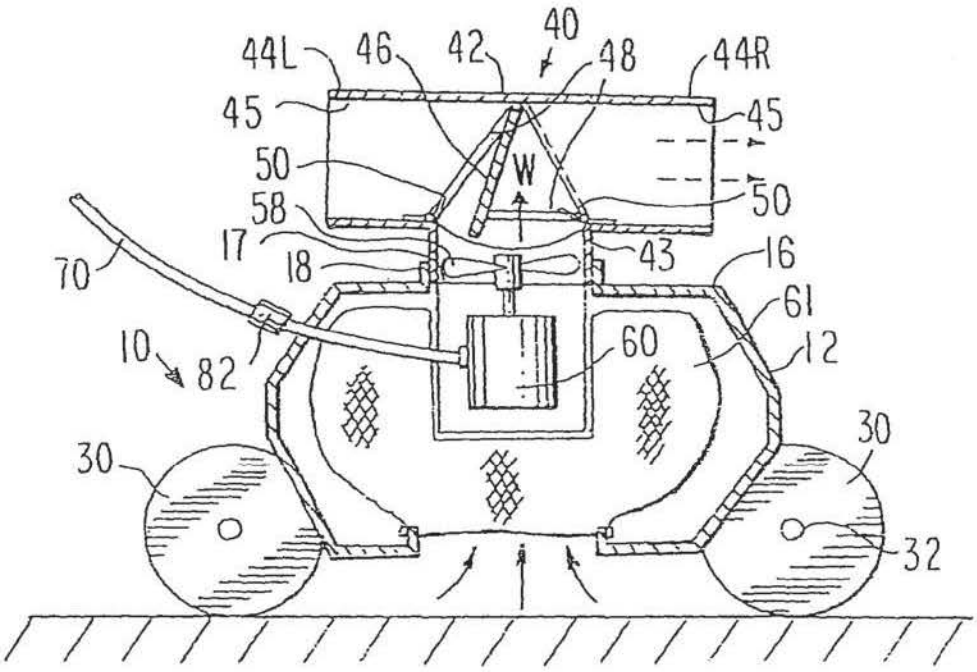

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FIG. 1

FIG. 1A

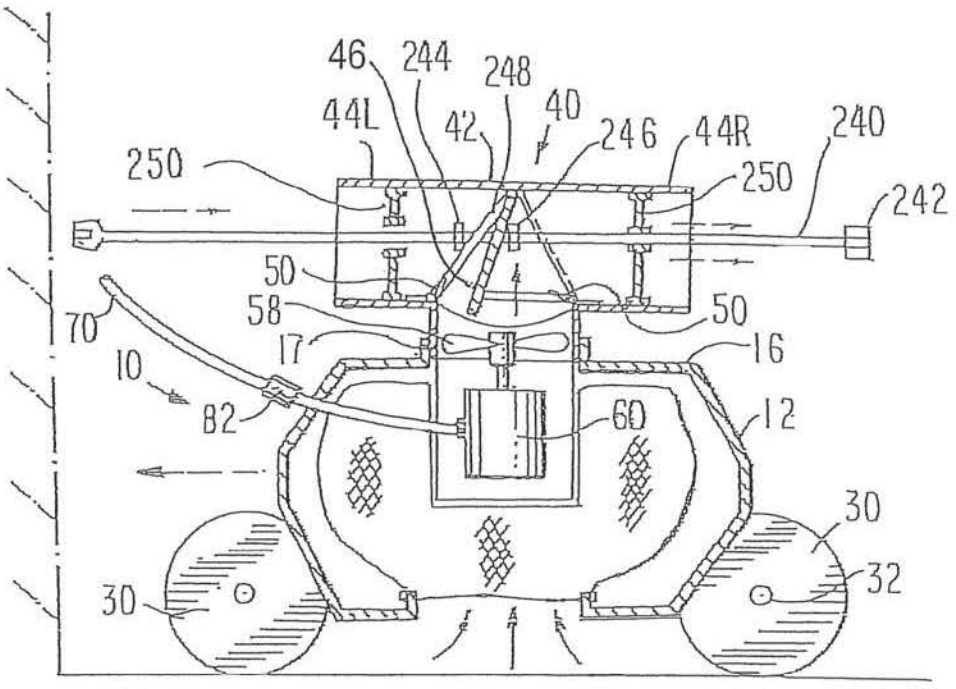
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FIG. 1B

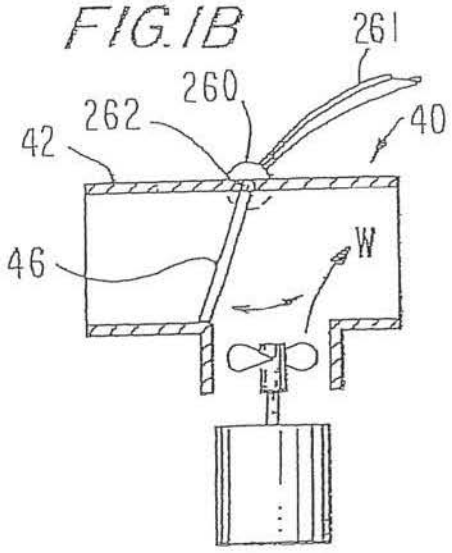
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FIG.2

