UNITED STATES PATENT AND TRADEMARK OFFICE

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BEFORE THE PATENT TRIAL AND APPEAL BOARD

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BEATBOT TECHNOLOGY (USA) CO. LTD.,
Petitioner,

v.

ZODIAC POOL SYSTEMS LLC,
Patent Owner.

_____

PTAB Case No. IPR2026-00200
U.S. Patent No. 11,262,766 B2

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PETITION FOR *INTER PARTES* REVIEW OF U.S. PATENT NO. 11,262,766 B2

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EXHIBIT LIST

No.	Exhibit
1001	U.S. Patent No. 11,262,766 B2 ("'766 Patent")
1002	File History of the '766 Patent
1003	Declaration of Jason Janét, Ph.D. ("Janét")
1004	Curriculum Vitae of Jason Janét, Ph.D.
1005	Chinese Publication No. CN1540119A ("Cui")
1006	German Publication No. DE102007053310A1 ("Knoll")
1007	Chinese Publication No. CN101139007A ("Fu-007")
1008	U.S. Patent No. 3,321,787 ("Myers")
1009	U.S. Patent No. 4,168,557 ("Rasch")
1010	Jonathan Horgan & Daniel Toal, Review of Machine Vision Applications in Unmanned Underwater Vehicles, Proc. 9th Int'l Conf. on Control, Automation, Robotics and Vision 1 (2006)
1011	Prosecution History of U.S. Patent No. 9,388,595
1012	Prosecution History of U.S. Patent No. 10,338,599
1013	U.S. Patent No. 9995051 B2
1014	U.S. Publication 20140015959A1 ("Durvasula")
1015	Chinese Publication No. CN101481957A ("Fu-957")
1016	U.S. Publication No. 20060053572A1 ("Porat")
1017	U.S. Publication No. 20140263087A1 ("Renaud")

LISTING OF CHALLENGED CLAIMS

U.S. Patent No. 11,262,766 B2
Claim 1
1[pre] A self-propelled pool cleaner for cleaning debris from a submerged surface of a swimming pool, comprising:
1[a] a. a vehicle body;
1[b] b. means for moving the vehicle body within the swimming pool;
1[c] c. a filter configured to retain debris collected from the submerged surface;
1[d] d. at least one camera mounted directly or indirectly to the body for capturing an image of at least a first portion of the submerged surface; and
1[e][i] e. a controller (i) positioned on or in the body,
1[e][ii] (ii) in electronic communication with the at least one camera, and
1[e][iii] (iii) configured to generate, in response to the captured image, at least one control signal to cause movement of the body within the swimming pool to, or away from, the first portion of the submerged surface.
Claim 2
2[pre] A self-propelled pool cleaner for cleaning debris from a submerged surface of a swimming pool, comprising:
2[a] a. a vehicle body;
2[b] b. means for moving the vehicle body within the swimming pool;
2[c] c. a filter configured to retain debris collected from the submerged surface;

2[d] d. at least one camera carried by the body for capturing an image of at least a first portion of the submerged surface; and
2[e][i] e. a controller (i) positioned on or in the body,
2[e][ii] (ii) in electronic communication with the at least one camera, and
2[e][iii] (iii) configured to generate, in response to the captured image, at least one control signal to cause movement of the body within the swimming pool to, or away from, the first portion of the submerged surface.
Claim 3
3[pre] A self-propelled pool cleaner for cleaning debris from a submerged surface of a swimming pool, comprising:
3[a] a. a vehicle body;
3[b] b. means for moving the vehicle body within the swimming pool;
3[c] c. a filter configured to retain debris collected from the submerged surface;
3[d] d. at least one camera positioned on or in, or carried by, the body for capturing an image of at least a first portion of the submerged surface; and
3[e][i] e. a controller (i) positioned on or in the body,
3[e][ii] (ii) in electronic communication with the at least one camera and a portable electronic device, and
3[e][iii] (iii) configured to generate, in response to at least one of the captured image or information from the portable electronic device, at least one control signal to cause movement of the body within the swimming pool to, or away from, the first portion of the submerged surface.
Claim 4
4[pre] A self-propelled pool cleaner for cleaning debris from a submerged surface of a swimming pool, comprising:

4[a] a. a vehicle body;
4[b] b. means for moving the vehicle body within the swimming pool;
4[c] c. a filter configured to retain debris collected from the submerged surface;
4[d] d. at least one camera for capturing an image of at least a first portion of the submerged surface; and
4[e][i] e. a controller (i) positioned on or in the body,
4[e][ii] (ii) in electronic communication with the at least one camera, and
4[e][iii] (iii) configured to generate, in response to the captured image, at least one control signal to cause movement of the body within the swimming pool to, or away from, the first portion of the submerged surface.
Claim 5
5[pre] A self-propelled pool cleaner for cleaning debris from a submerged surface of a swimming pool, comprising:
5[a] a. a vehicle body;
5[b] b. means for moving the vehicle body within the swimming pool;
5[c] c. a filter configured to retain debris collected from the submerged surface;
5[d] d. a chemical dispenser on, in, or carried by the vehicle body;
5[e] e. at least one camera on, in, or carried by the vehicle body, for capturing an image of at least a first portion of the submerged surface; and
5[f][i] f. a controller (i) on, in, or carried by the vehicle body,
5[f][ii] (ii) in electronic communication with the at least one camera and

5[f][iii] (iii) configured to generate, in response to the captured image, at least one control signal to cause movement of the body within the swimming pool to, or away from, the first portion of the submerged surface.

I. INTRODUCTION

Petitioner requests *inter partes review* ("IPR") of Claims 1-5 ("Challenged Claims") of U.S. Patent No. 11,262,766 B2 ("'766 Patent, EX1001).

II. IPR Requirements

A. Standing

The '766 Patent is available for IPR, and Petitioner is not barred or estopped from requesting IPR.

B. Challenged claims and relief requested

Petitioner respectfully requests cancellation of Claims 1-5 under 35 U.S.C.§103.

1. Prior art

Petitioner relies on prior art under pre-AIA 35 U.S.C.§102(b) or AIA 35 U.S.C.§102(a)(1) listed in the Table of Exhibits and declaration of Dr. Jason Janét, (EX1003, "Janét"). Specific invalidity grounds are listed in the table below.

Grounds under 35 U.S.C.§103	Claims	Prior Art
1	1-5	Durvasula and Fu-007
2A	1-4	Cui and Fu-007
2B	5	Cui, Fu-007, and Porat
3A	1-2, 4	Knoll
3B	3	Knoll and Fu-957
3C	5	Knoll and Porat
4A	1-4	Renaud
4B	5	Renaud and Durvasula

III. ’766 Patent

A. Overview

The ’766 Patent describes a pool cleaning system with one or more cameras for autonomous cleaning of a pool. EX1001, 2:62-3:53. The disclosed system includes **cameras 32** that capture images of swimming pool 22, a **controller 42** that analyzes the images and generates control responses for operating a pool cleaning vehicle 30. *Id.*, 2:62-5:7, 3:44-5:8; 8:24-9:56, FIG. 1 (annotated below).

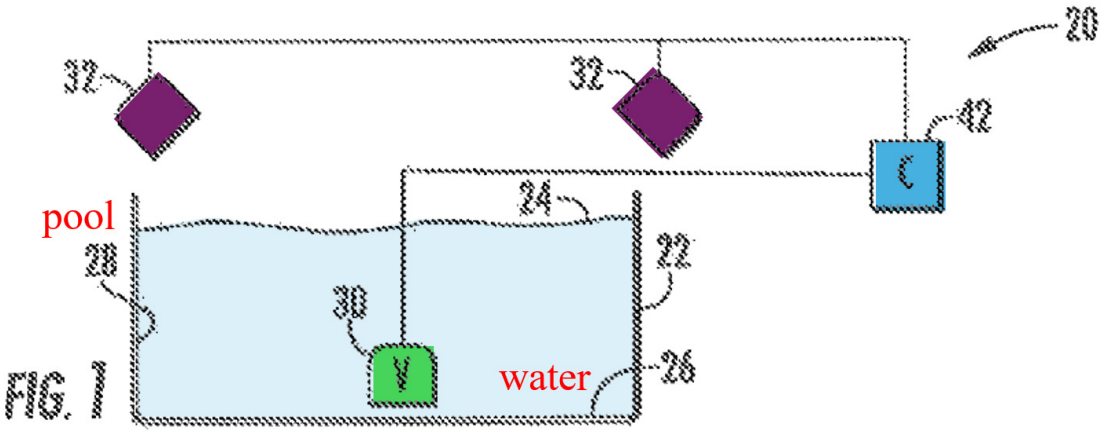


FIG. 1

The cleaning device (vehicle 30) has a body, a **drive system** for moving the body within the pool, and cleaning **brushes**. *Id.*, 3:5-43; 10:8-27, FIG. 10 (annotated below).

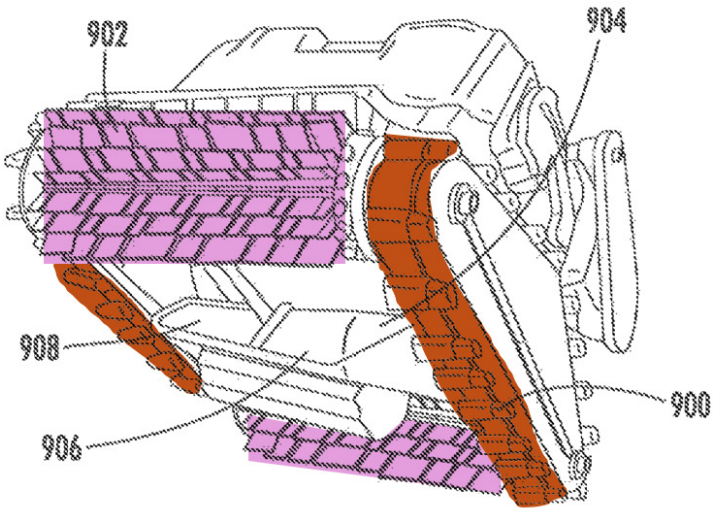


FIG. 10

Controller 42 is located in **dry station 246** outside pool 22, connected to **cameras 32**, and configured to generate control signals to cause movement of **vehicle 830**. *Id.*, 9:57-10:7; FIG.9 (annotated below). These control signals are transmitted from dry station 246 to vehicle 830. *Id.*

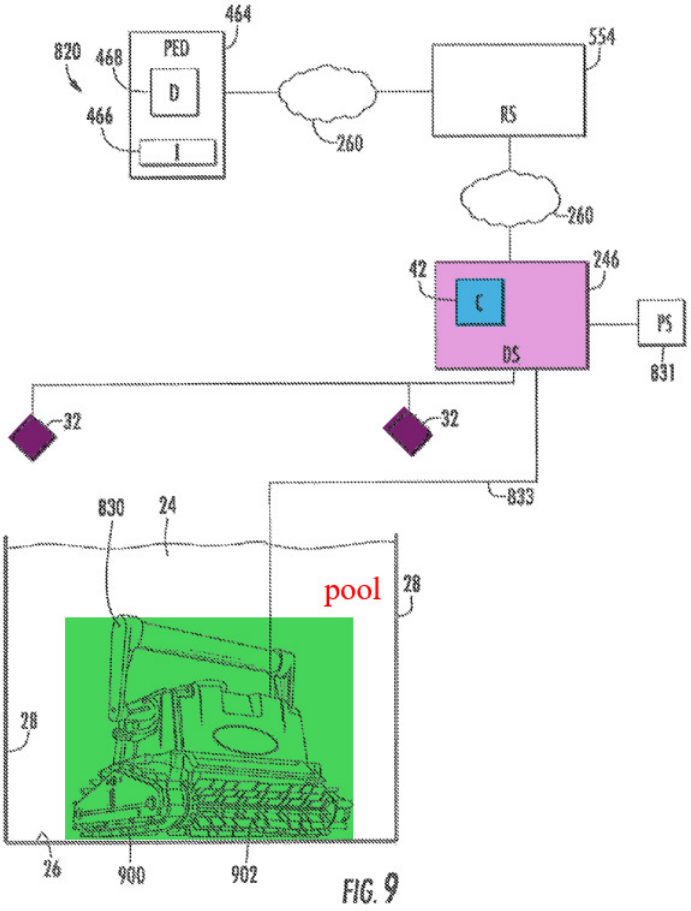


FIG. 9

B. Prosecution History

The '766 Patent issued from U.S. Application 17/143,624 ("'624 Application"), and purported to claim priority to U.S. Application No. 13/545,918 ("'918 Application") filed July 10, 2012, through a series of intermediate applications. EX1001, fields (21), (63).

Applicant filed a preliminary amendment cancelling original claims 1-19 and adding new independent claims 20-24. EX1002, pp.40-42. No prior art rejections were raised against claims 20-24; the sole issue raised was a non-statutory double patenting rejection which was overcome via a terminal disclaimer.

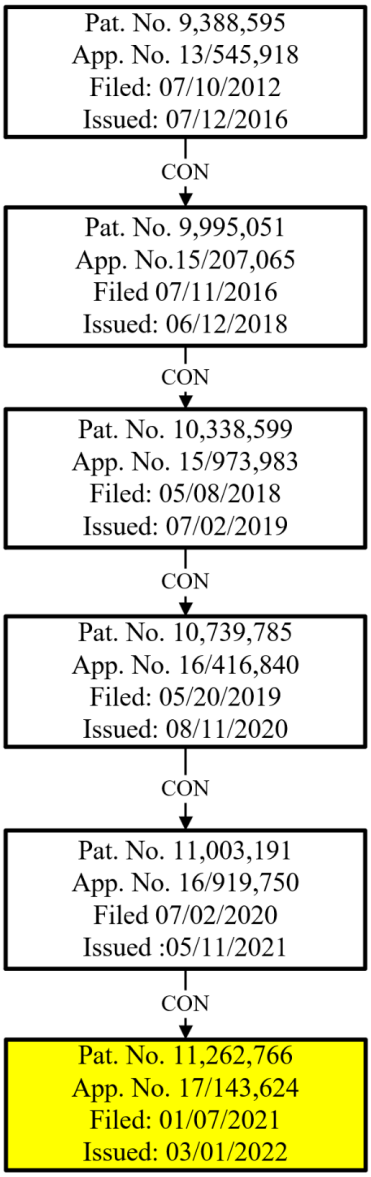
Id., 70-86, 116-118. Application claims 20-24 were issued as Claims 1-5 of the '766 Patent. *Id.*, 132-138.

Fu-007 (EX1007) was cited in an Information Disclosure Statement (IDS) (EX1002, pp.57, 93) but was not used as a basis for claim rejections or otherwise discussed during the prosecution. Fu-007 is not cumulative over the examination, because Fu-007 is used here in combination with other references, and the Examiner lacked expert testimony regarding Fu-007 combined with other references.

C. '766 PATENT'S PRIORITY DATE

The Board can consider the challenged claims' priority date. *Parus Holdings v. Google,* 70 F.4th 1365, 1373-74 (Fed. Cir. 2023). A priority claim to an earlier application is valid **only if** the earlier application, *inter alia*, provides description for the claims pursuant to 35 U.S.C.§112(a) or pre-AIA 35 U.S.C.§112¶1 under 35 U.S.C.§120. *Parus*, 70 F.4th at 1373-74; *Anascape v. Nintendo of America*, 601 F.3d 1333, 1334-35 (Fed. Cir. 2010).

The '766 Patent claims priority through a series of intermediate applications as shown by the patent family tree below:



The ’766 Patent’s priority chain includes the ’918 Application (filed July 10, 2012), which is subject to pre-AIA 35 U.S.C.§§102-103. The remaining applications are subject to AIA 35 U.S.C.§§102-103.

35 U.S.C.§120 requires an invention claimed in a later filed application be “disclosed in the manner provided by section 112(a) (other than the requirement to disclose the best mode) in an application previously filed in the United States,” to

claim priority to the earlier filed application. Thus, the disclosure in the earlier filed application must meet both the written description and enablement requirements under 35 U.S.C.§112(a). *Chiron v. Genentech*, 363 F.3d 1247, 1253 (Fed. Cir. 2004).

Under the written description requirement, the specification must "reasonably convey[] to the artisan that the inventor had possession at that time of the later claimed subject matter." *Vas-Cath v. Mahurkar*, 935 F.2d 1555, 1563 (Fed Cir. 1991). The specification demonstrates such possession by describing the claimed invention and all of its limitations. *Ariad Pharms. v. Eli Lilly*, 598 F.3d 1336, 1352 (Fed. Cir. 2010) (en banc) (citation omitted).

The '766 Patent includes five independent Claims 1-5. Representative Claim 1 recites "a controller (i) **positioned on or in the body**…(iii) configured to generate, **in response to the captured image**, at least one control signal to **cause movement of the body** within the swimming pool to, or **away from**, the first portion of the submerged surface."[1] EX001, 10:57, 59-62. Claims 2-5 recite similar limitations. *Id.*, 11:6-11, 22-29, 12:7-13, 26-31. However, as explained below, the '918 Application contains no disclosure of the above-identified claim

[1] All **bold**, *italic*, or colored emphases are added by Petitioner unless otherwise specified.

limitations. Accordingly, under 35 U.S.C.§120, Claims 1-5 of the '766 Patent are not entitled to the benefit of the July 10, 2012 filing date of the '918 Application.

Moreover, the specification also fails to satisfy the enablement requirement under 35 U.S.C.§112(a) for Claims 1-5. "It is the specification, not the knowledge of one skilled in the art, that must supply the novel aspects of an invention in order to constitute adequate enablement." *Genentech v. Novo Nordisk*, 108 F.3d 1361, 1366 (Fed. Cir. 1997). Here, the specification is entirely silent as to the above-identified claim limitations; thus, it fails to teach how to make and use an invention encompassing those features, and the knowledge of skilled artisans cannot fill this void. This provides another reason as to why Claims 1-5 are not entitled to the alleged July 10, 2012 priority date.

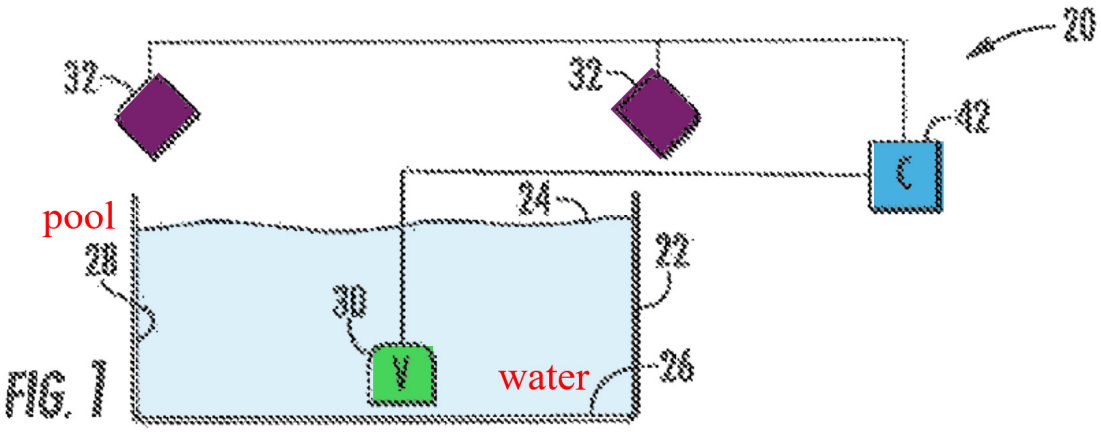
Therefore, the priority of Claims 1-5 can be no earlier than July 11, 2016, the filing date of the '918 Application's next immediate child application No. 15/207,065 (EX1013, field (22)), and Claims 1-5 are subject to AIA 35 U.S.C. §§102-103. Janet, ¶¶70-92.

1. The '918 Application does not disclose "a controller...positioned on or in the body"

The '918 Application fails to describe that its controller "positioned on or in the body," as recited in Claim 1 and similarly recited in Claims 2-5 of the '766 Patent. The '918 Application consistently describes, in its specification, drawings,

and claims, that a controller is located **outside the pool**, physically **remote** from the vehicle body inside the pool. The controller is not submerged, not collocated with the vehicle, and does not travel with the vehicle; it is connected to the vehicle through a wired or wireless communication link. EX1011, pp.23-28, 32. Therefore, the disclosed controller is **physically separated and remote from the vehicle** and does not teach a controller **on or in** the vehicle body. Janet, ¶¶81-86.

FIG. 1 of the '918 Application (annotated below) illustrates an embodiment where **controller 42** is located ***outside*** pool 22 and ***remote from*** **vehicle 30**. EX1011, p.38. Janet, ¶82.



FIGS. 2, 4, and 9 (annotated below) show embodiments where **controller 42** is part of **dry station 46/246** and/or **portable electronic device 464**, which are located ***outside*** pool 22 and ***remote from*** **vehicle 30/830**. EX1011, pp.24-25, 27-28, 32, 34, 38, 40. Janet, ¶83.