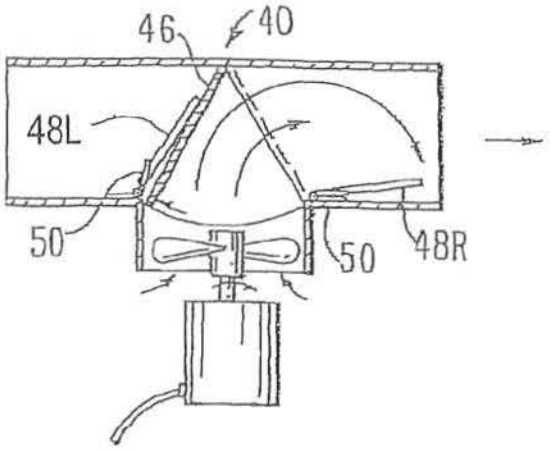


FIG.3

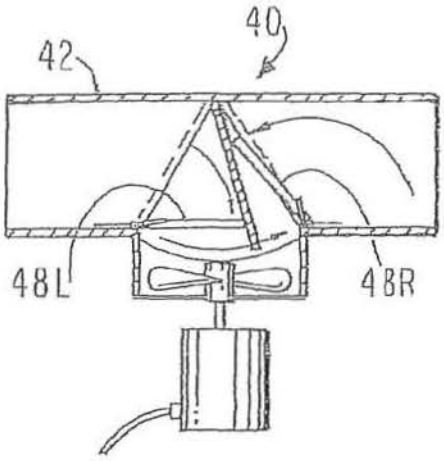


FIG.4

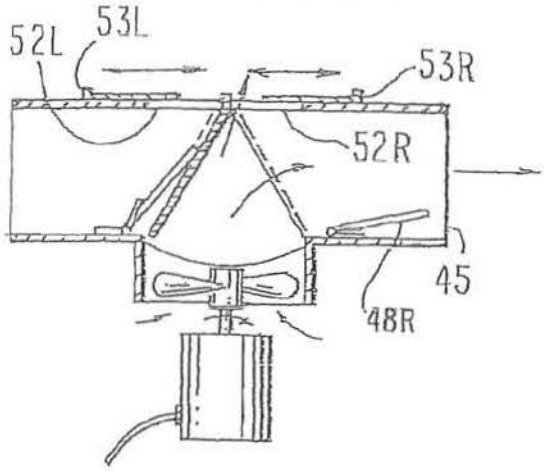


FIG.5

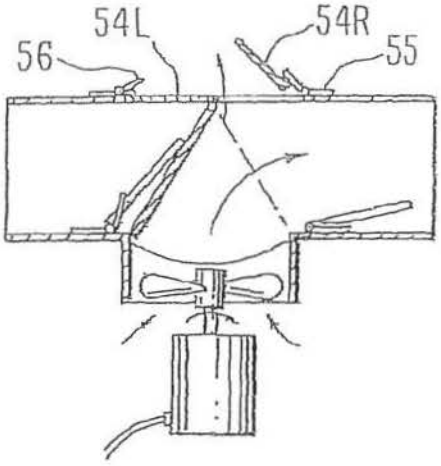


FIG.6

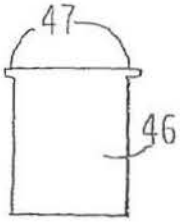


FIG.7

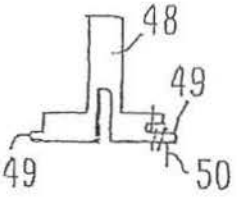


FIG.8

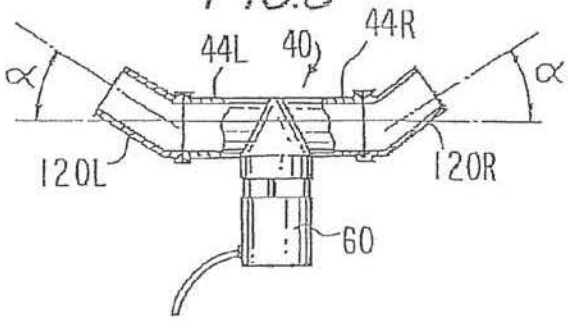


FIG.9

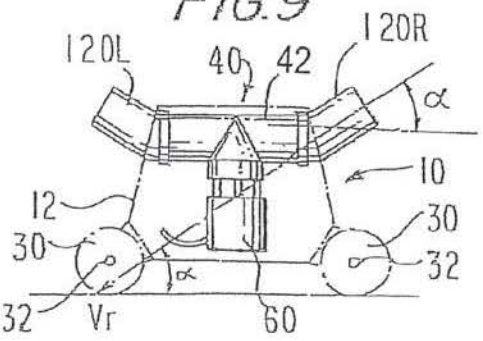


FIG.10

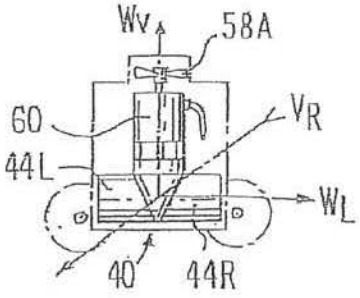


FIG.11

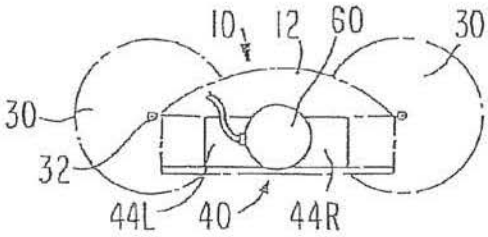


FIG.12

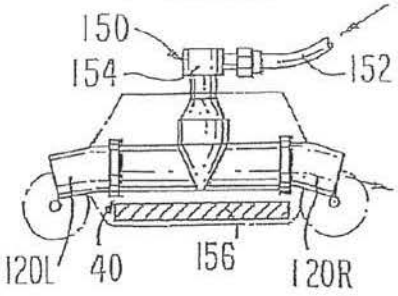


FIG.12A

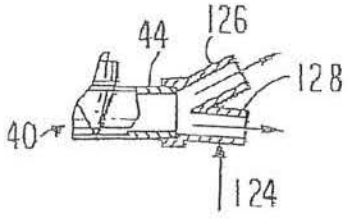


FIG.13

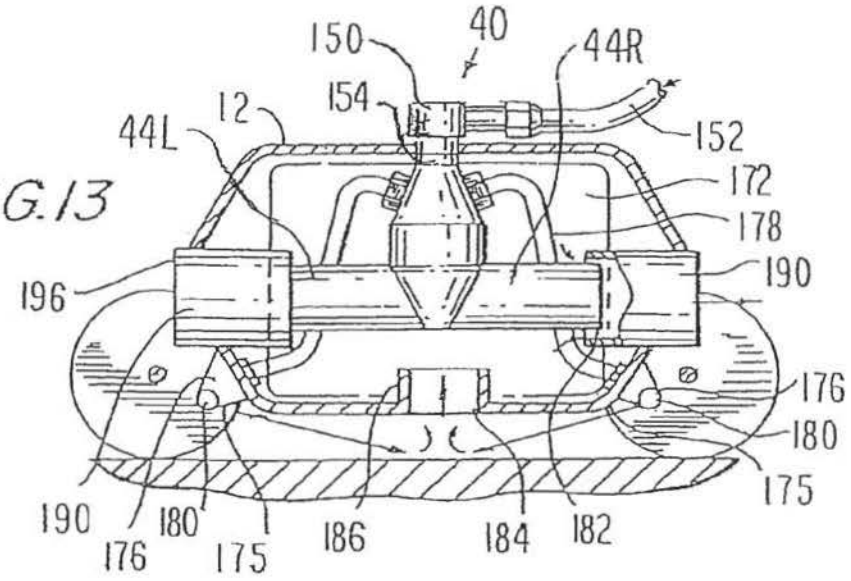


FIG.14

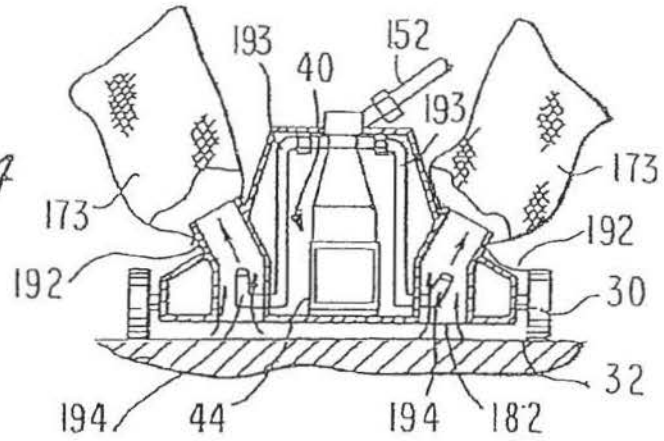


FIG.15

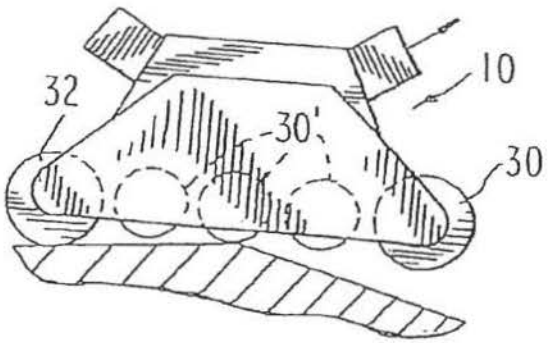


FIG. 16

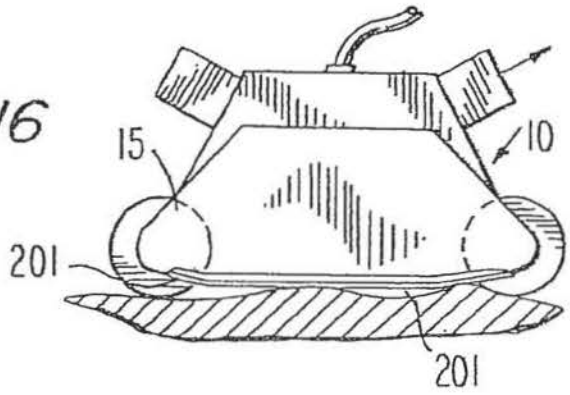


FIG. 17

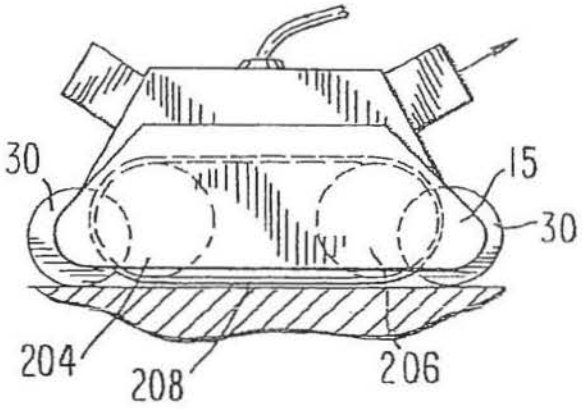


FIG. 18

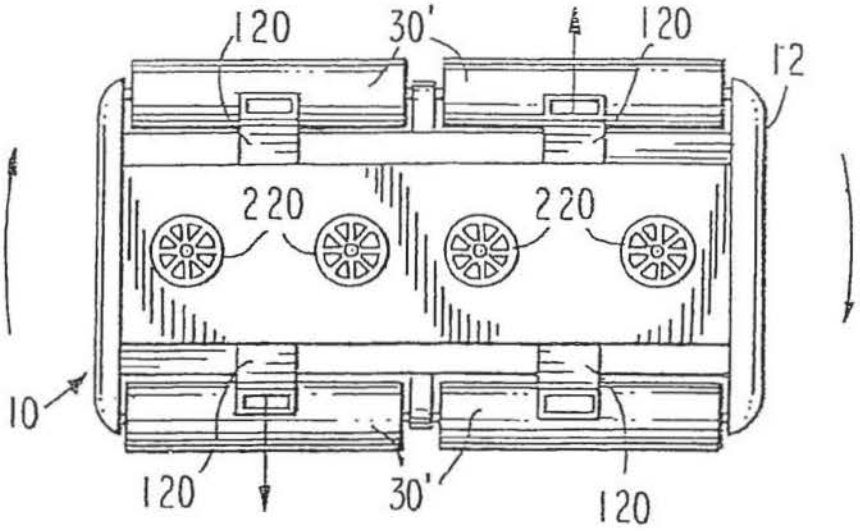


FIG. 20

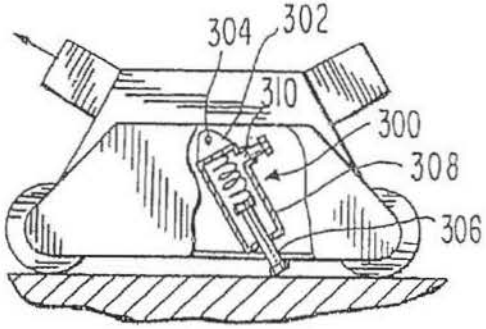


FIG. 21

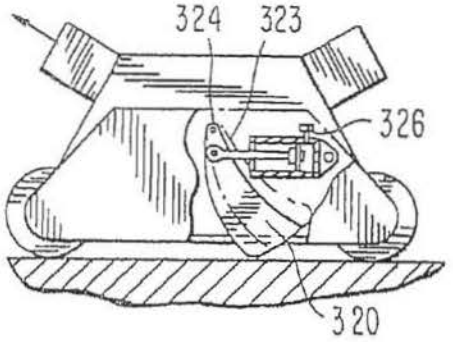


FIG. 22

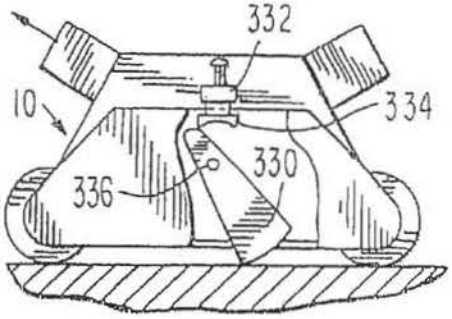


FIG. 19
PRIOR ART

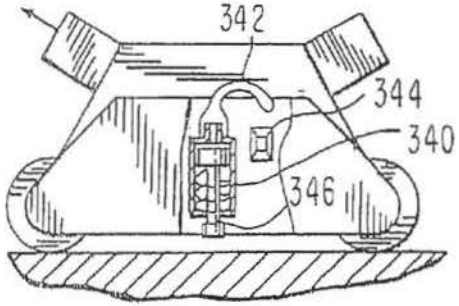


FIG. 23

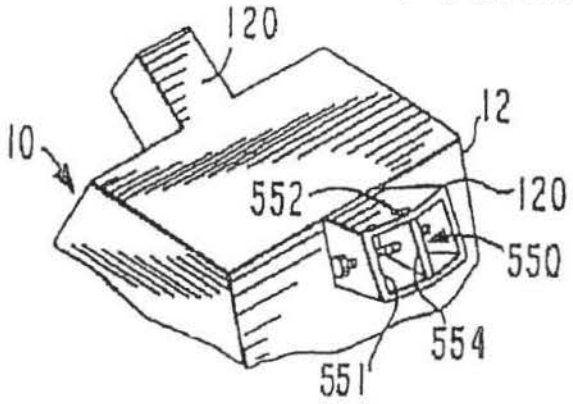


FIG. 24

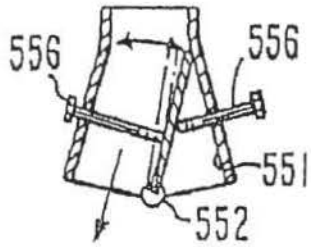


FIG. 25

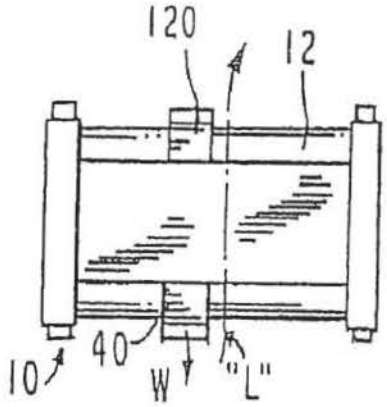
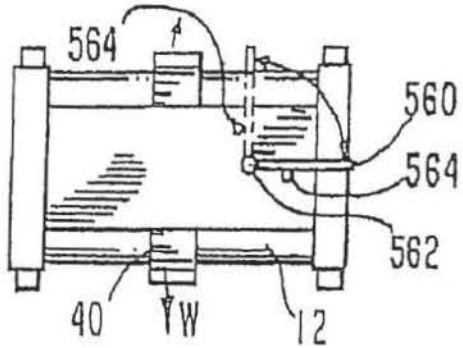