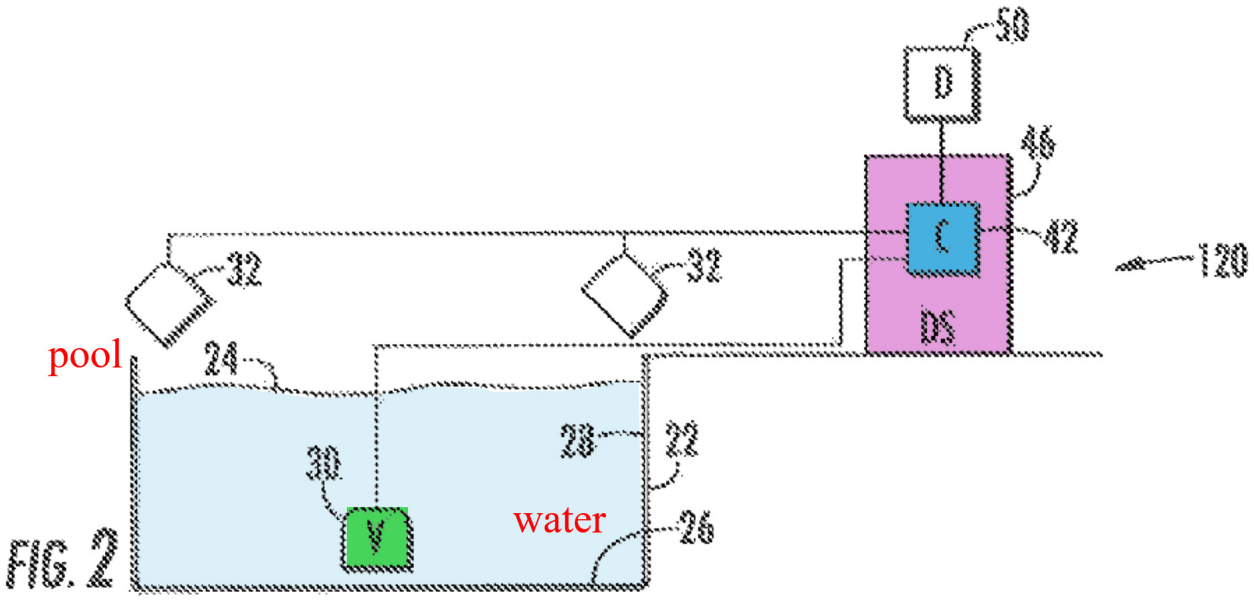

50
D
46
C
42
120
32
32
DS
pool
24
28
22
30
V
water
26

FIG. 2

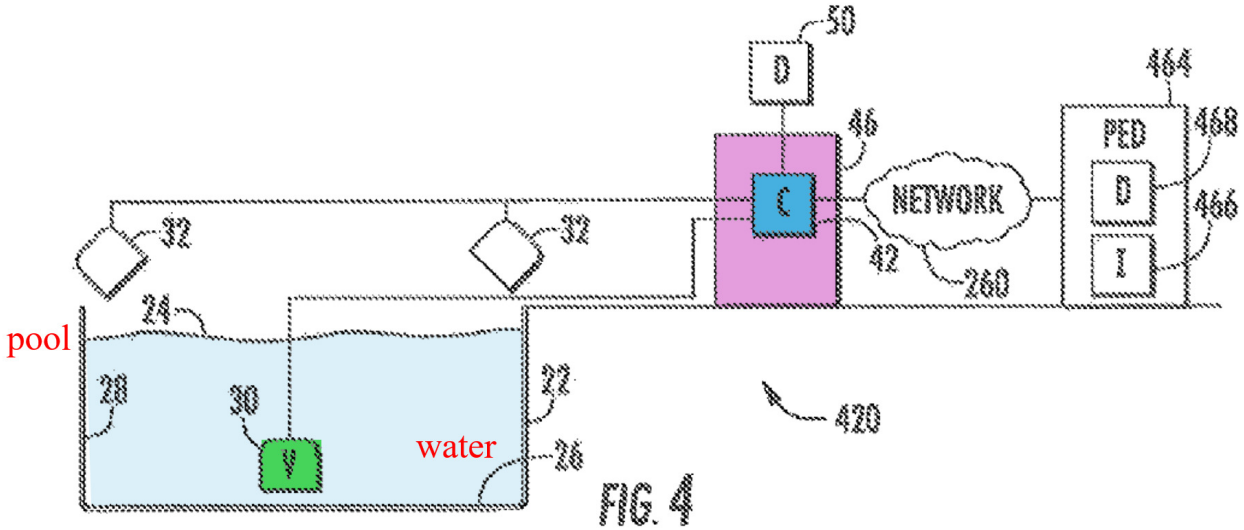

50
D
464
46
PED
468
C
NETWORK
D
466
32
32
42
260
I
24
pool
28
30
22
V
water
26
420

FIG. 4

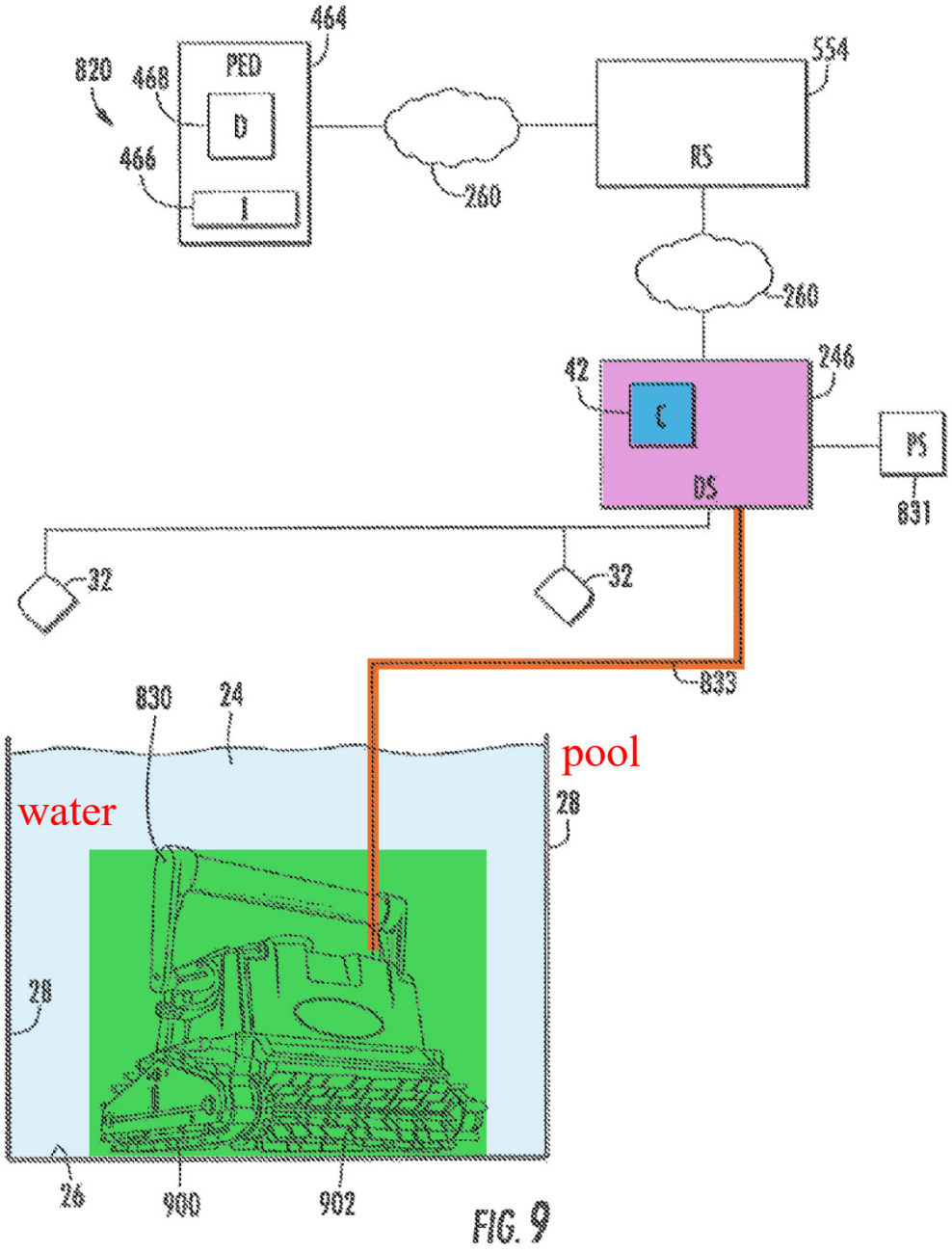


FIG. 9

Similarly, FIGS. 3 and 5 (annotated below) illustrate embodiments where **controller 42** is part of ***remote* server 254/554 *outside*** pool 22 and ***remote from* vehicle 30**. EX1011, pp. 26, 28-29, 32, 35, 38-39. **Controller 42** transmits control signals to the vehicle through **dry station 246** across **network 260**. *Id.* Other parts

of the '918 Application also describe its controller as a ***remote*** component from the vehicle and as being ***located outside the pool***. EX1011, pp. 38-40 (FIGS. 1-5, 9), 21-29, 32-35 (descriptions of FIGS. 1-5, 9), Claims 2-4, 10. The '918 Application, however, does not describe or suggest positioning the "controller...on or in the [vehicle] body." Janet, ¶84.

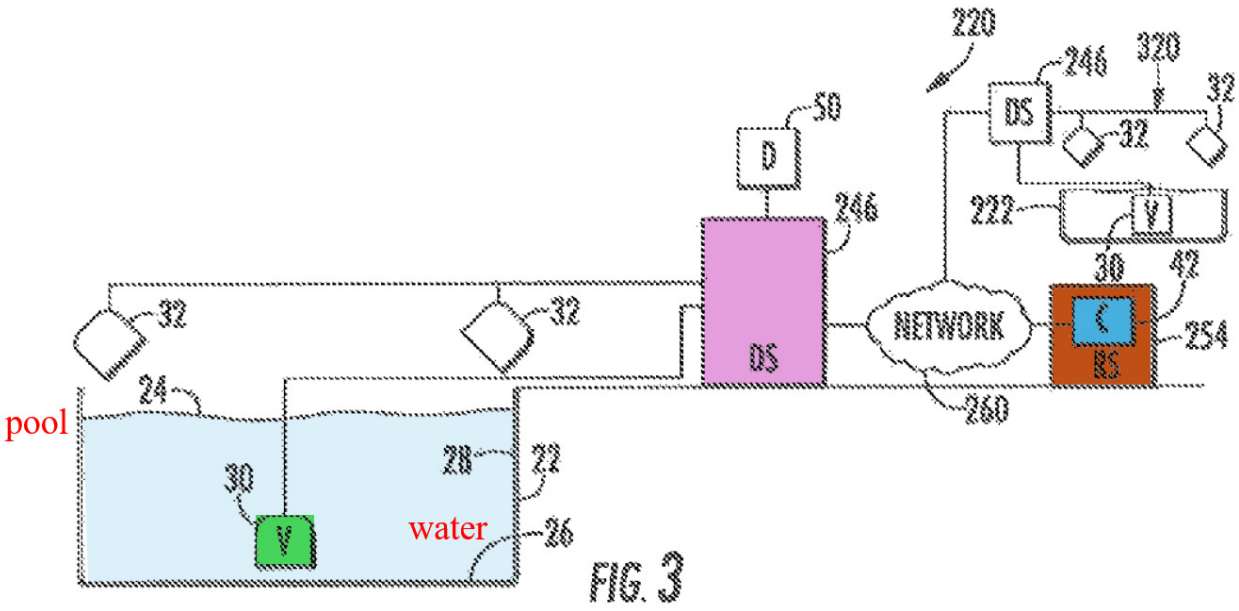


FIG. 3

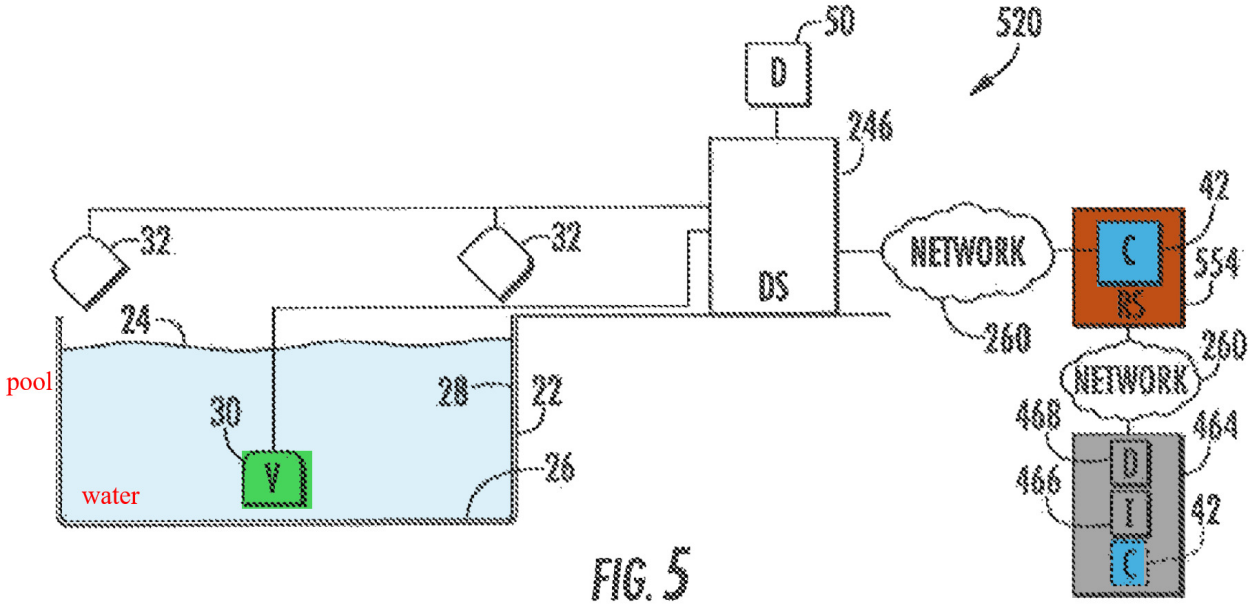


FIG. 5

The written description requirement mandates that "the specification must show the inventor actually invented the invention claimed." *Ariad Pharms.*, 598 F.3d at 1351. "One shows that one is 'in possession' of the invention by describing the invention, with all its claimed limitations, not that which makes it obvious." *Lockwood*, 107 F.3d at 1572. As explained above, the '918 Application does **not** provide written description support for the claimed limitation of "a controller…on or in the body" and further fails to meet the enablement requirement for this limitation. Accordingly, Claim 1 of the '766 Patent, as well as Claims 2-5—each reciting a limitation identical or substantially similar to the above-discussed "controller" limitation—is **not** entitled to the July 10, 2012 filing date of the '918 Application. Janét, ¶¶85-86.

2. The '918 Application does not disclose "caus[ing] movement of the body…away from…the first portion of the submerged surface"

Independently, the '918 Application fails to describe that its controller is configured to "generate, in response to the captured image, at least one control signal to cause movement of the body…***away from***…the first portion of the submerged surface," as recited in Claim 1 and similarly recited in Claims 2-5 of the '766 Patent. Janét, ¶¶87-91.

The '918 Application describes controller 42 generating control signals, in response to images captured by camera 32, to steer vehicle 30 ***to*** portions of the pool requiring cleaning or re-cleaning. For example, the '918 Application discloses that "[u]pon identifying a missed spot, controller 42 utilizes signals from camera 32 **to steer vehicle 32 [sic] cover such missed portions** of surfaces 26, 28." EX1011, p.24; *id.*, p.25 ("steer[ing] vehicle 30 back **to** such identified portions"), pp.31-32 ("steering vehicle 30 **to** re-clean portions of pool 22"; "steered back **to** such portions 638.").

These disclosures of the '918 Application, however, are limited to directing vehicle 30 **to** areas requiring cleaning. EX1011, pp.24-25, 31-32. Janet, ¶¶88-90. Notably absent is any disclosure of generating a control signal, **in response to captured images** of a portion of the submerged surface, to cause the vehicle to ***move away*** from the portion. Janét, ¶91.

Therefore, the '918 Application does not provide written description support for the limitation of the controller configured to "generate, **in response to the captured image**, at least one control signal to cause movement of the body…**away from**…the first portion of the submerged surface," and further fails to meet the enablement requirement for this limitation. Accordingly, Claims 1-5—each reciting a limitation identical or substantially similar to this limitation—are not entitled to the July 10, 2012 filing date of the '918 Application. Janét, ¶91.

In sum, because the '918 Application lacks written description support and fails to meet the enablement requirement, for the "on or in the body" and "away from" limitations, Claims 1-5 are not entitled to the July 10, 2012 filing date of the '918 Application. Instead, Claims 1-5 of the '766 Patent are entitled to a priority date no earlier than the filing date of the next application in the chain—July 11, 2016 for Application No. 15/207,065.[2] Janét, ¶¶28, 92; EX1013, field (22).

D. Level of Ordinary Skill

For the purposes of this Petition, a person of ordinary skill in the art (POSITA) would have had a bachelor's degree in electrical engineering,

[2] Petitioner reserves the right to challenge Patent Owner's entitlement to the July 11, 2016 filing date of App. No. 15/207,065 (and any later-claimed priority).

mechanical engineering, physics, or computer engineering, with at least two years' experience in autonomous camera-based robotic cleaning systems. Janét, ¶30.

E. Claim Construction

For determining invalidity in this Petition, Petitioner believes no constructions are necessary except for the means-plus-function (MPF) limitation "means for moving the vehicle body" in Claims 1-5.

When a claim limitation uses "means" or "module" and recites an associated function, the limitation is presumably an MPF term and be construed as such to cover the corresponding structure, material, or acts described in the specification and equivalents thereof. 35 U.S.C.§ 112(f) or 112¶6; MPEP §2181; *TriMedv. Stryker*, 514 F.3d 1256, 1259-60 (Fed. Cir. 2008).

Claims 1-5 each recite a claim limitation "*means for moving*…." and recites a claimed function of "moving the vehicle body within the swimming pool." The corresponding structure described in the '766 Patent includes wheels, rollers, tracks, or other surface contacting members powered by a motor and the like, a toothed track drive that provides traction and propulsion for vehicle, or a vacuum or liquid jet. EX1001, 3:31-43, 10:12-14, FIGS. 9-10; Janét, ¶95.

The above described structures in the specification of the '766 Patent are the corresponding structures for the "means for moving the vehicle body." Janét, ¶96.

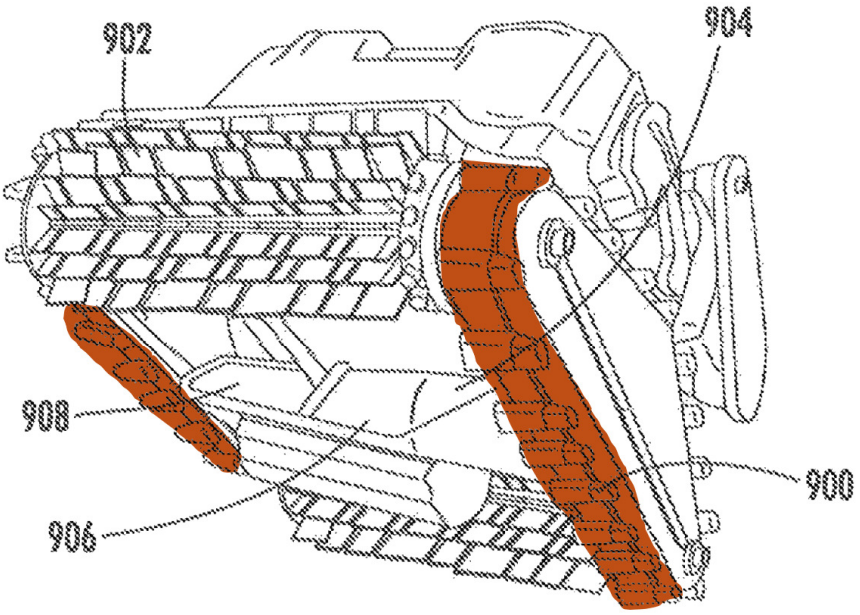


FIG. 10

IV. INVALIDITY GROUNDS

A. Ground 1: Claims 1-5 Unpatentable over Durvasula with Fu-007

1. Durvasula

Durvasula (EX1014) is U.S. Patent Application Publication No. US20140015959A1 of Patent Owner's '918 Application published on January 16, 2014. Durvasula is prior art under AIA 35 U.S.C.§102(a)(1) and pre-AIA 35 U.S.C.§102(b).

Durvasula discloses a pool cleaning system and contains technical features that are identical or similar to those of the '766 Patent and is analogous art. Janét, ¶¶97-98.

2. Fu-007

Fu-007 (EX1007) is prior art under AIA 35 U.S.C.§102(a)(1) and pre-AIA 35 U.S.C.§102(b). Janét, ¶99.

Fu-007 discloses an underwater cleaning robot for swimming pools using camera-based control. Fu-007, Abstract, pp.8-10[3], 14-16, Claims 1, 4. Fu-007 is analogous art. Janét, ¶100.

Fu-007's robot includes a control system with a central processing unit housed in **control system enclosure 8**, which housed within a sealed drive control enclosure, which is "installed on...the interior of the **robot main shell 19**...to sealingly enclose the control system components" and "has waterproof properties." Fu-007, pp.8-9, 12-14, Claim 4, FIGS. 1-2, 4 (annotated below).