FIG. 26



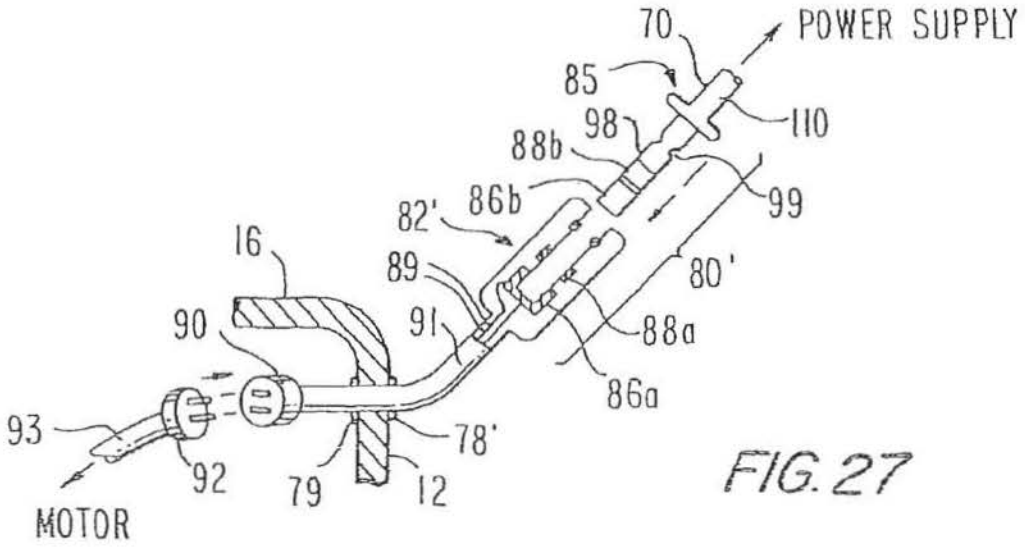

70
POWER SUPPLY
85
110
98
88b
99
82'
86b
16
89
80'
90
91
88a
86a
93
78'
92
79
12
MOTOR

FIG. 27

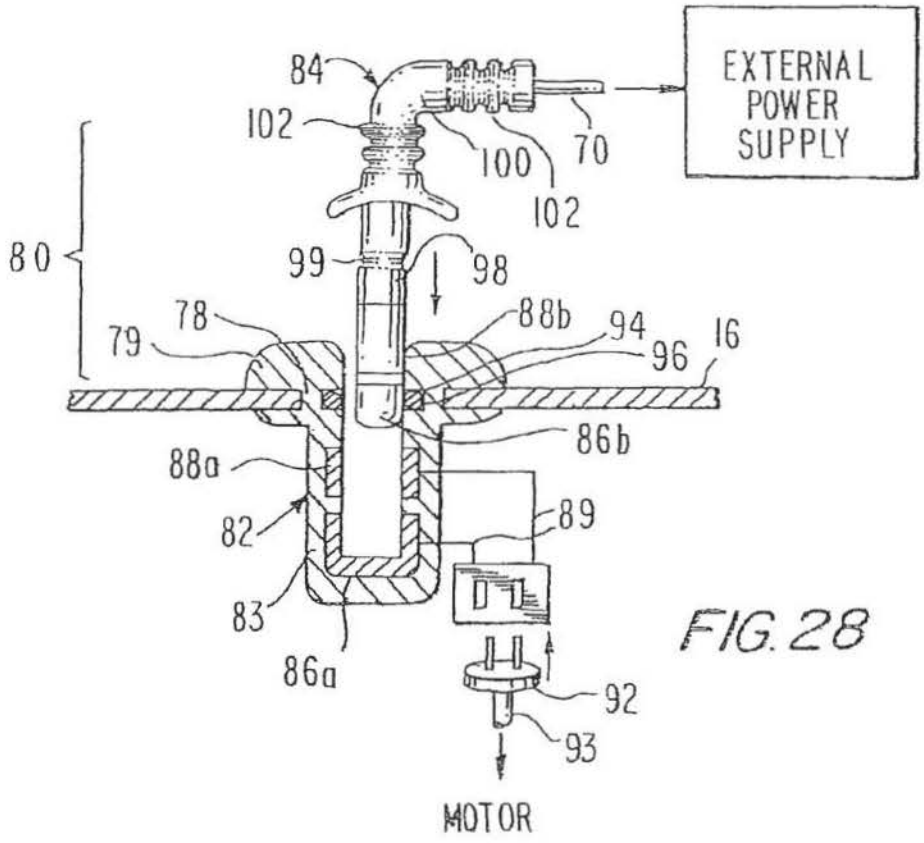

84
EXTERNAL POWER SUPPLY
102
100
70
102
80
99
98
78
88b
94
96
16
79
86b
88a
89
82
83
86a
92
93
MOTOR

FIG. 28

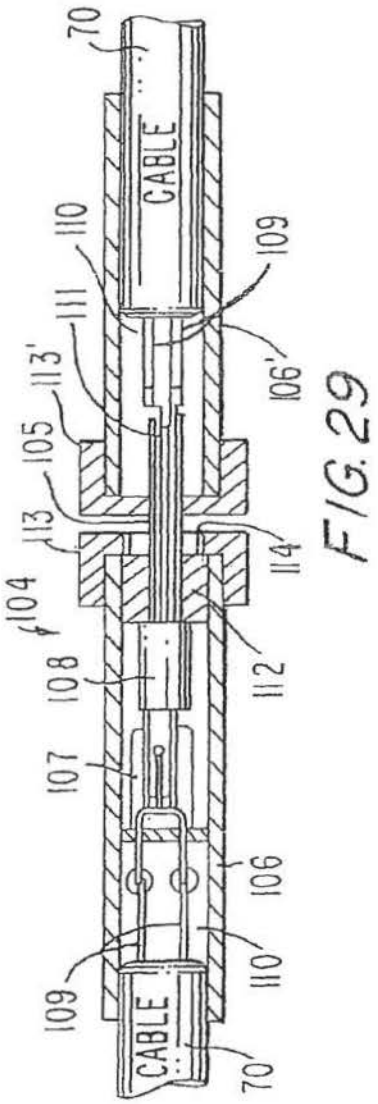

70
CABLE
110
109
111
113'
106'
105
113
114
104
108
112
107
106
110
109
CABLE
70

FIG. 29

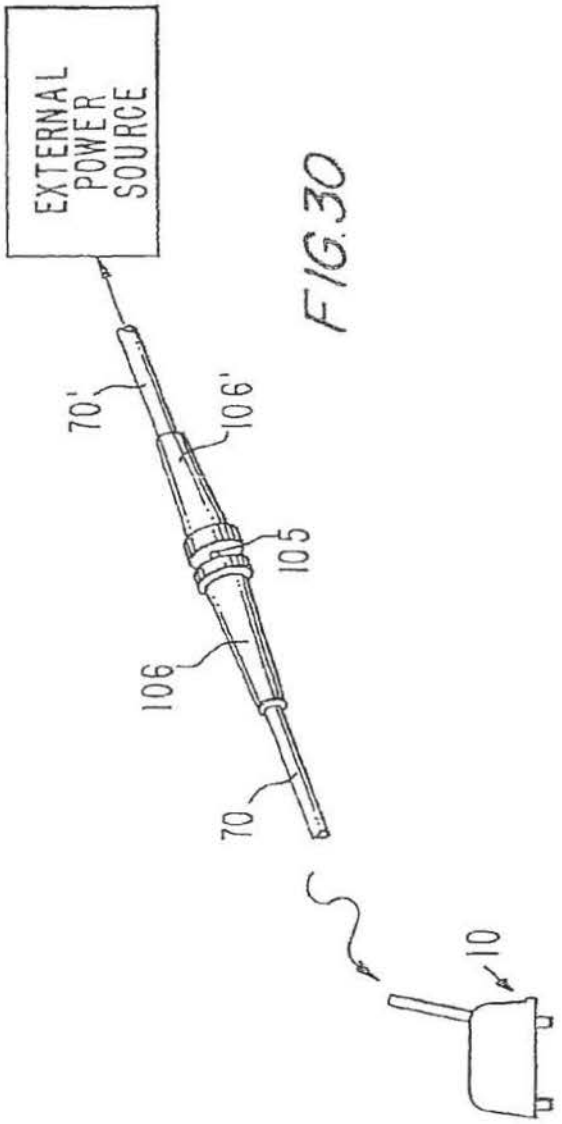

EXTERNAL POWER SOURCE
70'
106'
105
106
70
10

FIG. 30

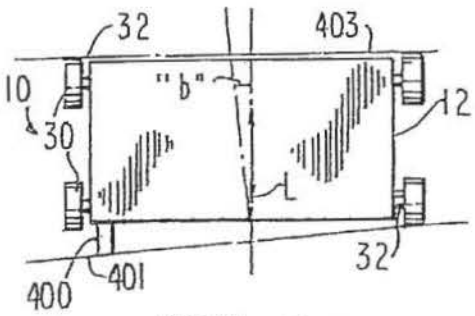


FIG. 31A
PRIOR ART

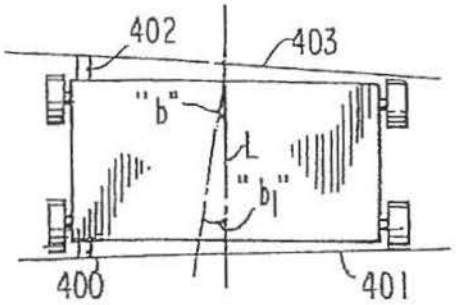


FIG. 32A
PRIOR ART

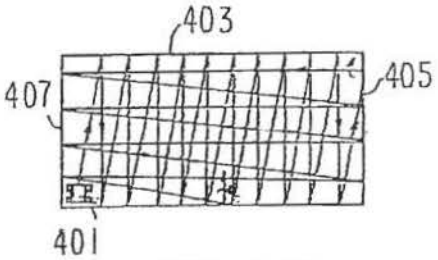


FIG. 31B
PRIOR ART

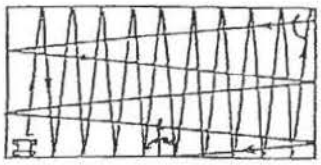


FIG. 32B
PRIOR ART

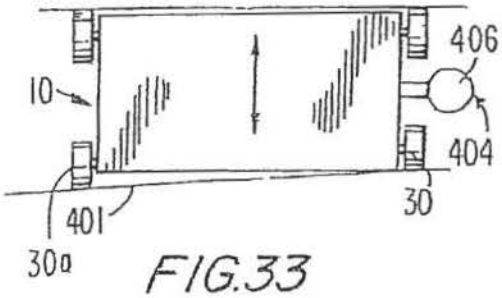


FIG. 33

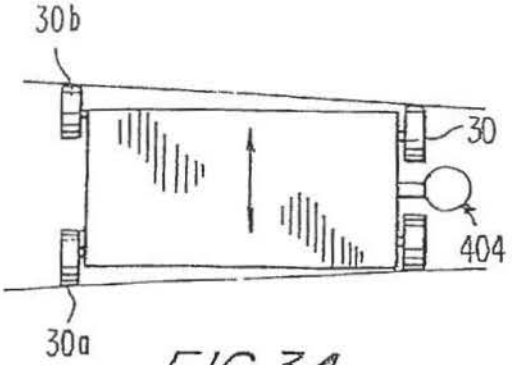


FIG. 34

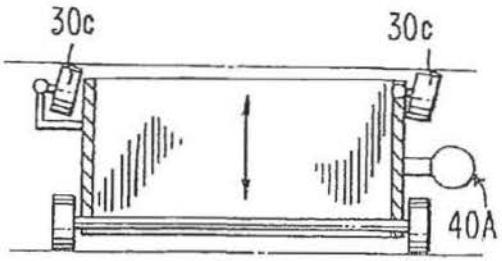


FIG. 35

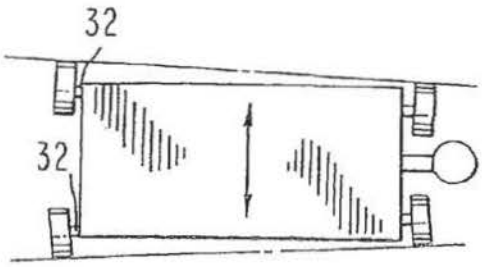


FIG. 36

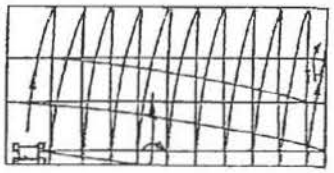


FIG. 35A

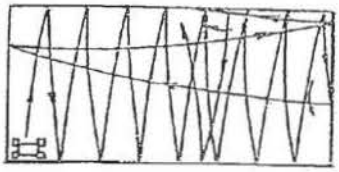


FIG. 35B

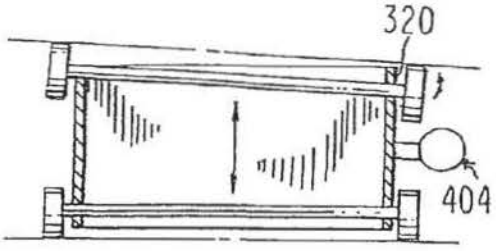


FIG. 37

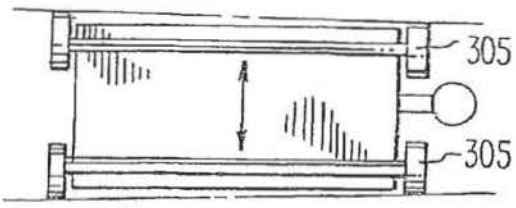


FIG. 38

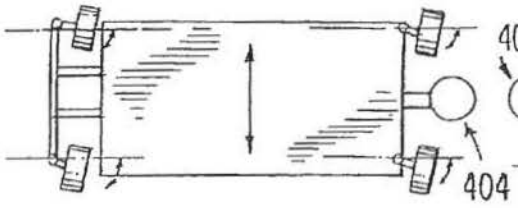


FIG. 39

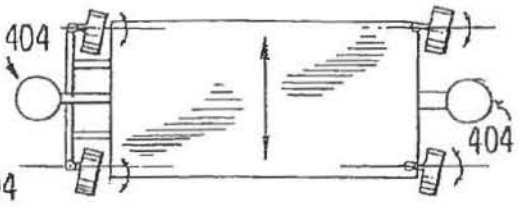


FIG. 40

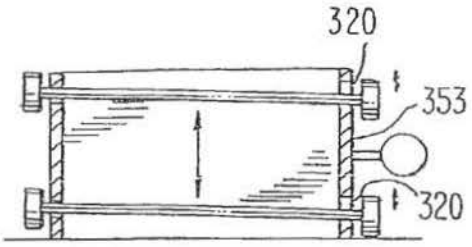


FIG. 41

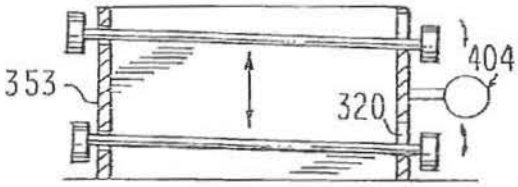


FIG. 42

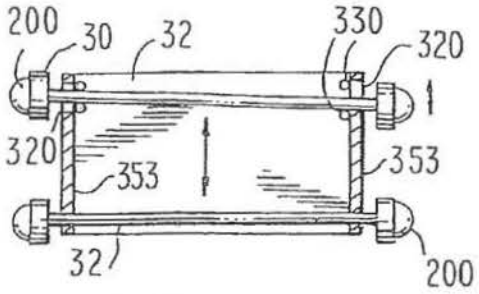


FIG. 43

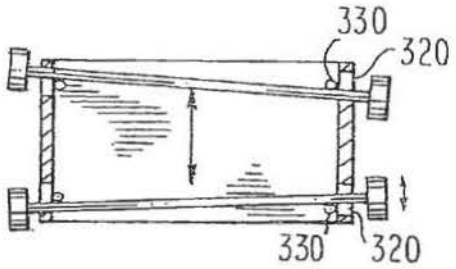


FIG. 44

FIG.45

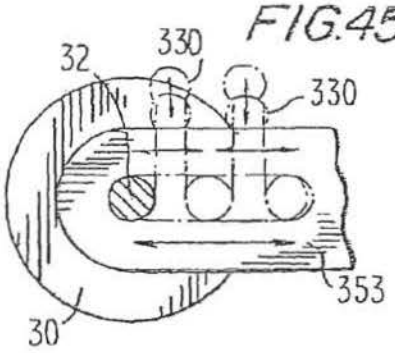


FIG.46

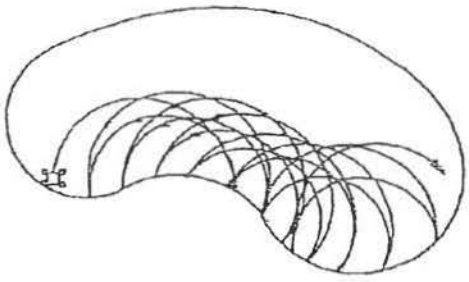


FIG.47

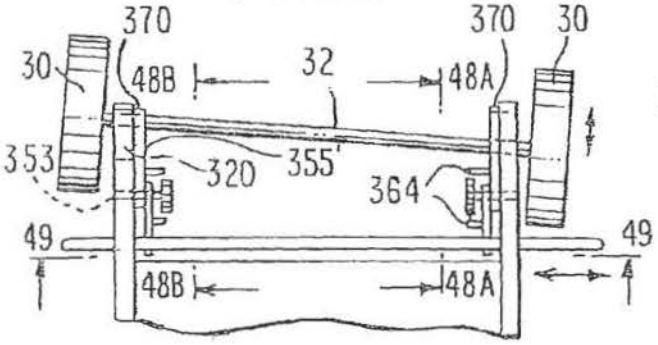


FIG.48A

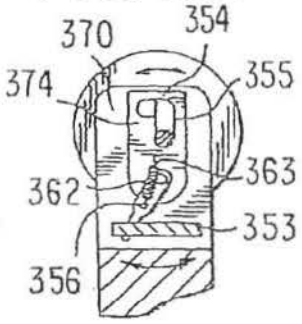


FIG.48B

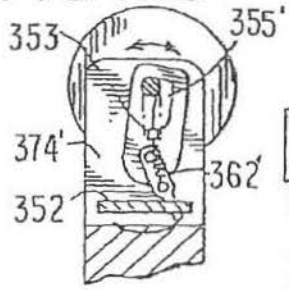
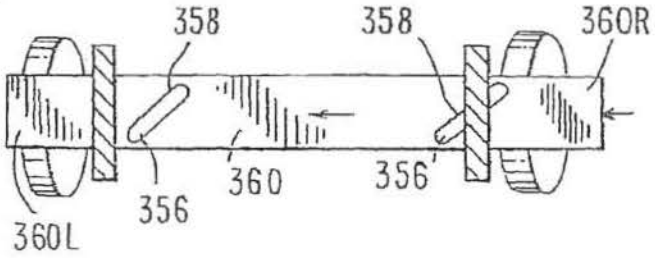


FIG.49



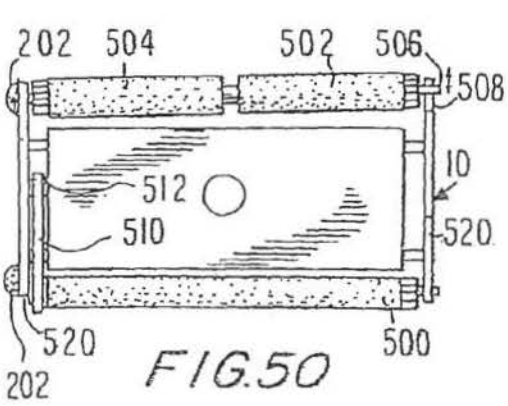


FIG.50

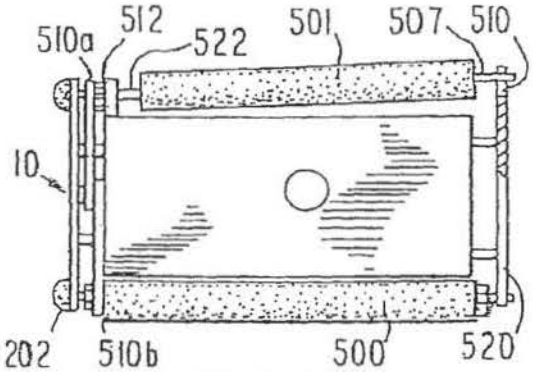


FIG.51

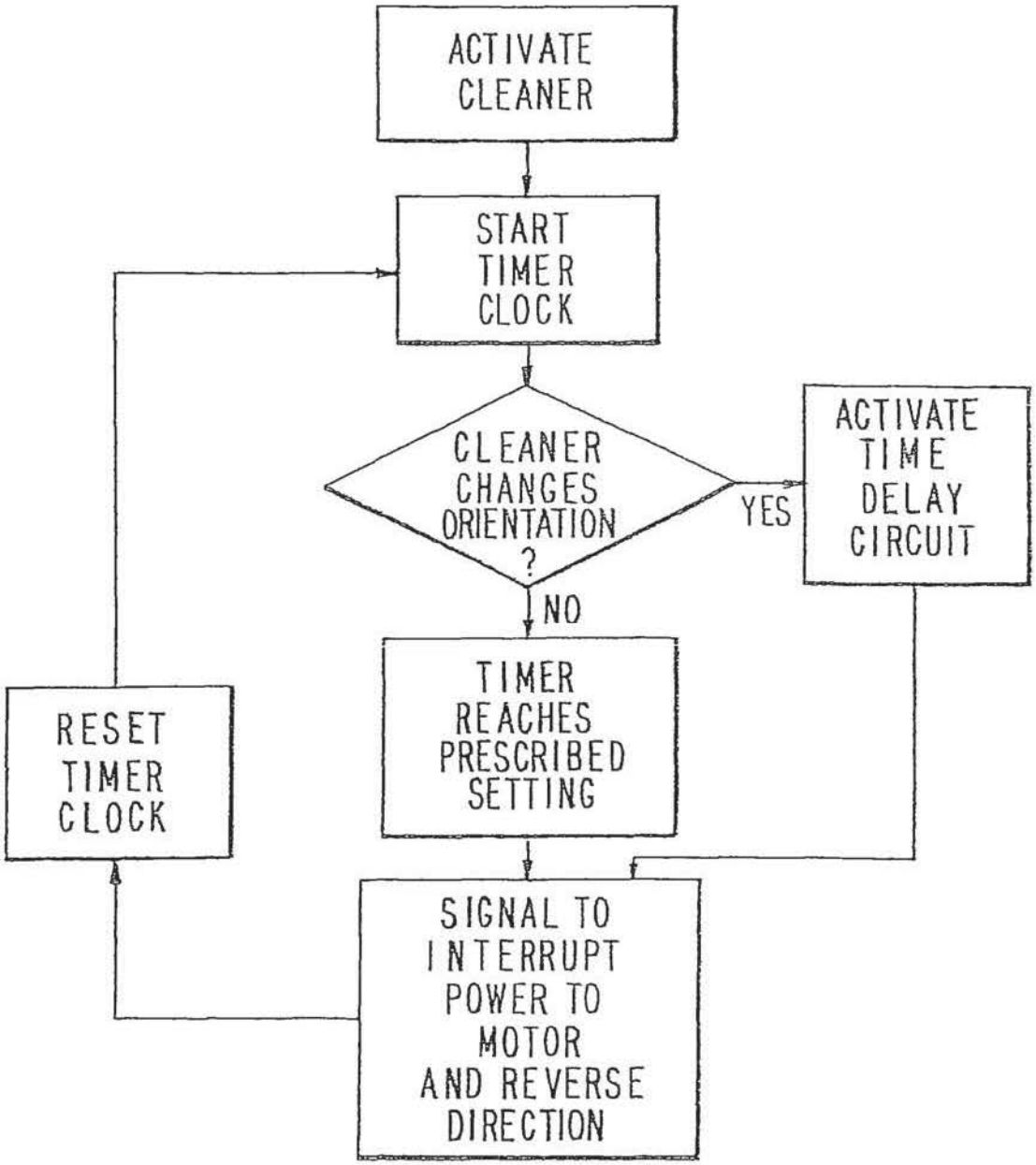

ACTIVATE CLEANER
START TIMER CLOCK
CLEANER CHANGES ORIENTATION ?
YES
ACTIVATE TIME DELAY CIRCUIT
NO
TIMER REACHES PRESCRIBED SETTING
RESET TIMER CLOCK
SIGNAL TO INTERRUPT POWER TO MOTOR AND REVERSE DIRECTION

FIG. 52

AUTOMATED SWIMMING POOL CLEANER HAVING AN ANGLED JET DRIVE PROPULSION SYSTEM

CROSS REFERENCES TO RELATED APPLICATIONS

This application is a continuation of U.S. application Ser. No. 12/924,554, filed Sep. 28, 2010, now pending, which is a divisional of U.S. application Ser. No. 11/606,809, filed Nov. 29, 2006, now U.S. Pat. No. 7,827,643 which is a divisional of U.S. application Ser. No. 10/793,447, filed Mar. 3, 2004, now U.S. Pat. No. 7,165,284, which is a divisional of U.S. application Ser. No. 10/109,689, filed Mar. 29, 2002, now U.S. Pat. No. 6,742,613, which is a division of U.S. Ser. No. 09/237,301 filed Jan. 25, 1999, now U.S. Pat. No. 6,412,133, the disclosures of which are incorporated herein by reference in their entireties.