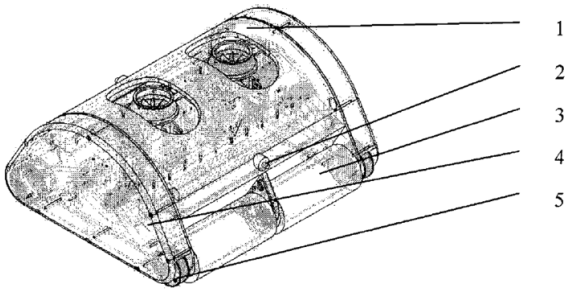


FIG. 1

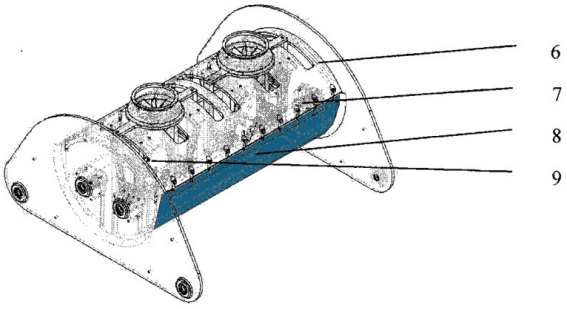


FIG. 2

[3] Page citations to Fu-007 are to the original pagination in the bottom center of each page.

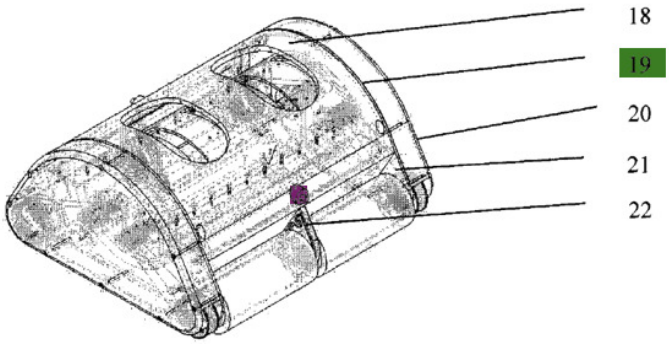


FIG. 4

Fu-007's robot also includes **monitoring camera 2** connected to the **central processing unit**. Fu-007, pp.8-9, 12-14, Claim 4, FIGS. 1, 6 (annotated below).

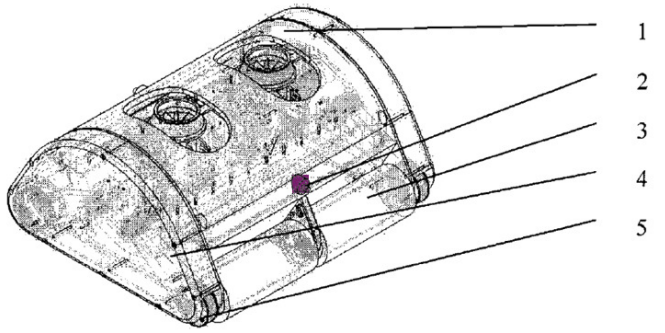


FIG. 1

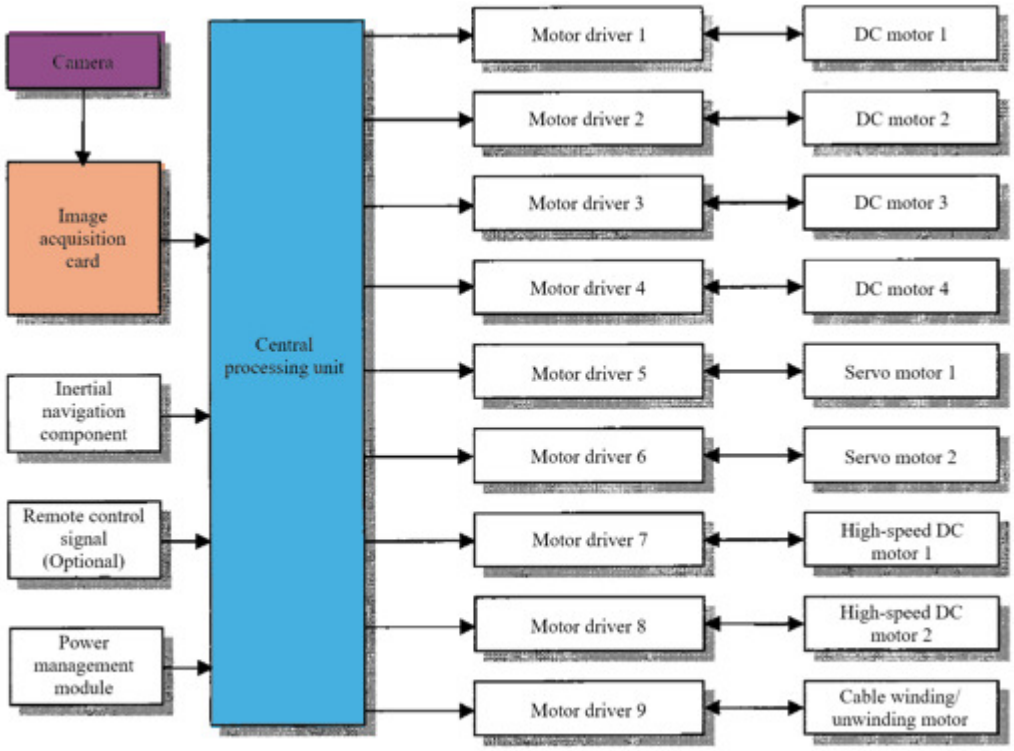


FIG. 6

3. Motivation to Combine

Both Durvasula and Fu-007 disclose underwater cleaning robots for pools using camera-based control, and both sought to improve autonomous pool cleaning. Janet, ¶105. Durvasula describes vehicle 30 as "an automated powered device" that autonomously cleans pool surfaces. Durvasula, [0014]. Fu-007 similarly describes an underwater cleaning robot that can "help and even replace humans to autonomously complete underwater cleaning work." Fu-007, p.11. POSITAs would have been motivated to combine the complementary teachings of Durvasula and Fu-007 to improve autonomous pool cleaning. Janét, ¶¶105-111.

POSITAs would have recognized that both address similar technical issues in the same pool cleaning field with similar solutions. Janét, ¶¶105-106. Both teach using a controller to generate control signals based on captured images to move the pool cleaner. *Compare* Durvasula, [0020], [0022]-[0023], *with* Fu-007, pp.10, 14-16, Claims 4, 7. Accordingly, POSITAs would have looked to both for guidance when designing pool cleaning systems. Janét, ¶¶105-106.

Fu-007 places its controller within the vehicle. Fu-007, pp.8-9, 12-14, Claim 4; Janét, ¶107. Hence, Fu-007 differs from Durvasula's placement of the controller outside the pool in a tethered configuration, or a remote server or portable electronic device (PED) (Durvasula, [0013]-[0039], [0045]-[0046], FIGS. 1-5, 9, Claims 2-4, 10). Janét, ¶107.

POSITAs would have been motivated to modify Durvasula by substituting Durvasula's external controller with Fu-007's onboard controller for various reasons. Janét, ¶¶107-111.

For example, Durvasula relies on an external controller and tether, which constrains autonomy by limiting range and requiring human intervention to manage cable entanglements, but Fu-007 moves the architecture onboard—specifically positioning the controller, camera connection, and power source within the body—allows the robot to operate autonomously. Fu-007, p.11; Janét, ¶108. POSITAs would have recognized that integrating Fu-007's onboard controller

would have enhanced autonomous operations by generating control signals onboard to plan paths and complete cleaning tasks, allowing the vehicle to navigate freely without cable constraints or human interventions. Janét, ¶108.

As another example, POSITAs would have been motivated to make this modification to further improve the safety of Durvasula's system. Janét, ¶¶109-110. Durvasula discloses a tethered configuration that transmits power to the vehicle through a cable. Durvasula, [0025] ("provid[ing] electrical power to vehicle 30 in a wired fashion"), [0029], [0045], FIG.9; Janét, ¶109. Fu-007 teaches a safer architecture including a "sealed drive control enclosure" with "waterproof properties" and a "rechargeable battery box" that allows operation "without using the signal relay and cable manager 28 and the signal and power cable 33." Fu-007, pp.8-9, 12-14, Claim 4; Janét, ¶110. POSITAs would have been motivated to replace Durvasula's tethered controller configuration with Fu-007's onboard, sealed, battery-powered architecture, because this modification would have eliminated the need for the power cable—thereby removing the potential electrical leakage and enhancing the overall safety. Janét, ¶¶109-111.

POSITAs would have reasonably expected success, because positioning the controller in the vehicle body was a well-known design choice in autonomous pool cleaning robots, as shown by the teachings in Fu-007. Fu-007, pp.8-10; Knoll, [0007], [0027]-[0028], FIG.1; §§IV.D.1-IV.D.2; Renaud (EX1017), [0008]-[0009],

[0029]-[0030]; §§IV.G.1-IV.G.2; Janét, ¶111. Additionally, Fu-007's onboard controller is already configured to execute image-based cleaning tasks similar to Durvasula's—analyzing images and generating drive signals to move the vehicle (Fu-007, pp.8-10, 14-16) so POSITAs would have reasonably expected that Fu-007's controller would implement Durvasula's control logic (e.g., processing images to steer toward missed portions; Durvasula, [0020], [0022]-[0023]), thereby yielding predictable results. Janét, ¶111.

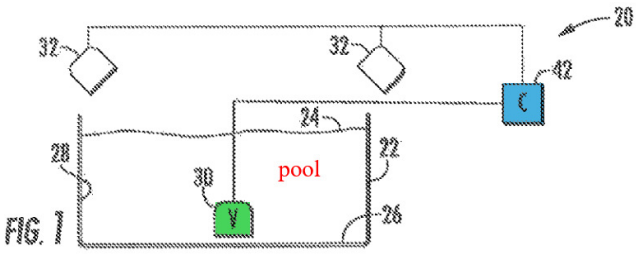
4. Claim 1 Unpatentable over Durvasula and Fu-007

Durvasula and Fu-007 render claim 1 obvious. Janet, ¶¶112-136.

a. 1[pre]

Durvasula discloses or suggests 1[pre]. Janet, ¶¶113-116.

Durvasula discloses a "self-propelled pool cleaner for cleaning debris from a submerged surface of a swimming pool." Durvasula, FIGS. 1-10 and [0002]-[0012], [0014], [0031], [0045]-[0046], Claims 1, 17, FIGS. 1, 9 (annotated below); Janet, ¶¶114-116.



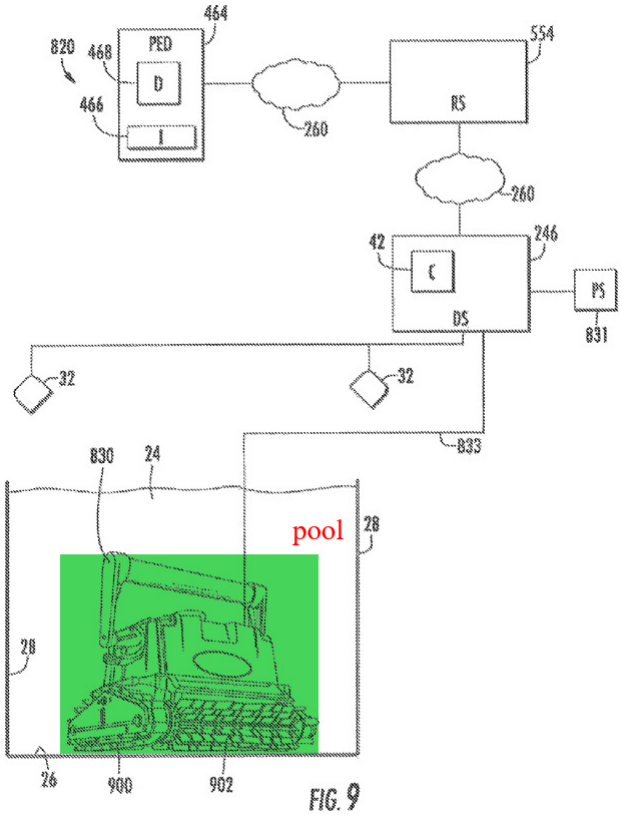


FIG. 9

b. 1[a]

Durvasula discloses vehicle 30/830 as a vehicle body. Durvasula, [0014]-[0015], [0046], Claims 1, 17, FIGS. 1 (annotated below), 2-5, 9 (annotated below), 10; Janet, ¶¶117-118.

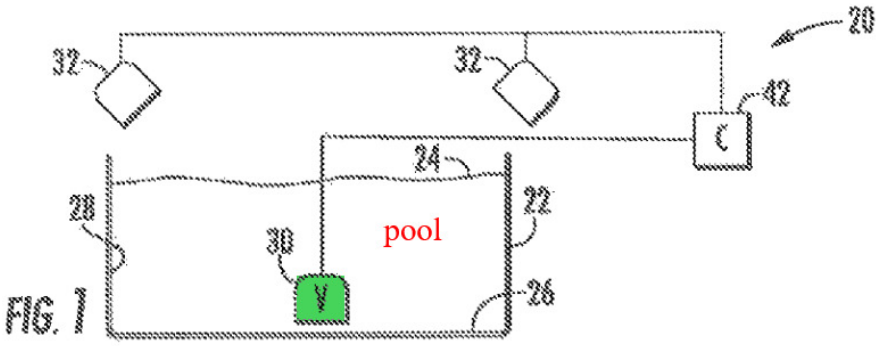


FIG. 1

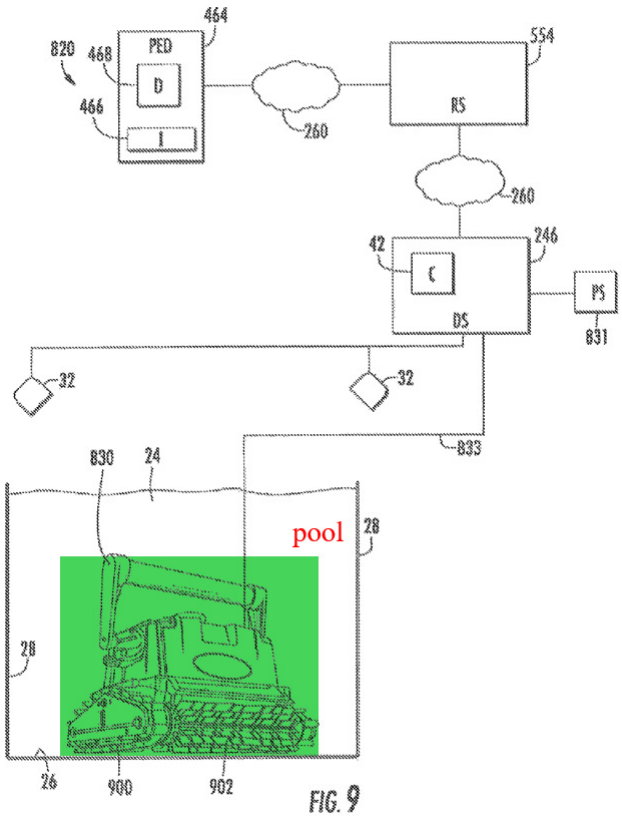


FIG. 9

c. 1[b]

Limitation 1[b] invokes §112¶6/§112(f); the function is "moving the vehicle body within the swimming pool," and the corresponding structure includes "wheels, rollers, tracks...powered by a motor." *See* §III.E.

Durvasula discloses this function and structure by describing moving the vehicle using "wheels, rollers, [or] tracks." Durvasula, [0014], [0016], [0046], Claims 1, 17, FIGS. 9-10 (annotated below); Janét, ¶¶119-121.

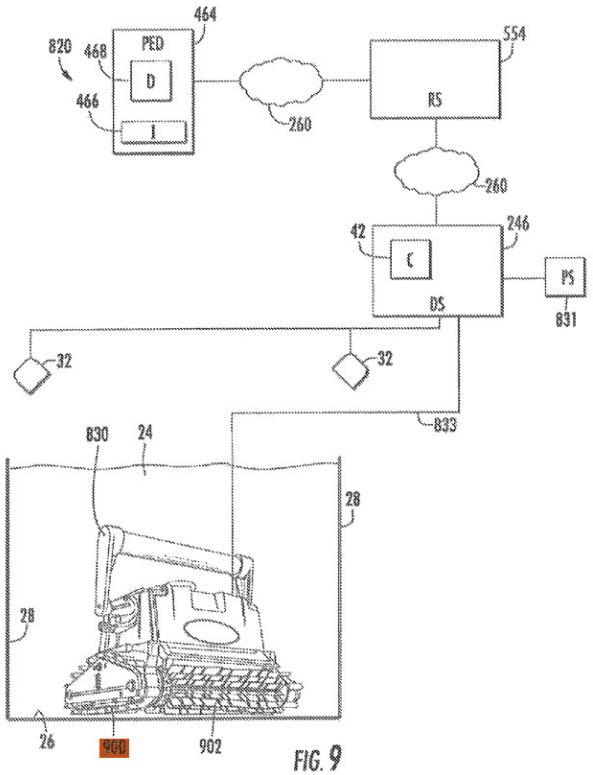


FIG. 9

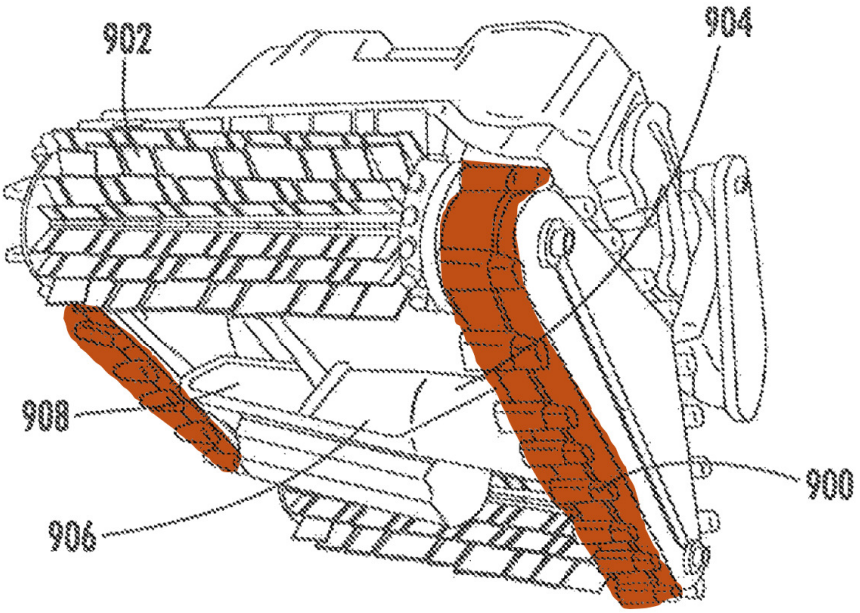


FIG. 10

d. 1[c]

Durvasula discloses 1[c]: "vehicle 30 may include…a **filter** to draw **debris**" and an "internally housed **filter bag**" through which "loosened **dirt and debris**" passes. *Id.*, [0014], [0046]; Janet, ¶122.

e. 1[d]

Durvasula discloses cameras 32 that are "configured to capture images of submerged surfaces 26, 28 of pool 22," and "cameras 32 may…be mounted to vehicle 30." Durvasula, [0013]-[0014], [0017]; Janét, ¶123.

f. 1[e][i]

The Durvasula-Fu-007 combination discloses or suggests the claimed controller in 1[e][i]. Janét, ¶¶124-128.

Durvasula describes controller 42 that "is in communication with vehicle 30 and cameras 32" and "is configured to generate control signals for steering vehicle 30." Durvasula, [0020], [0022]. Controller 42 "utilizes signals from camera 32 to steer vehicle 30" to "cover such missed portions" and "to re-clean such portions until such portions have been satisfactorily cleaned." Durvasula, [0023].

As explained in §III.C.1, Durvasula fails to disclose that its controller is "positioned on or in the body." Janét, ¶¶81-86, 125-126.

Like Durvasula, Fu-007 discloses an underwater cleaning robot for swimming pools using camera-based control. §IV.A.2. Fu-007's system includes monitoring camera 2, image acquisition card, central processing unit (controller)

housed in control system enclosure 8, and cleaning and moving platform with cleaning drive wheels 3. Fu-007, pp.12-14, Claims 1, 3, FIGS.1-2 (annotated below); Janét, ¶¶97-106, 127.

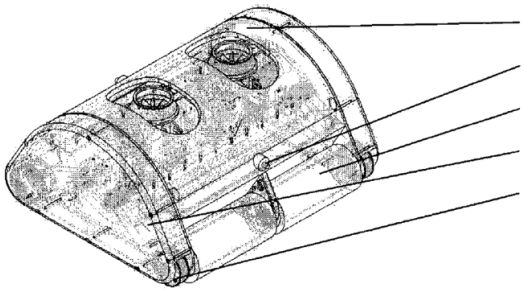


FIG. 1

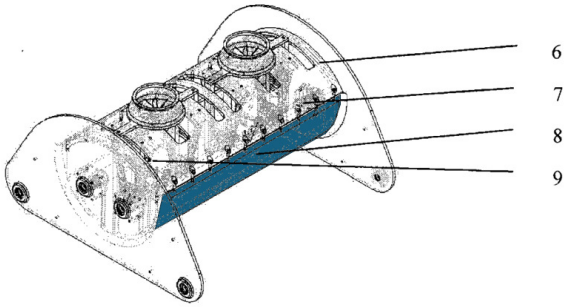


FIG. 2

Similar to Durvasula, Fu-007 teaches using cleaning drive wheels, belt gears, and drive belts as part of a cleaning and moving platform to control the movement of the platform during the pool cleaning operation. Fu-007, pp.8-9, 12-14, Claims 1, 3. Janét, ¶¶95-106, 127.