FIELD OF THE INVENTION

The invention relates to methods and apparatus for propelling automated or robotic swimming pool and tank cleaners and for controlling the scanning or traversing patterns of the automated cleaners with respect to the bottom and sidewalls of the pool or tank.

BACKGROUND OF THE INVENTION

Automated or robotic swimming pool cleaners traditionally contact and move about on the pool surfaces being cleaned on axle-mounted wheels or on endless tracks that are powered by a separate drive motor through a gear train. The wheels or tracks are aligned with the longitudinal axis of the cleaner. Swimming pool cleaning robots that move on wheels generally have two electric motors—a pump motor powers a water pump that is used to dislodge and/or vacuum debris up into a filter; the drive motor is used to propel the robot over the surfaces of the pool that are to be cleaned. The drive motor can be connected through a gear train directly to one or more wheels or axles, or through a belt and pulleys to propel the cleaner; or to a water pump, which can be external to the robotic cleaner that produces a pressurized stream, or water jet, that moves the cleaning apparatus by reactive force or by driving a water turbine connected via a gear train to the wheels or endless track. The movement of the pool cleaners of the prior art, when powered by either the turbine or the direct or reactive jet is in one direction and the movement is random.

Control of the longitudinal directional movement of the robot can be accomplished by elaborate electronic circuitry, as is the case when stepper and D.C. brushless motors are employed. Other control systems require the cleaner to climb the vertical sidewall of the pool until a portion of the cleaner extends above the waterline and/or the unit has moved laterally along the sidewall, after which the motor drive reverses and the cleaner returns to the bottom surface of the pool along a different path. The water powered cleaners of the prior art also rely on the reorientation of the cleaner while on contact with the wall to effect a random change in direction. However, under certain circumstances; it is a waste of time, energy and produces unnecessary wear and tear to have the robotic cleaner climb the sidewall solely for purpose of changing the pattern of movement of the cleaner.

It is known from U.S. Pat. No. 2,988,762 to provide laterally offset fixed bumper elements at each end of the cleaner to contact the facing sidewall and provide a pivot point as the cleaner approaches the wall. Another transverse slide rod can be provided to contact a side wall and causes the drive motor to reverse. The bumper elements are adjustable to provide variable angles. A third slide rod attached to a shut-off switch extends outboard of side facing the far end of the pool, so that when the cleaner has covered the entire length of the pool and approaches the wall is a generally parallel path, the third slide rod is pushed inboard and shuts off power to the unit.

It has also been proposed to direct the scanning movement of a pool cleaner mechanically by use of a three-wheeled array in which the third wheel is mounted centrally and opposite the other pair of wheels, and the axle upon which the third wheel is mounted is able to rotate in a horizontal plane around a vertical axis. A so-called free-wheeling version of this apparatus is shown on U.S. Pat. No. 3,979,788.

In U.S. Pat. No. 3,229,315, the third wheel is mounted in a plate and the plate is engaged by a gear mechanism that positively rotates the horizontal axle and determines the directional changes in the orientation of the third wheel.

It is also known in the prior art to provide a pool cleaner with a vertical plunger or piston that can be moved by a hydraulic force into contact with the bottom of the pool to cause the cleaner to pivot and change direction. The timing must be controlled by a pre-programmed integrated circuit ("IC") device.

It is also known from U.S. Pat. No. 4,348,192 to equip the feed water hose of a circular floating pool cleaning device with a continuous discharge water jet nozzle that randomly reorients itself to a reversing direction when the forward movement of the floating cleaner is impeded. In addition to the movable water jet discharge nozzle attached to the underside of the floating cleaner, the hose is equipped with a plurality of rearwardly-facing jet nozzles that move the water hose in a random pattern and facilitate movement of the cleaner.

Commercial pool cleaners of the prior art that employ pressurized water to effect random movement have also been equipped with so-called "back-up" valves that periodically interrupt and divert the flow of water to the cleaner and discharge it through a valve that has jets facing upstream, thereby creating a reactive force to move the hose and, perhaps, the attached cleaner in a generally backward direction. The back-up valve can be actuated by the flow of water through a fitting attached to the hose. The movement resulting from the activation of the back-up valve jets is also random and may have no effect on reorienting a cleaner that has become immobilized.

The apparatus of the prior art for use in propelling and directing the scanning movement of automated robotic pool cleaners is lacking in several important aspects. For example, the present state-of-the-art machines employ pre-programmed, integrated circuit ("IC") devices that provide a specific predetermined scanning pattern. The design and production of these IC devices is relatively expensive and the scanning patterns produced have been found to be ineffective in pools having irregular configurations and/or obstructions built into their bottoms or sidewalls.

Cleaners propelled by a water jet discharge move only in a generally forward direct, and their movement is random, such randomness being accentuated by equipping the unit with a flexible hose or tail that whips about erratically to alter the direction of the cleaner.

Cleaners equipped with gear trains for driving wheels or endless tracks represent an additional expense in the design, manufacture and assembly of numerous small, precision-fit parts; the owner or operator of the apparatus will also incur the time and expense of maintaining and securing replacement parts due to wear and tear during the life of the machine.

A cleaning apparatus constructed with a pivotable third wheel that operates in a random fashion or in accordance with a program has the same drawbacks associated with the production, assembly and maintenance of numerous small moving parts.

The robotic pool cleaners of the prior art are also lacking in mechanical control means for the on-site adjustment of the scanning patterns of the apparatus with respect to the specific configuration of the pool being cleaned.

Another significant deficiency in the design and operation of the pool cleaners of the prior art is their tendency to become immobilized, e.g., in sharp corners, on steps, or even in the skimmer intake openings at the surface of the pool.

It is therefore a principal object of this invention to provide an improved automated or robotic pool and tank cleaning apparatus that incorporates a reliable mechanism and method of providing propulsion using a directional water jet for moving the cleaner in opposite directions along, or with respect to, the longitudinal axis of the apparatus.

It is another object of this invention to provide a method and apparatus for adjustably varying the direction of, and the amount of thrust or force produced by a water jet employed to propel a pool or tank cleaning apparatus, and to effect change in direction by interrupting the flow of water.

It is another important object of the invention to provide a simple and reliable apparatus and method for adjustably controlling the direction of discharge of a propelling water jet that can be utilized by home owners and pool maintenance personnel at the pool site to attain proper scanning patterns in order to clean the entire submerged bottom and side wall surfaces of the pool, regardless of the configuration of the pool and the presence of apparent obstacles.

A further object of the invention is to provide an improved apparatus and method for varying the position of one or more of the wheels or other support means of the cleaner in order to vary the directional movement and scanning patterns of the apparatus with respect to the bottom surface of the pool or tank being cleaned.

It is another object of the invention to provide a novel method and apparatus for periodically changing the direction of movement of a pool cleaner by intermittently establishing at least one fixed pivot point and axis of rotation with respect to the longitudinal axis of the cleaner for at least one pair of supporting wheels

Another object of the present invention is to provide a method and apparatus for assuring the free and unimpaired movement of the pool cleaner in its prescribed or random scanning of the surfaces to be cleaned without interference from the electrical power cord that is attached to the cleaner housing and floats on the surface of the pool.

Yet another object of the invention is to free a pool cleaner that has been immobilized by an obstacle so that it can resume its predetermined scanning pattern.

It is also an object to provide magnetic and infrared ("IR") sensing means for controlling the power circuits for the propulsion means of the cleaner.

Another important object of the invention is to provide an economical and reliable pool cleaner with a minimum number of moving parts and no internal pump and electric motor that can be powered by the discharge stream from the pool filter system or an external booster pump and which can reverse its direction.

Another important object of this invention is to provide an apparatus and method that meets the above objectives in a more cost-effective, reliable and simplified manner than is available through the practices and teachings of the prior art.

SUMMARY OF THE INVENTION

The above objects are met by the embodiments of the apparatus and methods described below. In the description that follows, it will be understood that cleaner moves on supporting wheels, rollers or tracks that are aligned with the longitudinal axis of the cleaner body when it moves in a straight line. References to the front or forward end of the cleaner will be relative to its then-direction of movement.

In a first preferred embodiment, a directionally controlled water jet is the means that causes the translational movement of the robotic cleaner across the surface to be cleaned. In a preferred embodiment, the water is drawn from beneath the apparatus and passed through at least one filter medium to remove debris and is forced by a pump through a directional discharge conduit whose axis is aligned with the longitudinal axis of the pool cleaner. The resulting or reactive force of the discharged water jet propels the cleaner in the opposite direction. The water jet can be diverted by various means and/or divided into two or more streams that produce resultant force vectors that also affect the position and direction of movement of the cleaner.

In one preferred embodiment, a diverter or deflector means, such as a flap valve assembly, is interposed between the pump outlet and the discharge conduit, which diverter means controls the direction of movement of the water through one or the other of the opposing ends of the discharge conduit. The positioning of the diverter means, and therefore the direction of travel of the cleaner, can be changed when the unit reaches a sidewall of the pool or after the cleaner has ascended a vertical sidewall. The movement of the diverter means can be in response to application of a mechanical force, such as a lever or slide bar that is caused to move when it contacts a vertical wall, and through a directly applied force or by way of a linkage repositions the diverter means and changes the direction of the discharged, water jet to propel the cleaner away from the wall. In one preferred embodiment, power to the pump motor is interrupted and the position of the diverter means is changed in response to the change in hydrodynamic forces acting on the flap valve assembly. Mechanical biasing and locking means are also provided to assure the proper repositioning and seating of the flap valve.

The orientation of the discharged water jet can be varied to provide a downward component or force vector, lateral components, or a combination of such components or force vectors to complement the translational force.

In its broadest construction, the invention comprehends a method of propelling a pool or tank cleaner by means of a water jet that is discharged in at least a first and second direction that result in movement in opposite translational directions. The direction of the water jet is controlled by the predetermined orientation of a discharge conduit that is either stationary or movable with respect to the body of the cleaner. The discharge conduit can be fixed and the pressurized water controlled by one or more valves that operate in one or more conduits to pass the water for discharge in alternating directions. The discharge conduit can also comprise an element of a rotating turret that is preferably mounted on the top wall of the cleaner housing and is caused to rotate between at least two alternating opposed positions in order to propel the cleaner in a first and then a second generally opposite direction. The means for rotating the turret and discharge conduit can include spring biasing means, a motor or water turbine driven gear train, etc. During the change from one position to

the alternate opposing position, the cleaner is stabilized by interrupting the flow of water from the discharge conduit, as by interrupting the power to the pump motor or discharging water from one or more other orifices The invention comprehends methods and apparatus for controlling the movement of robotic tank and swimming pool cleaners that can be characterized as systematic scanning patterns, scalloped or curvilinear patterns and controlled random motions with respect to the bottom surface of the pool or tank. For the purposes of this description, references to the front and rear of the cleaning apparatus or its housing will be with respect to the direction of its movement. A conventional pool cleaner comprises a base plate on which are mounted a pump, at least one motor for driving the pump and optionally a second motor for propelling the apparatus via wheels or endless track belts; a housing having a top and depending sidewalls that encloses the pump and motor(s) is secured to the base plate; one or more types of filter media are positioned internally and/or externally with respect to the housing; and a separate external handle is optionally secured to the housing. Power is supplied by floating electrical cables attached to an external source, such as a transformer or a battery contained in a floating housing at the surface of the pool; pressurized water can also be provided via a hose for water turbine-powered cleaners. The invention also has application to tank and pool cleaners which operate in conjunction with a remote pump and/or filter system which is located outside of the pool and in fluid communication with the cleaner via a hose.

While the illustrative figures which accompany this application, and to which reference is made herein, schematically illustrate various embodiments of the invention on robotic cleaners equipped with wheels, it will be understood by one of ordinary skill in the art that the invention is equally applicable to cleaners which move on endless tracks or belts. Specific examples are also provided where the cleaner is equipped with power-driven transverse cylindrical rollers that extend across the width of the cleaner body.

In one embodiment of this aspect of the invention, an otherwise conventional cleaner is provided with at least one wheel or track that projects beyond the periphery of the apparatus in a direction of movement of the apparatus. In operation, this offset projecting wheel will contact the wall to stop the forward movement of the apparatus on one side thereby causing the cleaner to pivot until the opposite side makes contact with the wall so that the longitudinal axis of the cleaner forms an angle "b" with the sidewall of the pool. When the cleaner moves in the reverse direction away from the wall, it will be traversing the bottom of the pool at an angle "b". An apparatus equipped with only one projecting wheel or supporting member at one corner location of the housing will assume a generally normal position to an opposite parallel sidewall.

In a further preferred embodiment, a cleaner provided with a second projecting wheel or supporting member at the opposite end will undergo a pivoting motion as the cleaner approaches a wall in either direction of movement. The angle "b" can be varied or adjusted by changing the distance the wheel projects beyond the periphery of the cleaner. As will be appreciated by one of ordinary skill in the art, the angle "b" will determine the cleaning pattern, which pattern in turn will relate to the size and shape of the pool, the degree of overlap on consecutive passes along the surface to be cleaned, and other customary parameters.

In order to change the direction of movement when the cleaner assumes a path that is generally parallel to an end wall of the pool, the cleaner is provided with at least one side projecting member that extends outwardly from the cleaner housing from a position that can range from at or adjacent the forward end to midway between the drive wheels or ends of the cleaner. The side projecting member acts as a pivot point when contacting a sidewall of the pool so that the cleaner assumes an arcuate path until it engages the contact wall. When the unit reverses, the new cleaning pattern is initially at approximately a right angle to the former scanning pattern. In another embodiment of the invention, a pair of the wheels located at one or both ends of the cleaner are mounted for rotation at an angle that is not at 90 degrees or normal to the longitudinal axis of the cleaner. Where the pairs of front and rear wheels are each mounted on a single transverse axle, one or both of the axles is mounted at an angle that is offset from the longitudinal normal by an angle "b". In another preferred embodiment, one side of the axle is mounted in a slot that permits movement to either the front or rear, or to both front and rear, in response to movement of the apparatus in the opposite direction.

In yet another embodiment, at least one wheel of a diameter smaller than the other wheels is mounted on an axle to induce the apparatus to follow a curved path. In another embodiment, the apparatus is provided with at least one pair of caster or swivel-mounted wheels, the axes of which independently pivot in response to changes in direction so that the apparatus follows a curved path in one or both directions. In this embodiment, providing the apparatus with two pairs of caster-mounted wheels will produce a scalloped or accentuated curvilinear motion as the unit moves from one point of engagement with the vertical sidewalls to another.

In a further preferred embodiment of the slot-mounted axle, one or more position pins are provided to fix and/or change the range of movement of the axle in the slot. These adjustments allow the operator to customize the pattern based upon the size and/or configuration of the specific pool being cleaned.