For the reasons explained in §IV.A.3, POSITAs would have been motivated to modify Durvasula by substituting Durvasula's external controller with Fu-007's onboard controller structure housed in Fu-007's "sealed drive control enclosure" inside Durvasula's vehicle. Janét, ¶¶105-111, 128. Additionally, Fu-007's onboard controller would be in electronic communication with Durvasula's camera via onboard connection (per Fu-007's image acquisition card; pp.12-14), powered by an onboard power source (per Fu-007's rechargeable battery box; pp.12-14), and generates control signals for steering the vehicle based on camera-captured images

to clean or re-clean portions of the pool (per Durvasula's control logic). Janét, ¶¶105-111, 128.

g. 1[e][ii]

Durvasula-Fu-007 combination discloses or suggests 1[e][ii]. Janét, ¶¶129-131.

Durvasula describes controller 42 "communicates with...cameras 32…across a wired connection," "across a wireless connection," or "using a combination of both wired and wireless communication connections," and "utilizes signals from camera 32 to steer vehicle 30." Durvasula, [0020]-[0021], [0023].

As explained in §§IV.A.3&IV.A.4.f (1[e][i]), POSITAs would have been motivated, and reasonably expected success, to modify Durvasula to replace Durvasula's external controller with Fu-007's onboard controller structure, where the onboard controller is in electronic communication with Durvasula's camera via Fu-007's internal connection architecture (the camera connects to the controller via an "image acquisition card"). Fu-007, pp.12-14, Claim 4, FIGS. 1, 4, 6; Janét, ¶¶105-111, 124-131.

h. 1[e][iii]

Durvasula's controller 42 generates control signals "in response to the captured image," because controller 42 identifies a portion requiring cleaning or re-cleaning based on "signals from camera 32," and steers vehicle 30 accordingly.

Durvasula, [0022]-[0023]; Janét, ¶133. Durvasula discloses generating control signals to cause movement "to...the first portion of the submerged surface," because Durvasula's controller 42 steers vehicle 30 to "cover such missed portions" and to "re-clean such portions." Durvasula, [0023], [0026], [0044]. Janét, ¶133.

As explained in §§IV.A.3&IV.A.4.f (1[e][i]), POSITAs would have been motivated, and reasonably expected success, to modify Durvasula's system to use Fu-007's onboard controller structure to execute Durvasula's control logic, including generating control signals to cause the body movement "to...the first portion of the submerged surface" in response to the captured image described above. Janét, ¶134. Thus, because the Durvasula-Fu-007 combination teaches control signals that cause movement "to" the first object, the Durvasula-Fu-007 combination discloses or suggests this limitation. Janét, ¶¶134-135.

5. Claim 2 Unpatentable over Durvasula and Fu-007

Durvasula and Fu-007 render independent Claim 2 obvious. Janét, ¶¶137-141.

a. 2[pre], 2[a]-2[c], 2[e][i]-[iii]

Limitations 2[pre], 2[a]-2[c], and 2[e][i]-2[e][iii] are identical to 1[pre], 1[a]-1[c], and 1[e][i]-1[e][iii], respectively. For the reasons in §§IV.A.4.a-IV.A.4.d (1[pre], 1[a]-1[c]), Durvasula discloses or suggests 2[pre] and 2[a]-2[c].

Additionally, for the reasons in §§IV.A.4.f-h (1[e][i]-[iii]), the Durvasula-Fu-007 combination discloses or suggests 2[e][i]-2[e][iii]. Janet, ¶138.

b. 2[d]

Limitations 2[d] and 1[d] only differ in:

<table>
<tr><td>1[d]</td><td rowspan="2">“camera”</td><td>“mounted directly or indirectly to”</td><td rowspan="2">“the body”</td></tr>
<tr><td>2[d]</td><td>“carried by”</td></tr>
</table>

Durvasula discloses 2[d], because a camera “mounted directly...to the body” (§IV.A.4.e (1[d])) is also “carried by the body.” Janet, ¶¶139-140.

6. Claim 3 Unpatentable over Durvasula and Fu-007

Durvasula and Fu-007 render Claim 3 obvious. Janet, ¶¶142-159.

a. 3[pre], 3[a]-3[c], 3[e][i]

Limitations 3[pre], 3[a]-3[c], and 3[e][i] are identical to 1[pre], 1[a]-1[c], and 1[e][i], respectively. For the reasons in §§IV.A.4.a-d (1[pre], 1[a]-1[c]), Durvasula discloses or suggests 3[pre] and 3[a]-3[c]. Additionally, for the reasons in §IV.A.4.f (1[e][i]), the Durvasula-Fu-007 combination discloses or suggests 3[e][i]. Janet, ¶143.

b. 3[d]

Limitations 3[d] and 1[d] only differ in:

1[d]	"camera"	"mounted directly or indirectly to"	"the body"
3[d]		"positioned on or in, or carried by,"	

Durvasula discloses 3[d], because a camera "mounted directly...to the body" (§IV.A.4.e (1[d])) is also "positioned on or in, or carried by, the body." Janét, ¶144.

c. 3[e][ii]

As explained in §IV.A.4.g (1[e][ii]), the controller in the Durvasula-Fu-007 combination is "in electronic communication with the at least one **camera**."

Durvasula also discloses a **portable electronic device** ("PED") **464** including an input to "facilitate[] entry of inputs or commands by a person to cause **controller 42** to generate control signals varying the control of vehicle 30." Durvasula, [0032]-[0034], [0045], FIGS. 4-5, 9 (annotated below).

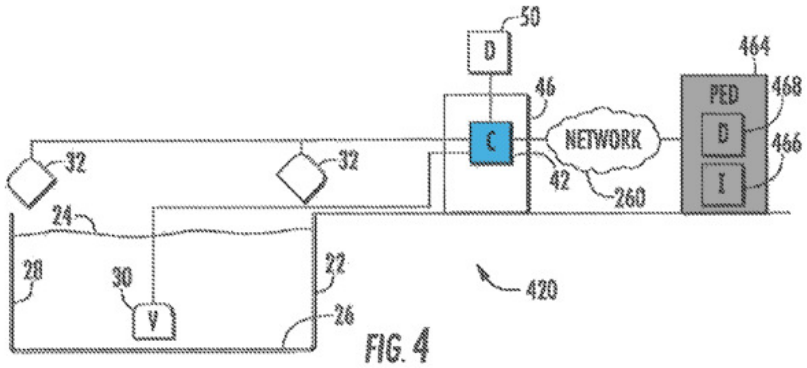


FIG. 4

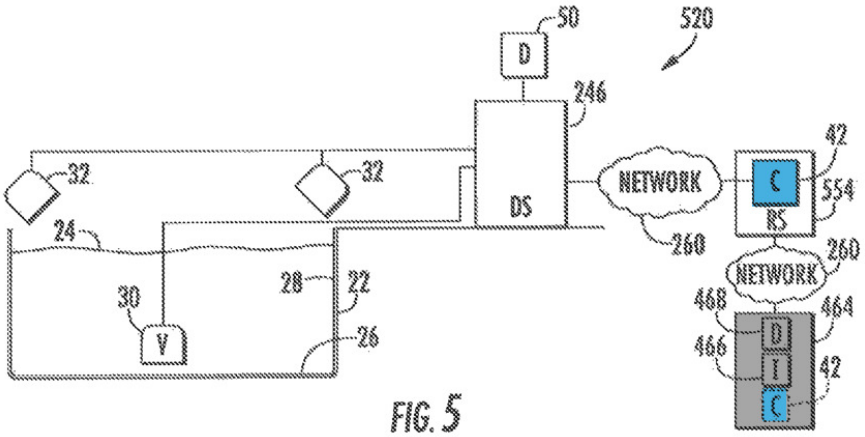

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FIG. 5

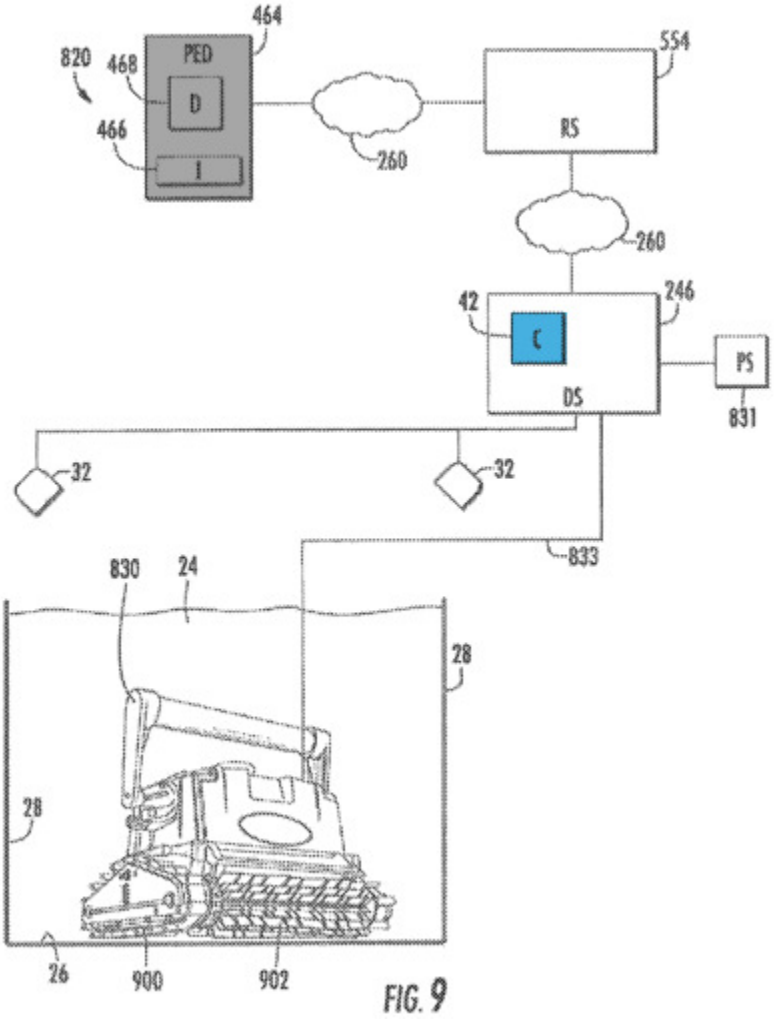

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FIG. 9

Fu-007 discloses that its robot operates in a "remote control" mode where its **central processing unit** (controller) receives commands from a **remote control keyboard 31** (PED) through a "remote control signal interface." Fu-007, pp.8-9, Claim 4, FIGS.6, 8 (annotated below). To receive signals while submerged, the robot uses a **control signal buoyant antenna 27** that "floats on a water surface to **wirelessly communicate** with the control keyboard 31" and is "configured to directly communicate with the **remote control signal interface** of the robot via the **control signal buoyant antenna cable (35)**." Fu-007, pp.8-9, 12-14, FIG. 8.