Another embodiment of the invention improves the ability of the cleaner to follow a particular pattern of scanning without interference or immobilization by providing an improved connector for the power cable. A swivel or rotating electrical connector is provided between the cleaner and the external power cord in order to reduce or eliminate interference with the scanning pattern caused by twisting and coiling of the power cord as the cleaner changes direction. The swivel connector can have two or more conductors and be formed in a right-angle or straight configuration, and is provided with a water-tight seal and releasable locking means to retain the two ends rotatably joined against the forces applied during operation of the cleaner.

In another embodiment of the invention, control means are provided to periodically reverse the propelling means to assure that the cleaner does not become immobilized, e.g., by an obstacle in the pool. If the pool cleaner does not change its orientation with respect to the bottom or sidewall as indicated by a signal from the mercury switch indicating that such transition has occurred during the prescribed period, e.g., three minutes, the control circuit will automatically change the direction of the drive means in order to permit the cleaner to move away from the obstacle and resume its scanning pattern. In a preferred embodiment of the invention, the predetermined delay period between auto-reversal sequences is adjustable by the user in the event that a greater or lesser delay cycle time is desired. Sensors, such as magnetic and infrared responsive devices are provided to change the direction of movement in response to prescribed conditions.

BRIEF DESCRIPTION OF THE DRAWINGS

The above objects and other advantages and benefits of the invention will be apparent from the following description in which:

FIG. **1** is a side elevation, partly in cross-section, of a pool cleaner illustrating one embodiment of the directional water jet of the invention;

FIG. **1**A is a side elevation, partly in cross-section of another embodiment of the invention of FIG. **1**;

FIG. **1**B is a side elevation, partly in cross-section, of a water jet valve assembly schematically illustrating another embodiment of the invention of FIG. **1**;

FIGS. **2** and **3** are side elevation views, partly in cross-section, schematically illustrating the operation of the water jet valve assembly shown in FIG. **1**;

FIGS. **4** and **5** are side elevation views of the embodiments of the valve assembly of FIGS. **2** and **3** provided with additional vertical discharge valves of the invention;

FIG. **6** is a top plan view of a flap valve member suitable for use with the embodiment of FIG. **1**;

FIG. **7** is a top plan view of a flap valve assembly locking bar;

FIG. **8** is a side elevation, partly in cross-section, of the valve assembly of the invention installed on a pump;

FIG. **9** is a side elevation of the embodiment of FIG. **8**, schematically illustrated in relation to a pool cleaner, shown in phantom;

FIG. **10** is a side elevation of another embodiment of the water jet valve assembly of the invention schematically illustrated in relation to a cleaner, shown in phantom;

FIG. **11** is a side elevation of another embodiment of the water jet valve assembly of the invention schematically illustrated in relation to a cleaner, shown in phantom;

FIG. **12** is a side elevation of another embodiment of the water jet valve assembly of the invention with pressurized water supplied by an external source, schematically illustrated in relation to a cleaner, shown in phantom;

FIG. **12**A is aside elevation view, partly in cross-section, of a modified discharge conduit attachment in accordance with the invention;

FIG. **13** is a side elevation, partly in cross-section, of a pool cleaner equipped with the water jet valve assembly of the invention and external pressurized water source with venturi discharge openings;

FIG. **14** schematically illustrated an embodiment similar to that of FIG. **13** in which the filter system is externally mounted;

FIGS. **15-17** are side elevation views of a cleaner provided with auxiliary support means in accordance with the invention to improve the movement over obstacles and irregular surfaces;

FIG. **18** is a top plan view of a tandem cleaner provided with two water jet valve assemblies of the invention;

FIG. **19** is a side elevation of a prior art pool cleaner, partly cut away to show a fluid activated plunger assembly;

FIGS. **20-22** are side elevation views of pool cleaners, partly cut away, to show laterally mounted directional pivot assemblies of the invention;

FIG. **23** is a top and side perspective view of a portion of a pool cleaner to show a discharge conduit provided with an adjustable diverter for varying the directional discharge of the water jet form the valve assembly;

FIG. **24** is a top cross-sectional plan view of the diverter mechanism of FIG. **23**;

FIG. **25** is a top plan view of a cleaner illustrating one embodiment of offsetting the discharge conduits to produce a non-linear movement of the cleaner in both directions;

FIG. **26** is a top plan view of a cleaner provided with means to create an uneven hydrodynamic drag force on side of the cleaner to produce a non-linear movement of the cleaner in one direction.

FIG. **27** is a side perspective view, partly in cross-section of an in-line electrical connector of the invention shown in relation to a segment of the cleaner housing;

FIG. **28** is a side elevation view, partly in cross-section, of an angular electrical swivel connector of the invention;

FIG. **29** is a plan view, partly in cross-section, of another embodiment of an in-line swivel electrical connector;

FIG. **30** is a prospective view of the assembled in-line swivel connector of FIG. **29** schematically illustrating its relation to the cleaner;

FIGS. **31**A and **32**A are top plan views schematically illustrating the prior art construction of a pool cleaner with pivot members extending from the front, and from the front and rear, respectively, in the direction of movement of the cleaner;

FIGS. **31**B and **32**B are schematic representations of the pattern of movement of the prior art pool cleaners of FIGS. **31**A and **32**A, respectively;

FIGS. **33** and **34** are top plan views schematically illustrating embodiments of the invention in which the cleaner's supporting wheels extend beyond the periphery to the front and to the front and rear, respectively to provide a pivot point;

FIGS. **35**A and **35**B are schematic illustrations of the patterns created by the embodiments of FIGS. **35** and **36**;

FIGS. **35-44** are top plan views schematically illustrating embodiments of the invention in which the cleaner's supporting wheels are mounted on one or more axles that are offset at an angle to line that is normal to the longitudinal axis of the cleaner;

FIG. **45** is a side elevation view of an adjustable axle and wheel assembly similar to the embodiments illustrated in FIGS. **43** and **44**;

FIG. **46** is a plan view of a curvilinear or free-form pool or tank schematically illustrating the predetermined scanning pattern in accordance with one embodiment of the invention;

FIG. **47** is a bottom plan view of one end of a pool cleaner wheel and axle assembly illustrating a mechanism for automatically changing the orientation of the wheels in response to a lateral contact with the side wall of a pool;

FIG. **48**A is a sectional view of the wheel and mechanism taken along line AA of FIG. **47**;

FIG. **48**B is a sectional view of the opposite wheel and mechanism taken along line B-B of FIG. **47**;

FIG. **49** is a sectional view taken along a line **49-49** of FIG. **47**;

FIG. **50** is a top plan view of a cleaner equipped with motor-driven supporting rollers on a moving axle in accordance with the invention;

FIG. **51** is a top plan view having supporting rollers and a sliding axle in accordance with the invention that includes a universal joint; and

FIG. **52** is a flow chart illustrating a method of the invention for reversing the direction of movement of a cleaner in accordance with a prescribed program.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

In the description that follows, a pool cleaner **10** has an exterior cover or housing **12** with a top wall **16**, an internal pump and drive motor **60** that draws water and debris through openings in a base plate that are entrained by a filter **61**.

The series of FIGS. **1-14** illustrate embodiments in which a single motor is used to vacuum debris and propel a swimming pool cleaning robot in combination with mechanically simple directional control means. In this embodiment, a temporary interruption of power to the motor will result in the reversal of the robot's movement. The interruption of power

to the motor can result from a programmable power control circuit or be initiated by physical conditions affecting the cleaner.

FIG. **1** schematically illustrates, in partial cross-section, a pool cleaner **10** having a water jet valve assembly **40** forming a pump outlet that is mounted on top of a motor-driven water pump **60** and using impeller **58** to drive water "W" up through housing aperture **17** and into the valve assembly. The valve assembly **40** comprises a generally T-shaped valve housing **42** with depending leg **43** having a first end that is secured to cleaner housing flange **18**, and a second end that is in fluid communication with discharge conduits **44**R and **44**L. Positioned in the interior of valve housing **42** is flap valve member, or diverter, **46** (shown in a transitory position). Referring now to FIGS. **6** and **7**, flap **46** is illustratively provided with mounting posts **47**, and two "T"-shaped spring-loaded lock bars **48**R and **48**L (also referred to generally as "lock bar(s)" **48**) pivotally mounted on pivot posts **49** on either side of the flap **46**. Lock springs **50** urge lock bars **48** into contact with flap member **46**. The cross-section of the conduits **44**L and **44**R (also referred to generally as conduit(s) **44**) can be round, rectilinear, or of any other convenient shape, the rectangular configuration illustrated being preferred.

FIG. **2** illustrates the sequence of movements inside valve housing **42**. When power to the pump motor **60** is turned on, the water being pumped through jet valve housing **42** is a pressurized water stream W, which enters the housing and acts on the flap member **46** to urge it into a first position to close discharge conduit **44**L at the left side of the valve. The pressurized water stream W also applies a force that urges the lock bar **48**R to fold away from the valve member **46** in the right discharge conduit **44**R, resulting in a water jet propulsion force that is emitted from the right end of discharge conduit **44**R.

FIG. **3** illustrates the next sequence of steps or movements that result when power to the motor **60** is shut off and/or the flow of water W is interrupted. The sudden interruption of the water W flowing into the valve housing **42** causes the exiting water stream to create a low pressure or partial vacuum in the pump outlet, thereby causing flap member **46** to swing to the transitory (i.e., second) position over the pump outlet and towards the right discharge conduit. This movement of the flap member is followed by the movement of left lock bar **48**L to lock the valve member **46** into position to the right of center. When power to the motor is turned back on, a second high pressure water stream is formed within the pump outlet that moves the diverter to a third position to close the right discharge conduit **44**R, and the water flow will be directed into left discharge conduit **44**L. It is possible to operate the jet valve assembly **40** without lock bars **48**L and **48**R; however, precise timing is required to turn the power on and to reactivate the pump **60** before valve member **46** swings back to its previous position prior to the interruption of the water flow.

FIG. **4** illustrates a further preferred embodiment in which provision is made for a reduction of excessive water jet pressure through the open end **45** of conduits **44**R and **44**L. To control and adjust the water pressure, openings are provided at both sides of flap valve **46**, and adjustable closures, which can be e.g., sliding **53**R, **53**L doors proximate the openings provide for the desired amount of by-pass water the force of which, when directed upward, urges the robot **10** against the surface of the pool.

FIG. **5** illustrates an automatic mechanism to accomplish the above in which spring-loaded doors **54**R, **54**L open when the initial operating pressure is too high to maintain proper speed of robot, e.g., when the filter bag is clean. Doors **54** are mounted by hinged members **55** and biased into a closed position by springs **56**. As filter **61** accumulates debris and dirt, the bag clogs up, pressure drops and the spring-loaded doors close partially or completely.

FIG. **6** illustrates the configuration of a preferred embodiment of the flap valve member **46** and FIG. **7** shows one embodiment of a lock bar **48** of FIG. **1** (i.e., lock bars **48**L or **48**R, and the relation of associated lock spring **50**. Other forms of biased mechanisms, including electronic and electromechanical means can be employed.

In another preferred embodiment of the invention, the flap **46** is moved by positive mechanical means in response to a contact with a side wall or other structure in the pool. For example, FIG. **1**A illustrate a cleaner **10**, similar in construction to that of FIG. **1**, on which is mounted valve assembly **40'**. Valve actuating member **240**, is slidably mounted internally and parallel to the axis of the discharge conduits **44**L and **44**R in spiders **250** and passes through a slotted opening **248** in flap member **46'**, Contact members **244** and **246** are mounted on rod member **240** on either side of flap member **46'** and positioned to urge the valve into one or the other of its sealing positions to divert the water flow W. In operation, as the cleaner **10** approaches the sidewall, resilient tip member **242** contacts the wall and rod **240** is moved to the left in FIG. **1**A until contact member **244** reaches flap **46'** and moves it to the right. When the left-hand wheel **30** reaches the wall, the movement of rod **240** ceases and flap **46'** is seated. With water W exiting discharge conduit **44**L, the cleaner moves away from the wall with actuating rod **240** extending beyond the periphery of the cleaner and positioned to contact the opposite wall, where the process is repeated.

In another preferred embodiment, the flap **46** is moved by electro-mechanical means, e.g., a linear or circular solenoid. As schematically illustrated in FIG. **1**B, a circular solenoid **260** having power cord **261** is mounted on the exterior of valve housing **42**. The axially rotating element **262** of solenoid **260** engages flap **46**. In one preferred embodiment, the IC controller for the cleaner sends a signal to activate the solenoid moving the flap **46** to its opposing position. It will be understood that the force of water stream W will seat flap **46** in the reversing position.

FIG. **8** illustrates the jet valve assembly as described in FIGS. **1-3** on which additional directional flow elbows **120**R, **120**L are secured to the terminal ends of the discharge conduits **44**R, **44**L. The assembly **40** can be produced with elbows **120** as an integral unit from molded plastic, cast aluminum or other appropriate materials.

The water jet discharged from the elbow **120** at an angle "a" to the translational plane of movement of the cleaner **10** produces a force vector component in a downward direction towards the wheels **30** as well as a translational force vector tending to move the cleaner across the surface being cleaned.

FIG. **9** illustrates the especially preferred location and orientation of the jet valve assembly **40** of FIG. **8** in relation to robotic cleaner **10** (shown in phantom.) In this embodiment, the discharge conduits **44**, through their associated elbows **120**L and **120**R (also referred to generally as "elbow(s)" **120**), project through the sidewalls of housing **12**. In a further preferred embodiment, the elbows and valve housing **42** are integrated into the molded housing **12** which is produced from an impact resistant polymer. With further reference to the arrow "VR" indicates the resultant vector force produced by the expelled jet stream, the angle "a" of which is critical to the proper movement of robot **10** while on or off the vertical or angled side wall of a pool. As shown in FIG. **9**, the projected resultant vector "Vr" crosses the horizontal or translational plane between the axles **32**, and preferably in closer proximity to the front axle, where the front axle is defined by

the direction of robot's movement as the leading axle. Providing an angle that places the line of resultant vector "Vr" between the axles assures the stable operation of the cleaner.

In addition to providing a more compact and damage resistant construction, incorporation of discharge valve **40** into housing **12** reduces the number of separate parts required for the practice of the invention, thereby reducing costs. In this regard, use of a source of pressurized water from external source as specifically illustrated in FIGS. **12-14** (and which can be applied to all of the other embodiments described) eliminates the pump and motor assembly **60** resulting in further cost and material savings, as well as a reduction in operating and maintenance expenses. Moreover, by incorporating the valve assembly **40** in the interior of housing **12**, other elements conventionally attached to the exterior of cleaners of the prior art can continue to be used, e.g., floating handles that control the alignment of the unit on the sidewall at the water line of the pool.

FIG. **10** illustrates a jet valve assembly similar to that of FIGS. **1-3** that is mounted upside down in a robotic cleaner (shown in phantom). In this embodiment the motor operates two propellers, one located at either end of the drive shaft. The upper propeller **58**A creates a downward force, which when coupled with the horizontal or translational jet force emitted from discharge conduit **44**R or **44**L produces a resultant vector R (V_R) that can be set in the proper angle by selecting the appropriate size for the upper propeller. In this embodiment, directional elbows are not required to provide a downward hydrodynamic force vector to urge the apparatus into contact with the surface to be cleaned.

FIG. **11** illustrates a jet valve assembly **40** that is mounted in cleaner **10** in a horizontal position, permitting a low profile for the cleaner housing **12**. In the embodiment shown, the housing **12** is supported by large diameter wheels **30** and the axles **32** are positioned above valve assembly **40**. As a result of the low center of gravity of the unit the discharge of the propelling force of the water jet can be limited to the horizontal or translational direction. The large wheel diameter allows the unit to traverse uneven surfaces.

FIG. **12** illustrates a jet valve assembly **40** which is connected to an external pump (not shown) by a flexible hose **152** attached to housing adapter **150** and therefore requires no internal pump motor. The hose **152** is secured to the robotic cleaning apparatus by means of a housing adapter **150** forming a discharge outlet (e.g., a swiveling elbow joint) **154** to allow unimpeded movement of the robotic cleaner and to prevent twisting of the hose **152**. The housing adapter **150** is tubular and includes the discharge outlet **154** for discharging a pressurized stream of water from the external pump into the jet valve assembly **40**. The jet valve assembly **40** directs the pressurized stream of water through one of the opposing ends (i.e., openings) of the directional conduit **44** to propel the cleaner in a forward direction. The switching of jet valve is accomplished by a solenoid valve (not shown) installed in-line near the external pump. Cleaners using this external pump system do not have filter bags to collect debris. Rather, the jet outlet is deflected slightly downward toward the surface being cleaned by directional flow elbows **120**R, **120**L so that the water jet turbulence stirs up the debris from the bottom or submerged surface of the pool or tank; once buoyant, the debris is filtered by the pool's permanent internal filter system. Generally, outside filtering systems have multiple inlets to the pool, one of them usually is equipped with a fitting so that flexible hose **152** can be connected to it. Utilizing this embodiment of the invention, an outside filter system becomes much more efficient since it is able to filter not only floating debris from the water's surface, but also debris dislodged from the bottom or submerged surface of the pool or tank. To assure the downward directed jet streams do not flip the cleaner, supplemental weight member **156** is added to the bottom of the apparatus to maintain an overall negative buoyancy. The weight member can be one or more batteries for providing power to cleaner **10** where the pump is powered by an internal motor, as in FIGS. **1-11**.

FIG. **12**A illustrates a bi-axial flow diverter **124** attached to discharge conduit **44** for use with the robot of FIG. **12**. It is desirable for ease of handling not to add additional weight to the cleaner. Instead of adding weight **156** (as shown in FIG. **12**), each opposing end or opening of the discharge conduit **44** in this embodiment is provided with flow diverted with at least two channels **126** and **128** shaped so that part of the emitted water is directed downward at a relatively shallow angle via the first channel **128**, while the other portion of the stream is directed upwardly at greater angle to the translational plane via the second channel **126**. The combined force of the two streams results in a vector R (see, e.g., vector V_R of FIG. **10**) that urges the robot against the surface on which it is moving.

FIG. **13** illustrates a robot of construction similar to that of the cleaner of FIG. **12**, where an external pump is used to provide a pressurized stream of water to the cleaner via the discharge outlet **154** of the housing adapter **150**. Further, the jet valve assembly **40** with its flap assembly **46** (see FIGS. **1**A and **1**B) can be used to control the direction in which the pressurized stream of water flows through the conduit 44_L or 44_R to propel the cleaner. This embodiment is further equipped with a coarse filter medium **172** (shown in phantom) and means **176** to dislodge debris from the pool surface so that it can be drawn into the filter **172**. The open ends of the discharge conduits **44** (i.e., individually shown as discharge conduits 44_L and 44_R) are each fitted with a first end of an expansion sleeve **190** that has an inside dimension (e.g., inner diameter) that is larger than the outside dimension(s) (e.g., outer diameter) of the discharge conduit **44**. The opposing end of each expansion sleeve **190** forms a discharge opening **196** from which the discharged water jet is expelled to propel the cleaner. The gap **182** formed between the conduit **44** and sleeve **190** creates a path through which water is drawn by the venturi effect, which is created as a result of the sudden increase in volume of the flow path and corresponding pressure drop. This pressure drop creates a negative pressure inside the robot housing **12** so that the jet streams that converge under the surface **184** of the cleaner are able to lift debris and carry it through the intake port **186** and into contact with the robot's filter medium **172**. The jet streams are tapped off the inlet side of valve assembly **40** by hoses **178** connected to a transverse manifold **180** at the front and back of the robot. The manifold **180** has multiple openings **175** that extend across the full width of the robot's housing so that the jet cleaning streams impinge on the entire surface to be cleaned.

FIG. **14** illustrates another embodiment of the invention in which the cleaning robot is operated by an external pump (not shown). As shown in the cross-sectional view, the cleaner is provided with two external coarse filter or collector bags **173** that are secured to the outlets of the venturi chambers **192**. Outlet jets **194**, fed by hoses **193**, are positioned in the chambers **192**. Water issuing from jets **194** creates a low pressure zone drawing up water and loose debris from beneath cleaner **10**, the debris being retained by filter bag **173**. The chambers are connected to the intake side of the jet valve housing **44**.

FIG. **15** illustrates a robot that is equipped with a plurality of auxiliary wheel or rollers **30'** along the bottom or sidewalls between the supporting wheels **30** at either end of the cleaner **10**. The auxiliary wheels can be mounted for free rotation on

the housing **12** or external side plate. This configuration prevents the robot from being immobilized on a hump or other vertical discontinuity in the bottom surface of the swimming pool or tank being cleaned.

FIG. **16** illustrates a robot similar to that of FIG. **15**, but instead of wheels or rollers, the bottom edges of the robot's side walls **12** or side plates **15** facing the pool surface are provided with Teflon* or other low-friction engineering plastic strips **201** so that the apparatus slides along on the bottom edges.

FIG. **17** illustrates another embodiment of the robot that is equipped with "immobilization" means. These means comprise two idling wheels **204**, **206** connected to each other by a belt **208**. It should be noted that although the so-called "immobilization" devices generally are installed on opposing sidewalls of the robot, there are instances in which it is desirable to equip the robot only on one side. This will result in random turning of the robot in one direction or the other whenever it goes over a hump as shown in FIG. **15**.

FIG. **18** illustrates a cleaning robot with two water jet valve assemblies to which are attached directional flow elbows **120**. In addition, there are a plurality of pumps having outlets **220** to increase the vacuum effect and cleaning ability of the robot. The multiple jet valve system is especially suited for remote control operation, since each jet valve can be controlled independently. As illustrated, the robot is equipped with rollers **30**; however, wheels can also be used with this embodiment.

Vertical Pivot Axis

FIG. **19** illustrates a conventional fixed spring-loaded cylinder assembly **330** of the prior art which is activated by hydraulic force supplied by a pump motor (not shown) via hose **342**, the timing of which is controlled electronically, e.g., by a pre-programmed integrated circuit device **344**. When the hydraulic force is applied, the piston **346** moves to engage the surface causing the cleaner to pivot about the axis of piston **346**. Use of this device produces random motion by the cleaner.

FIG. **20** illustrates a robot that is equipped on one side only with a cylinder assembly **300** that is free to rotate longitudinally towards both ends of the cleaner. The assembly's upper end **302** is pivotally mounted at **304** on the side of the robot at a position that is transversely displaced from the central longitudinal axis of the apparatus. At the lower end of the cylinder **300**, a spring-loaded piston **306** extends downwardly toward the bottom of the pool. Each time the robot reverses its direction, the cylinder assembly **300** applies a transitory frictional braking force to the motion of the robot on one side which results in a pivoting action about the vertical axis of the piston and the repositioning of the longitudinal axis of the apparatus. This braking action lasts until the piston **306** is pushed into the surrounding cylinder **308** far enough to allow the cylinder assembly to pivot past its vertical position. The rate at which the piston moves can be controlled, e.g., by an adjustable valve **310** at the top of the cylinder. In the practice of this embodiment of the invention, the robot can have wheels mounted on fixed axles in parallel relation and still be able to scan the bottom surface of a rectangular pool.

FIG. **21** illustrates a robot that is equipped with an arm **320** pivotally mounted on one side of the cleaner housing at a position similar to that of FIG. **20**, but which engages the pool bottom when the cleaner moves in only one direction. The lower end of arm **320** is arcuate, e.g., shaped as a segment of a circle, the center of which coincides with the pivot point **324** of the arm. A cylinder assembly **322** similar to the one described in FIG. **20**, but without the spring, is pivotally linked to the arm at **323**. However, the piston **326** is free to move in one direction only; movement in the other direction is controlled by an adjustable valve **310**. When the robot changes direction, only every second time does the cylinder assembly apply a frictional braking force to halt the forward motion of the robot. Use of this apparatus and method of operation produces a scanning pattern for the cleaner that which consists of alternating perpendicular and angular paths with respect to the sides of a rectangular pool. In pools where the robot climbs the vertical side walls, the braking or pivot arm will continue to pivot while on the wall (due to gravity) as shown in phantom, so that when the robot comes off the wall, the arm will not immediately touch the bottom of the pool. In this mode of operation, a few seconds will pass before gravity pulls the arm **320** down to make contact with the bottom surface of the pool. The robot will move horizontally for a short distance before it changes direction by pivoting around the pivot arm.

FIG. **22** illustrates yet another embodiment in which pivot arm **330** extends in a downward direction to make contact with the bottom floor of the pool to provide a frictional braking force in both directions of movement and a pivot axis on one side of the robot **10**. This mechanism works similarly to that of FIG. **20**, and is relatively simpler and less expensive. A friction pad **334** is attached to adjustment means **332** which permits the frictional contact between the pad **334** and end of pivot arm **330** to be varied to thereby control the pivoting time that the opposite end of said arm is in contact with the pool surface and before disengagement of the pad and pivot arm. The friction pad can be a directional resistance material that is, greater resistance is provided in one direction than in the other.

As shown in FIG. **23**, the open end of one or both of the outlets of the discharge conduit or directional flow elbow is provided with internal flow diverter means **550**. Internal dove tail configuration **35** has an outwardly tapered throat and is provided with adjustable diverter flap **554** in the discharge flow path that directs the flow of water to one side or the other of the outlet **120**. As more clearly shown in the cross-section view of FIG. **24**, the dove tail outlet is provided with diverter flap positioning means **556**, e.g., two set screws to adjust the position of the diverter flap **554**. The cross-sectional area of the elbow when the diverter means is positioned at one side or the other is about the same as the area of the discharge conduit **120**, i.e.; there is no restriction of the flow, or increased back pressure. By having the water jet exit angularly to the left or to the right of the longitudinal centerline, the robot will follow an arcuate path in one direction or the other. The radius of the arc can be controlled by the adjustable positioning of the diverter flap **554**. The cleaning apparatus of this embodiment can also be set to operate in a more random manner by retracting the adjusting screws **556** to allow the diverter flap to pivot freely from left or right each time the water jet impacts it. A manually adjustable flap **554** enables the user to change its position from time to time in order to unwind a twisted power cord, should that occur.

FIG. **25** illustrates another method by which a scanning pattern is achieved without changing the position of the wheels or the axles. The jet valve assembly **40** is positioned off-center of the central longitudinal axis "L" of the cleaner **10** to thereby produce movement in a semi-circulator other curvilinear pattern.

FIG. **26** illustrates another embodiment in which a scanning movement is achieved by providing the exterior of the housing **12** with a configuration that presents an asymmetrical hydrodynamic resistance to movement through the water. In the specific embodiment illustrated, the unequal hydrodynamic resistance is effected by adding a resistance flap **360** to one side of an otherwise symmetrically designed robot hous-

ing **12**. The water resistance causes the robot to curve to the left or right. If the resistance means is pivotally mounted at **362** as shown, the robot moves straight in one direction and assumes a curved path in the other. A plurality of flap position members **364** are provided for adjusting the stop position of pivoting flap **360** to thereby vary the resistance. The asymmetrical hydrodynamic resistance can also be achieved by integrally molding the housing on one or both ends so that it presents unequal hydrodynamic resistance during movement.

Power Cord Swivel Connector

In order to reduce or eliminate interference with the scanning pattern of the cleaner associated with twisting and coiling of the floating power cord **70** as the cleaner repeatedly changes direction which results in the tethering of the cleaner, another embodiment of the invention comprehends a swivel or rotatable connection at a position along the power cord, or between the power cord and the moving cleaner.

With reference to FIG. **27**, there is schematically illustrated a cross-sectional view of the upper surface **16** of housing **12** provided with an aperture **78** adapted to accommodate socket portion **82** of electrical swivel connector socket **80**. Socket **82** is fabricated from dielectric material **83** and is provided with electrical contacts **86***a* and **88***a* which in turn are joined to female plug **90** by conductive wires **89**. Plug **90** is adapted to mate with male plug **92** which terminates electrical wire **93** from the motor (not shown.)

With further reference to socket **82**, a groove **94** is provided proximate the open end to receive an o-ring **96** or other means for sealing the socket and locking the plug or jack portion **84** into secure mating relation. Jack **84** is comprised of insert member **98** fabricated from dielectric material, and electrical contacts **86***b* and **88***b* that are adapted to be received in sliding contact with corresponding elements **86***a* and **88***a* in socket **82**. Insert member **98** is also provided with a groove or annular recess **99** that is adapted to engage ring **96** in fluid-tight sealing and locking relationship when jack **84** engages socket **82**. It will also be understood that different or additional means can be provided to secure the mating sections **82** and **84** together that will also permit them to rotate when mated. Insert member **98** is secured in water-tight relation to right angle member **100**, preferably fabricated from a resilient dielectrical material, through which are passed a pair of electrically conductive wires (not shown) from power cord **70** that terminate, respectively, at conductors **86***b* and **86***b*. Right-angle jack member **100** is also constructed with a plurality of flexure members **102** about its periphery in order to provide additional flexibility between the housing connection and the power cord **70** during operation of the cleaner. It will be understood that the right-angle jack member **100** will freely swivel in the opening of socket member **82** in response to a force applied by power cord **70**. Thus, the power cord **70** remains free of coils, does not suffer any effective shortening in its length and therefore does not exert any tethering restraining forces on the cleaner that would adversely effect the ability of the cleaning apparatus to freely traverse its path.

With reference to FIG. **28** there is shown a second embodiment of an electrical swivel connector for joining the power cord **70** to the motor electrical wire **93** via elements as described above in connection with FIG. **27**. In the embodiment illustrated, a straight-line swivel is comprised of socket member **82'** and plug member **85**, the former being joined by a short length of power cord **91** extending through restraining gasket **79** secured in opening **78'** in a sidewall of cleaner housing **12**. The two sections of the swivel connector are securely joined together in rotating relationship as described above with reference to FIG. **27**. As the cleaning apparatus moves about the pool surfaces, the socket **80** moves in response to the tension transmitted through power cord **70** and any twisting or torsional forces are dissipated by the rotation of plug **85** in socket member **82**. The power cord therefore does not form coils, or otherwise have its effective length reduced, and does not stop adversely effect the movement of the cleaned.

In another preferred embodiment of the swivel connector, a permanent in line or straight connection between two sections of power cable **70** is provided by a connector permitting angular displacement between-its elements. As illustrated in FIG. **29**, connector **104** comprises a rigid non-corroding ferrule **105**, which can be in the form of a length of polymeric or stainless steel tubing that extends between waterproof tubular junction members **106**, **106'** that also receive opposing cable ends **70**. One of the junction members **106** contains electrical connector jack **107** and plug **108** which are axially rotatable with respect to each other. A conductor pair **109** of cable **70** are permanently joined to the adjacent terminals of jack **107** and secured in place within junction member **106**, e.g., by a plug of flowable epoxy resin **110** or other potting material that hardens after the elements have been assembled.

With further reference to FIG. **29**, a pair of conductors **111** extending from the rear of plug **108** extend axially through ferrule **105** and a bushing **112** is placed on ferrule **105** to engage the rear shoulder of jack **108**. In a preferred embodiment, the ferrule end is flared and the adjacent surface of annular bushing **112** is shaped to receive the ferrule. The junction member containing the connector jack and plug is completed by securing on tubular member **106**, cap **113** having a central orifice into which is secured axial seal **114** which passes over ferrule **105** and permits rotation of the ferrule in water-tight relation. The assembly of the adjoining junction member **106'** is completed by joining conductor pair **111** to the conductor pair **109** of cable **70** and filling the end with flowable epoxy resin **110** and installing cap **113'**. When the epoxy or other potting compound has set, it will be understood that the two ends of cable **70** are permanently joined and that ferrule **105** has been secured to junction member **106'** in water-tight relation and that plug **108** is free to rotate with respect to jack **107** and the assembly of junction member **106**. In this embodiment, the swiveling or rotatable connector assembly **104** is positioned approximately three meters from the cleaner to reduce the likelihood that the user will lift the cleaner from the pool using a section of the power cable that includes the connector.

As schematically illustrated in FIG. **30**, any twisting or torsional forces transmitted by the movement of the cleaner **10** through the attached length of power cord **70** will be dissipated by the rotation of member **106**.

It will also be understood by one of ordinary skill in the art that various other mechanical constructions can be provided that will permit relative rotation between adjacent sections of the power cable, one end of which is attached to the cleaner and the other to the external fixed power supply to thereby eliminate the known problems of cable twisting, coiling and tethering that adversely effect the desired scanning patterns or random motion of the pool cleaner.

Axle Orientation

By way of background, the series of FIGS. **31**A and **32**A are representative of the prior art. FIGS. **33-44** schematically illustrate in plan view the apparatus and methods embodying the invention to control the movement of a swimming pool cleaning robots **10** to produce systematic scanning patterns and scalloped or curvilinear patterns, and to provide controlled random movement on the bottom surface of pool. The configurations will provide one or more of the above three

mentioned movements. The cleaner can be propelled either mechanically or by a discharged jet or stream of water.

In the prior art arrangement shown in FIG. **31**A, an offset extension member **400** is secured to one end of housing **12** at a position that is displaced laterally from the longitudinal axis "L" of the cleaner and which causes the robot to position itself angularly in relation to vertical swimming pool wall **401** (shown in phantom.) When the robot **10** reverses its direction, it travels at an angle "b" away from the side wall **401**. When cleaner **10** contacts the opposite side wall **403**, the robot's body again pivots and comes to rest in a position where its longitudinal axis "L" is at a 90 degree angle to side wall **403**. The resulting scanning pattern is illustrated in FIG. **31**B.

In the prior art configuration of FIG. **32**A, a second offset extension member **402** is added to the housing opposite extension member **400**. The scanning pattern provided by two opposing extension members is generally shown in FIG. **32**B. The 90 degree pivoting turns occur in both a clockwise and counter-clockwise direction.

In accordance with the improved method and apparatus of the invention, separate members projecting from the front and rear housing surfaces are eliminated, and in one preferred embodiment, at least one supporting wheel, or track, or roller end, projects beyond the periphery of the cleaner in the direction of movement to contact a vertical side wall or other pool surface.

In the preferred embodiment of FIG. **33**, one of the wheels **30***a* is mounted so that it projects forward of the housing **12** as a pivot point and thereby causes the same angular alignment between the robot **10** and swimming pool wall **401**, as the apparatus of FIG. **31**, and produces a scanning similar to that of FIG. **31**A. With further reference to FIG. **33** is a ball-shaped side extension **404** terminating in tip **406** formed of resilient, soft rubbery material which, when it comes in contact with the end wall of pool **405**, **407**, causes the robot to make a 90 degree pivoting turn, indicated turn by arrow in FIG. **31**B. As the pattern shows, every time this 90 degree turn occurs the cleaner turns in a clockwise direction. It will be understood that if the side projection member **406** had been placed at the upper left side of the housing **12**, the 90 degree turns would have been counter-clockwise.

In the embodiment of FIG. **34** two opposing wheels **30***a*, **30***b* at the left side of robot **10** are mounted forward of the periphery at their respective ends of the cleaner to provide a translational pivot axis. This configuration creates a scanning pattern similar to that shown in FIG. **32**B. In this embodiments of FIGS. **31**A to **34**, the wheels are individually rotatable and their axles are stationary. With this embodiment, power cable twisting is not a problem.

With reference to the embodiment of FIG. **35**, a pair of wheels **30***c* is mounted on caster axles pivoted for limited pivoting movement defining an arc in the translational plane passing through the center of the wheels. The axles and wheels **30***c* swivel so that when the robot moves in the direction opposite the caster mounts, all four wheels are parallel with each other along the longitudinal axis of the robot. When the robot moves in the opposite direction, i.e., the caster wheels lead, the caster wheel axles swivel or pivot to a predetermined angle, which angle can be adjustable. The robot scans a rectangular pool in a manner shown in FIG. **35**A, where the path is curvilinear in one direction and straight in the other. The angular arc can be up to about 15 degrees from the normal, and are preferably adjustable to account for the pool dimensions.

In an embodiment related to that of FIG. **35** (but not shown), all four wheels are caster mounted, the opposing pairs being set for angular displacement when the cleaner moves in opposite directions. That is, depending on the direction of the robot's movement, when one pair of wheels are at an angle to the robot's longitudinal axis the opposite set of wheels are parallel to the axis "L", and vice versa. The scanning pattern would be as illustrated in FIG. **35**B.

In the embodiment of FIG. **36**, the transverse axles **32** are mounted in an angular relation to each other so that the wheels on one side of the cleaner are closer together than those on the opposite side. The scanning pattern is as illustrated in FIG. **5**B.

As shown in FIG. **37**, one end of one of the axles is mounted in a slot so when the robot moves one direction it follows a curved path, and when it moves in the opposite direction (i.e.; where the slot is in the rear of the cleaner) the robot follows a straight line. (The pattern is shown in FIG. **35**A).

In the embodiment of FIG. **38**, the wheel axles are parallel to each other and normal to the longitudinal axis "L" of the robot, and the wheels **305** on one side of the cleaner are smaller in diameter than the wheels on the opposite side. The scanning pattern is as illustrated by FIG. **35**B.

As shown in FIG. **39**, all four wheels of the robot **10** are caster mounted, and all four wheels move together to be either parallel to the robot's axis, or at an angle to the axis "L", depending on the direction in which the robot moves. The scanning pattern is as shown in FIG. **31**B. The angular displacement can be up to 45 degrees, since all four wheels are moving in parallel alignment.

In FIG. **40**, the four wheels are mounted to swivel in unison, and move as in FIG. **39**. When the wheels are rotated to their extreme (i.e., maximum) positions, they are angular to the robot's body, but symmetrical to each other. This arrangement provides a scanning pattern as shown in FIG. **32**B. Again, the angular displacement of the caster wheels can be up to 45 degrees in both directions from the normal. It will be understood that the longitudinal axis of cleaner **10** will be perpendicular to the wall it contacts.

As also illustrated in FIG. **40**, both longitudinal sides of the cleaner **10** are provided with at least one projecting member **404**. As will be described in more detail below, the pivoting function of side-extending pivot contacts as represented by the specific embodiments of elements **404**, can also be effectuated by elements projecting from the external hubs of two or more of wheels **30** (see e.g., FIG. **43**), or the side wall surfaces of cover **12** (see, e.g., FIG. **18**) or other side peripheral structure of the cleaner **10**. The transverse projection of such elements is determined with reference to their longitudinal position and the shape or footprint of the peripheral projection of the cleaner on the pool surface. For example, a side-projecting frictional pivot member located at the leading edge of a generally rectilinear cleaner will require less projection than a single member of FIG. **33** that is located mid-way between the ends of the cleaner.

In FIG. **41**, both axles are mounted in slots **320** on one side of the unit so that the wheels adjacent the slots can slide up and down to be either parallel to the robot's longitudinal axis, or at an angle thereto, depending on the direction of movement of the cleaner. This arrangement produces the scanning pattern of FIG. **31**B.

In the embodiment of FIG. **42**, the axles swivel in larger slots **320** to achieve angular positioning of wheels to the robot's body in both extreme positions, but in symmetrical fashion, with a resulting scanning pattern as shown in FIG. **32**B.

From the above description, it will be understood that when operating in a rectangular pool or tank, the embodiments shown in FIGS. **39-42** allow the robot to move parallel to the swimming pool's end walls, even when it travels other than

perpendicular to the sidewalls. In other words, the correct scanning pattern does not require an angular change in the alignment of the robot's body caused by a forceful contact with a swimming pool wall as with the prior art. This is particularly important where a water jet propulsion means is employed, because as the filter bag accumulates debris in the jet propulsion system, the force of the water jet weakens and the force of impact lessens, so that the robot's body may not may not be able to complete the pivoting action required to put it into the correct position before it reverses direction. This is especially true in Gunite or other rough-surfaced pools in which a robot with even a clean filter bag may not be able to pivot into proper position because the resistance or frictional forces between the wheels and the bottom surface of pool may be too great to allow the necessary sideways sliding of the wheels before reversal of the propelling means occurs.

As shown in FIG. **43**, one of the axles is mounted in slots **320** that permit it to move longitudinally at both ends. This longitudinal sliding motion is restricted by one or more repositionable guide pins **330**. These pins allow the user to adjust the angular positioning of the axle to accommodate the width or other characteristics of the pool. By reversing the position of the pins on both left and right sides, the robot will follow a pattern which is similar to that shown in FIG. **35**A. This method of operation will also unwind a twisted cable.

With further reference to FIG. **43**, there are shown mounted on the ends of axles **32** or hubs of wheels **30** side projecting pivot member **200**. These members serve the same function and can be constructed of materials as described with reference to side projecting members **404** as described in connection with FIG. **33**, above. Pivot member **200** can be mounted on one or both sides of the cleaner **10** to engage the sidewall of the pool and cause the cleaner to pivot into that wall.

In FIG. **44**, both axles are mounted in slots permitting longitudinal movement at both ends. This will allow the robot with proper positioning of the guide pins to advance in a relatively small circular pattern in one direction and in a slightly larger one in the other.

It is to be noted that the odd-numbered embodiments of FIGS. **31** to **44** illustrate devices which turn only one way when they make 90 degree pivoting turns, and that the embodiments of even-numbered FIGS. **2** to **14** turn both ways. Simply put, when the robot scans in an asymmetrical pattern, such as in FIGS. **1**A, **3**, **5**, **7**, **9**, **11** and **13**, it turns either clockwise or counter-clockwise; when the robot scans in a symmetrical pattern, such as in FIGS. **2**, **4**, **6**, **8**, **10**, **12** and **14**, it turns in both directions. The two main categories are in relation to their movements. Within these principal categories, there are variations where straight-line movements are replaced by curved paths, e.g., in FIG. **20**, or the two are combined, e.g. in FIG. **18**.

It is relatively easy to clean a rectangular pool in any systematic scanning manner as shown above, but it is more difficult to clean an irregularly-shaped pool. Applying the method and apparatus of the invention and using the guide pins set as described above, the robot can scallop a free form pool in a systematic manner as shown in FIG. **46**.

FIG. **45** shows the six different arrangements in which each wheel **32** can be positioned. By pressing the appropriate pins **330** down or pulling them up, the wheel axle **30** can be placed in three stationary positions: outside, center and inside. It can also be placed in three sliding positions outside to inside; outside to center; and center to inside. Since there are four wheels, the total combination of positions of these wheels is 1296 (6 to the 4th power) which provides a total of 361 different scanning patterns.

In a particularly preferred embodiment employing a transverse axle **32** one-half inch in diameter, the axle supporting members **353** are provided with slots **320** extending 1.5 inches longitudinally to receive the axle in slidable relation. Each slot is provided with a central lock pin **330** which can optionally be withdrawn from the slot. This configuration provides a sufficiently large number of combinations and angular displacements of wheels and axles to cover essentially all of the sizes and shapes of pools in common use today. The flexibility of this embodiment gives the user the ability to select an optimum cleaning pattern for all types, sizes and shapes of pools.

The embodiment illustrated in FIG. **47** provides an apparatus and method that automatically switches the positions of two wheels when the scanning robot reaches the end of the pool. Unlike the embodiments described above that provided the robot with means by which to turn 90 degrees clockwise or counter-clockwise, this embodiment allows the robot to maintain its orientation in a rectangular pool that is parallel with the swimming pool's walls. Using this embodiment, the power cord cannot become twisted or formed into tight coils. Moreover, a coarse surface having a high coefficient of friction does not adversely effect desired scanning patterns. The robot has two side plates **350** which are provided with horizontal slots **352** to hold the ends of transverse axle **32**. Pivotally mounted at pivot pin **353** on the inner side of the side plates and overlapping the horizontal slots are two identical guide plates **354**, **354'** each of which is provided with an L-shaped slot **355** to freely accommodate movement of axle **32**. Two levers **356**, each of which is pivotally mounted at one of its ends concentrically with the pivot point of each of the guide plates. The other end of each lever **356** extends into a 45 degree slot **358** provided in slidably mounted in transverse cross-bar **360**, which cross-bar extends beyond the periphery of a side wall of housing **12** a distance that is sufficient to contact on adjacent pool wall. Each of said guide plates **354** is linked with its corresponding lever **356** through a spring **362**, said spring being secured to pins **364** protruding from said guide plates and levers.

With respect to FIG. **48**A, which is a view taken along line **22-22** of FIG. **47**, it can be seen that spring **362** is pulling guide plate **354** counter-clockwise holding the longer vertical leg of the upside down L-shaped slot in position for the wheel axle to slide freely.

With reference to FIG. **48**B, which is a view taken along line **23-23** of FIG. **47**, it can be seen that spring **362** pulls corresponding opposite guide plate **354'** clockwise, locking that end of wheel axle **32** into a forward stationary position relative to the opposite end of the axle.

During operation, as the cleaner approaches a pool side wall that is generally parallel to the longitudinal axis of the cleaner, the projecting end **360**R of the slidably mounted cross-bar comes in contact with the swimming pool wall, and the bar slides to the left, as indicated FIG. **49**. This horizontal movement of bar **360** is translated into a vertical or lifting force on levers **356** via the 45 degree slots **358** in bar **360**. This results in the flipping of levers **356** to their opposite side. This movement causes springs **362** to pull their respective guide plates **354**, **354'** to the opposite position, locking the right end of the axle **32**, while freeing up the left end. While this action on the left end of axle **32** is instantaneous, the right end is not locked in position until the robot reverses direction, at which time the right end of axle **32** slides into a trap provided by the short leg of L-shaped slot **355** in guide plate **354**. Using this apparatus, the cleaner **10** continues to travel back and forth between the same end walls of the pool but over a different

reverse path that is determined by the angular displacement of the wheels and/or axles, thereby assuring cleaning of the entire surface.

FIG. **50** illustrates another embodiment of the invention in which pool cleaner **10** is provided with a plurality of rolling cylindrical members in place of wheels. The long cylinder **500** is driven at one end by a flexible chain belt **510** at presses around sprocket **512** attached to an electric motor or water turbine drive shaft (not shown.) A pair of shorter rollers **502**, **504** is mounted on transverse axle **506**. As schematically illustrated, the right end of axle **506** is free to move longitudinally in slot **508** provided in axle support member **520**. The use of a drive chain and sprocket allows for changing alignment of supporting axle **506** and eliminates problems of tensioning and resistance to movement associated with timing belts used by the prior art. A cleaner constructed in accordance with this embodiment will exhibit a scanning pattern similar to that of FIG. **32**B.

FIG. **51** schematically illustrates a robot **10**, which uses a pair of drive belts or chains **510***a*, **510***b* to power two cylindrical members **500**, **501**. The right end of axle **506** is free to move in slot **510** provided in axle support member **520** and the opposite end of axle is provided with a universal joint **522** which in turn is attached to a driven pulley or sprocket **512**. The scanning pattern of this unit is also similar to the one shown in FIG. **32**B.

With further reference to FIGS. **50** and **51**, there are shown side projecting pivot members **202** secured to the exterior of side supporting member **520**. Similarly, pivot members **202** can be secured to the opposite side, e.g., on housing **12**, or other outboard supporting member to provide a point of frictional engage with a sidewall of the pool to effect a pivoting turn of the cleaner into the wall where it is properly oriented for eventual movement away from the wall, e.g., upon reversing of the cleaner's water jet or other drive means.

It will be understood that in the apparatus of FIGS. **31-44** the wheels mounted on transverse axles can be replaced with cylindrical roller members of the types illustrated in FIGS. **50** and **51**.

In determining the optimum angular displacement of the axles and caster mounted wheels, it will be understood that the length of the longitudinal slots provide a practical limitation on the angle of the axle, while the caster axles can provide a greater angular displacement for the wheels. The angular displacement of the coaster wheel axles can be up from 20 degrees to 45 degrees from the normal and are preferably up to 10 degrees, the most preferred being up to about 5 degrees from the zero, or normal line.

Auto-Reversal Sequence

One embodiment of the apparatus and method of the invention addresses problems associated with the immobilization of the cleaner. The electronic control means of the pool cleaner is programmed and provided with electrical circuits to receive a signal from at least one mercury switch of the type which opens and closes a circuit in response to the cleaner's movement from a generally horizontal position to a generally vertical position on the sidewall of the pool or tank. The use of mercury switches and a delay circuit to reverse the direction of the motor is well-known in the art. As will be understood by one of ordinary skill in the art, a pool cleaner can become immobilized by a projecting ladder or other structural feature in the pool so that its continuing progress or scanning to clean the remaining pool surfaces is interrupted. In accordance with the improvement of the invention, the electronic controller circuit for the motor is preprogrammed to reverse the direction of the motor automatically if no signal has been generated by the opening (or closing) of the mercury switch after a prescribed period of time. A suitable period of time for the auto-reversal of the pump or drive motor is about three minutes.

This sequence of program steps is schematically illustrated in the flow chart of FIG. **52**, where the time clock begins to count-down a prescribed time period after the cleaner is activated. In a preferred embodiment, the timer can be manually set to reflect the user's particular pool requirements. Alternatively, the time clock can be factory-set for a period of from about 1.5 to 3 minutes. If the mercury switch changes position the time clock stops its count-down and/or a delay circuit is activated to allow time for the cleaner to climb the sidewall of the pool, e.g., about 5-10 seconds. At the end of the delay period, the drive motor is stopped and/or reversed to move the cleaner down the wall. In the event the timer reaches the prescribed time period without receiving a signal from the mercury switch, a signal is transmitted to stop and/or reverse to drive motor. If the cleaner has been immobilized by an obstacle, this timed auto-reversing of the drive motor will move the cleaner away from the obstacle to resume its scanning or random motion cleaning pattern.

Power Shut-Off

The method and apparatus of the invention also comprehends the use of a power shut-off circuit that is responsive to a signal or force that corresponds to a magnetic field. In one preferred embodiment, a magnet or magnetic material is formed as, incorporated in, or attached to a movable element that forms part of the cleaner, e.g., a non-driven supporting wheel or an auxiliary wheel that is in contact with the pool surface on which the cleaner is moving. One suitable device is a reed switch that is maintained in a closed position (e.g., passing power to the pump motor) so long as the adjacent magnet is moving past at a specified rotational speed, or rpm. If the rotation of the magnet stops, as when the cleaner's advance is stopped by encountering a sidewall of the pool, the reed switch opens and the power to the drive motor is interrupted. In a preferred embodiment, the circuit includes a reversing function so that the cleaner resumes movement in the opposite direction and the reed switch is closed to complete the power circuit until the unit again stops, e.g., at the opposite wall.

In a further specific and preferred embodiment of the invention, the cleaner is provided with an impeller that is rotatable in response to movement through the water. One or more of the impeller blades and/or mounting shaft is provided with or formed from a magnetic material. A sensor is mounted proximate the path of the moving magnet and an associated circuit is responsive to the signal generated by the sensor due to the movement, or absence of movement, of the magnet. In one preferred embodiment, the magnetic sensor circuit is incorporated in the cleaner IC device that electronically controls the pump motor, so that when the cleaner's movement is halted by a vertical side wall, the movement of the impeller and associated magnetic material also ceases and the sensor sends a signal through the circuit to interrupt power to the pump motor. After a predetermined delay period, the pump motor can be reactivated, in either the same or the reverse direction, to cause the unit to move away from the wall. The same circuit can be employed to control a drive motor that propels the drive train for wheel, track or roller mounted cleaners.

In another embodiment, the cleaner is provided with an infrared ("IR") light device that includes an IR source and sensor and related control circuit that is responsive to a static position of the cleaner adjacent a side wall of the pool or tank.

When the returned IR light indicates a static position the circuit transmits a signal that results in the reverse movement of the cleaner.

In a further preferred embodiment, the electric or electronic controller circuit of the cleaner includes an "air sensor" switch that sends a signal or otherwise directly or indirectly interrupts the flow of water stream W when the sensor emerges from the water. In one preferred embodiment the sensor is a pair of float switches, one located at either end of the cleaner. When the cleaner climbs the vertical sidewall of the pool, and the end with the air sensor emerges from the water line, water drains from the float chamber and the switch is activated to either directly interrupt the flow of electrical power to the pump motor, or to send a signal to the IC controller to effect the immediate or delay interruption of power to the pump motor. The same sequence of events occurs during operation of an in-ground pool of the "beach" type design, where one end has a sloping bottom or side that starts at ground level. Once the forward end of the moving cleaner emerges from the water, the flow of water is interrupted for a brief time and then resumed in the opposite direction to propel the unit down the slope to continue its scanning pattern.

As will be understood from the preceding description and from that which follows, this aspect of the invention comprehends various alternative means for interrupting the flow of the water jet. For example, if the pressurized water stream is delivered via hose **152** from a source external to the cleaner, e.g., the pool's built-in filter pump, an electro-mechanical bypass valve (not shown) located adjacent the hose fitting at the sidewall of the pool can be activated for a predetermined period of time to divert the flow of water from the hose directly into the pool. When the flow of water W is interrupted, the flap valve **46** of valve assembly **40** changes position and the cleaner reverses direction when the flow W is resumed.

As will be understood by one of ordinary skill in the art, the means of generating signals directed to the control circuit can also be combined. For example, an air sensor of the float type can be combined with, or fabricated from a magnetic material and installed proximate a magnetic sensor so that a change in position of the float when it is no longer immersed in water produces a signal in the magnetic sensor circuit.

The flow of water W can also be interrupted by a water-driven turbine timer having a plurality of pre-set or adjustable timing sequences. For example, a water-powered cam or step-type timer in combination with a by-pass or diverter valve located downstream is installed on the hose **152** from the external source of pressurized water. As water flows through the hose, the timer mechanism is advanced to a position at which the associated by-pass valve is actuated and the flow is diverted into the pool for a predetermined period of time. The turbine timer then advances to the next position at which the by-pass valve moves to the main flow position to redirect water to the cleaner, which now moves in the opposite direction. In this embodiment, the by-pass/diverter valve can comprise an adjustable pinch valve that compresses the hose to interrupt flow to cleaner **10**.

In another preferred embodiment, the rpms of the pump and/or drive motor are monitored and if the rpm decreases below a certain minimum, as when the impeller is jammed by a piece of debris that escaped the filter, the power to the pump motor is interrupted. If the rpms exceed a maximum, as when the unit is no longer submerged and the motor is running under a no-load condition, the power is interrupted to both pump and drive motors. This will constitute an important safety feature, where the cleaner is turned on while it is not in the pool, either by inadvertence, or by small children playing with the unit.

We claim:

1. A self-propelled cleaning apparatus for cleaning a submerged surface of a pool or tank, comprising:

a housing having a front portion as defined by the direction of movement of the apparatus when propelled by a water jet, an opposing rear portion and adjoining side portions defining the periphery of the apparatus, and a baseplate with at least one water inlet;

rotationally-mounted supports coupled proximate the front and rear portions of the housing to enable movement of said apparatus over the submerged surface;

a water pump mounted in the interior of said housing, said water pump being configured to draw water and debris from the pool or tank through the at least one water inlet for filtering; and

a stationary directional discharge conduit in fluid communication with the water pump and having at least one discharge opening through which a pressurized stream of water forming the water jet is directionally discharged at a predetermined angle that is acute with respect the surface over which the apparatus is moving.

2. The apparatus of claim **1** in which the discharge conduit is linear in shape.

3. The apparatus of claim **1**, wherein a portion of the discharge conduit terminating in the at least one discharge opening is fixed at a predetermined upward angle with respect to the surface over which the apparatus is moving, wherein the water jet discharged produces a resultant force vector that crosses a plane passing through between the axes of rotation of the front and rear rotationally-mounted supports.

4. The apparatus of claim **3** in which the resultant force vector crosses the plane proximate the axis of rotation of the supports mounted proximately the front of the apparatus.

5. The apparatus of claim **3**, wherein the resultant force vector discharged from said discharge opening includes a longitudinal force vector component and a vertical force vector component, said longitudinal force vector component being aligned with the longitudinal axis of the apparatus and being greater than the vertical force vector component.

6. The apparatus of claim **1**, wherein the discharge conduit has at least two discharge openings, each of which discharge openings is located at opposite ends of the discharge conduit and each of which discharge openings is configured to produce a downwardly directed resultant force vector in the respective discharged water jet, the resultant vector having a longitudinal force vector component that is larger than the vertical force vector component.

7. The apparatus of claim **1**, wherein the rotationally-mounted supports comprise first and second pairs of axially mounted wheels respectively positioned proximate the front and rear portions of the housing.

8. The apparatus of claim **7**, wherein a portion of the discharge conduit terminating in the at least one discharge opening is angled upward with respect to an adjacent portion of the discharge conduit to produce a resultant force vector in the water jet discharged from said at least one discharge opening that is directed to pass through the plane of the axis of rotation of the pair of wheels at the front portion of the apparatus.

9. The apparatus of claim **8**, wherein the resultant force vector discharged from said at least one discharge opening includes a longitudinal force vector component and a vertical force vector component, said longitudinal force vector com-

ponent being aligned with the longitudinal axis of the apparatus and being greater than the vertical force vector component.

10. The apparatus of claim **7**, wherein each pair of wheels is mounted on an axle extending transversely across the housing of the apparatus.

11. The apparatus of claim **10**, wherein a portion of discharge conduit adjacent the at least one discharge opening is angled upwardly with respect to the discharge conduit to produce a resultant force vector in the water jet discharged from said at least one discharge opening that is directed to a position that is proximate to, and rearwardly displaced from the axle of the front pair of wheels.

12. The apparatus of claim **10**, wherein a portion of the discharge conduit terminating adjacent the at least one discharge opening is angled upwardly with respect to the discharge conduit to produce a resultant force vector in the water jet discharged that is directed to intersect the axle of the front pair of wheels.

13. The apparatus of claim **1** further comprising at least one filter assembly positioned to filter water from the at least one water inlet prior to its passage through the directional discharge conduit.

14. The apparatus of claim **13**, wherein the at least one filter assembly is mounted within the housing of the cleaning apparatus.

15. The apparatus of claim **13**, wherein the at least one filter assembly is mounted externally from the housing of the cleaning apparatus.

16. The apparatus of claim **1**, wherein water drawn into the at least one water inlet flows through a filter prior to its discharge as the water jet to propel the pool cleaner in a forward direction of movement.

17. The apparatus of claim **1** further comprising a water jet valve located between the pump discharge outlet and the at least one discharge opening in the discharge conduit, the water jet valve being operable between first and second discharge positions to direct the water jet in generally opposite directions.

18. The apparatus of claim **17**, wherein the pressurized water stream discharged from the pump discharge outlet undergoes only one right-angle change of direction before being discharged from the apparatus to move over the submerged surface of the pool in a direction that is determined by the position of the water jet valve.

19. The apparatus of claim **1**, wherein a portion of the discharge conduit terminating in the at least one discharge opening is fixed at a predetermined upward angle with respect to the surface over which the apparatus is moving, wherein the water jet discharged produces a resultant force vector that crosses a plane passing through the axes of rotation of the front rotationally-mounted supports.

20. A self-propelled cleaning apparatus for cleaning a submerged surface of a pool or tank, said apparatus being propelled by the discharge of a water jet, the apparatus comprising:

a housing including a baseplate with at least one water inlet, a front portion, a rear portion and opposing side portions defining the periphery of the apparatus, said front portion being defined with respect to the forward directional movement of the apparatus when propelled by the water jet;

rotationally-mounted supports coupled to the housing to enable movement of said apparatus over the submerged surface;

a water pump mounted in the interior of said housing, said water pump configured to draw water and debris from the pool or tank through the at least one water inlet for filtering, and a pump discharge outlet for emitting a pressurized stream of filtered water;

a directional discharge conduit in fluid communication with the pump discharge outlet, the discharge conduit having at least one discharge opening through which the water jet is directionally discharged from the apparatus at a predetermined angle that is less than normal with respect to the surface beneath the apparatus.

21. A method for cleaning a submerged surface of a pool or tank, comprising the steps of:

providing a self-propelled cleaning apparatus, said cleaning apparatus including a housing having a baseplate with at least one water inlet, and further including a front portion as defined by the direction of movement of the cleaning apparatus when propelled by a water jet, an opposing rear portion and adjoining side portions defining the periphery of the apparatus, rotationally-mounted supports coupled to the housing to enable movement of said apparatus over the submerged surface, a water pump mounted in the interior of said housing, and a directional discharge conduit in fluid communication with the water pump and having at least one discharge opening;

activating the water pump to draw water and debris from the pool or tank through the at least one water inlet;

filtering the water drawn into the housing;

discharging the filtered water through the directional discharge conduit at an acute angle with respect to the surface over which the apparatus is moving, said discharged filtered water forming a water jet having a resultant force vector acutely angled towards the surface beneath the apparatus; and

propelling the apparatus in a forward direction of movement.

* * * * *

UNITED STATES PATENT AND TRADEMARK OFFICE

CERTIFICATE OF CORRECTION

PATENT NO.	: 8,273,183 B2
APPLICATION NO.	: 13/135684
DATED	: September 25, 2012
INVENTOR(S)	: Erlich et al.

It is certified that error appears in the above-identified patent and that said Letters Patent is hereby corrected as shown below:

Claim 1, Column 24, Line 24, after "respect" insert --to--.

Signed and Sealed this
Twenty-fifth Day of December, 2012

David J. Kappos

David J. Kappos
Director of the United States Patent and Trademark Office

CERTIFICATE OF SERVICE

I certify that on March 17, 2015, this CORRECTED BRIEF FOR APPELLANT AQUA PRODUCTS, INCORPORATED was filed electronically using the CM/ECF system and served via the CM/ECF system on counsel for the Appellee, Zodiac Pool Systems, Inc., as follows:

Christopher D. Bright
Daniel R. Foster
McDermott Will & Emery LLP
4 Park Plaza, Suite 1700
Irvine, California 92614

/s/ John W. Kozikowski
Litigation Legal Assistant
Finnegan, Henderson, Farabow,
Garrett & Dunner, LLP

CERTIFICATE OF COMPLIANCE

I certify that this BRIEF FOR APPELLANT AQUA PRODUCTS, INCORPORATED contains 12,724 words as measured by the word-processing software used to prepare this brief.

/s/ James R. Barney