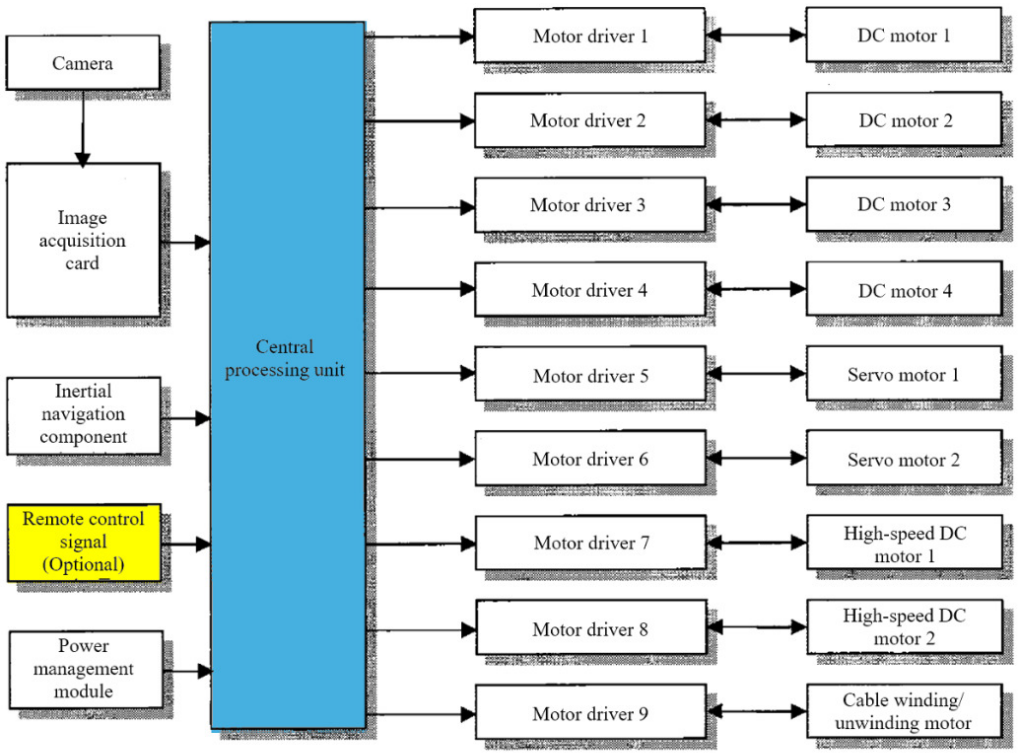


FIG. 6

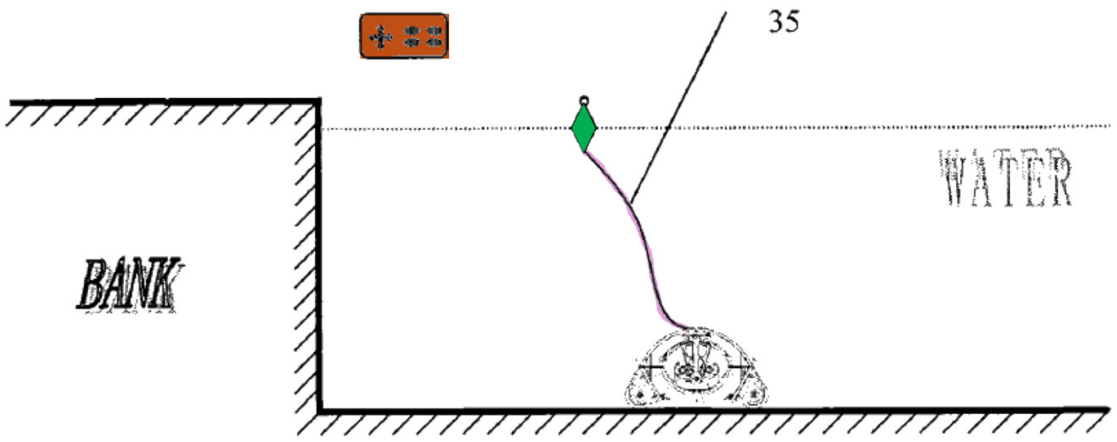


FIG. 8

POSITAs would have understood the "control keyboard 31" is a PED because it is a handle device (Fu-007, FIG. 8) distinct from the vehicle and designed to "wirelessly communicate" with the antenna. Fu-007, pp.12-14, FIG. 8; Janét, ¶150.

As explained in §IV.A.4.f (1[e][i]), POSITAs would have been motivated to replace Durvasula's controller with Fu-007's onboard controller. POSITAs would have been further motivated to establish electronic communication between Fu-007's onboard controller and Durvasula's PED using Fu-007's wireless communication mechanism. Janét, ¶151. Specifically, the combined system utilizes Fu-007's onboard wireless infrastructure (the remote control signal interface, antenna 27, and antenna cable 35) to receive signals transmitted by Durvasula's PED. Durvasula, [0033], FIGS. 4-5, 9; Fu-007, pp.12-14, FIG. 8; Janét, ¶151.

POSITAs would have been motivated to make such combination.

First, as discussed in §IV.A.4.f (1[e][i]), POSITAs would be motivated to remove Durvasula's tether to eliminate entanglement risks and electrical leakage hazards. To preserve the user's ability to manually operate the vehicle (Durvasula, [0034]), POSITAs would be motivated to utilize Fu-007's antenna-communication system, which would allow the manual control without reintroducing the safety risks of a shore-to-robot power cable. Durvasula, [0033], FIGS. 4-5, 9; Fu-007, pp.12-14, FIG. 8; Janét, ¶153.

Second, POSITAs would have recognized that using Fu-007's buoyant antenna, the user could reliably drive the robot to the wall for removal using the PED, instead of, e.g., pulling a cord or waiting for the robot to surface. Durvasula, [0033], FIGS. 4-5, 9; Fu-007, pp.12-14, FIG. 8; Janét, ¶154.

POSITAs would have reasonably expected success, because Fu-007 teaches a working implementation where its onboard controller is already configured with a "remote control signal" interface and "buoyant antenna" designed to communicate with a remote keyboard, and configuring this existing wireless interface with Durvasula's PED would have been a routine integration yielding predictable results. Fu-007, pp.12-14, FIG. 8; Janét, ¶155.

d. 3[e][iii]

As explained in §IV.A.3, IV.A.4.f-h (1[e][i]-[iii]), POSITAs would have been motivated, and reasonably expected success, to modify Durvasula's system to

use Fu-007's onboard controller to generate control signals "in response to...the **captured image**" to steer the vehicle "to...the first portion of the submerged surface" (e.g., to re-clean missed portions). Durvasula, [0022]-[0023], [0026], [0044]; Fu-007, Abstract, pp.8-9, 14-16, Claims 1, 4; Janét, ¶157. Thus, the Durvasula-Fu-007 combination satisfies this limitation through the "captured image" prong alone. *Id.*

Additionally, for reasons in §§IV.A.4.f&IV.B.5.c (1[e][i], 3[e][ii]), POSITAs would have been motivated, and reasonably expected success, to configure Fu-007's onboard controller to process control signals from Durvasula's PED and generate drive signals that cause the robot to move "to" a specific target area selected by the user (i.e., the "first portion of the submerged surface") for cleaning. Fu-007, pp.8-9, 14-16, Claim 7; Durvasula, [0033], [0036]; Janét, ¶158.

7. Claim 4 Unpatentable over Durvasula and Fu-007

Durvasula and Fu-007 render independent Claim 4 obvious. Janet, ¶¶160-162.

a. 4[pre], 4[a]-4[c], 4[e]

Limitations 4[pre], 4[a]-4[c], and 4[e] are identical to 1[pre], 1[a]-1[c], and 1[e], respectively. For the reasons in §§IV.A.4.a-d (1[pre], 1[a]-1[c]) and §§IV.A.4.f-h (1[e][i]-[iii]), Durvasula discloses or suggests 4[pre] and 4[a]-4[c]

and the Durvasula-Fu-007 combination discloses or suggests 4[e][i]-[iii]. Janet, ¶161.

b. 4[d]

Limitation 4[d] is nearly identical to 1[d], differing only in that 4[d] omits the requirement that the camera be "mounted directly or indirectly to the body." For the reasons in §IV.A.4.e (1[d]), Durvasula discloses 4[d]. Janet, ¶162.

8. Claim 5 Unpatentable over Durvasula and Fu-007

Durvasula and Fu-007 render independent claim 5 obvious. Janet, ¶¶163-168.

a. 5[pre], 5[a]-5[c]

Durvasula discloses or suggests limitations 5[pre] and 5[a]-5[c] for the reasons in §§IV.A.4.a-d (1[pre]-1[c]), because they are identical to 1[pre] and 1[a]-1[c]. Janét, ¶164.

b. 5[d]

Durvasula discloses or suggests 5[d] because it teaches "vehicle 30 may include a **chemical dispenser** to closely apply pool cleaning chemicals to the pool surfaces as the vehicle 30 traverses such surfaces." Durvasula, [0015]; Janét, ¶165.

c. 5[e]

Limitations 5[e] and 1[d] only differ in:

1[d]	"camera"	"mounted directly or indirectly to"	"the body"

5[e]		"on, in, or carried by"	"the vehicle body"

Durvasula discloses 5[e], because a camera "mounted directly...to the body" (§IV.A.4.e (1[d])) is also "on, in, or carried by the vehicle body." Janét, ¶166.

d. 5[f][i]

Limitations 5[f][i] and 1[e][i] only differ in:

1[e][i]	"controller"	"positioned on or in"	"the body"
5[f][i]		"on, in, or carried by"	"the vehicle body"

The Durvasula-Fu-007 combination discloses or suggests 5[f][i], because a controller "positioned on or in the body" (§IV.A.4.f (1[e][i])) is also "on, in, or carried by the vehicle body." Janét, ¶167.

e. 5[f][ii]-5[f][iii]

The Durvasula-Fu-007 combination discloses or suggests limitations 5[f][ii] and 5[f][iii] for the reasons in §§IV.A.4.f-h (1[e][ii]-[iii]), because they are identical to 1[e][ii] and 1[e][iii]. Janét, ¶168.

B. Ground 2A: Claims 1-4 Are Unpatentable over Cui with Fu-007

1. Cui

Cui (EX1005) is prior art under AIA 35 U.S.C. §102(a)(1) and pre-AIA 35 U.S.C. §102(b). Janét, ¶169.

Cui discloses a pool cleaner with debris detection capability for use in swimming pools. Cui, Title, Abstract. A CCD camera is used to capture images of pool surfaces, compare them with pre-stored standard images of clean surfaces, and control the cleaner's operation based on detected debris levels/distributions. *Id.*, Abstract, pp.5-7.[4] Cui is analogous art. Janét, ¶170.

Cui's pool cleaner comprises a housing 4 containing various components including a **water pump motor 2**, an **infrared distance sensor 3**, a **camera 5**, a **filter bag 6**, a computer 7, **track-type crawling mechanisms 10**, **roller brushes 11**, and **hybrid stepper motors 15**. Cui, Claim 1, pp.5-6, FIGS. 1-2 (annotated below).

[4] Page citations to Cui are to the original pagination in the bottom center of each page.

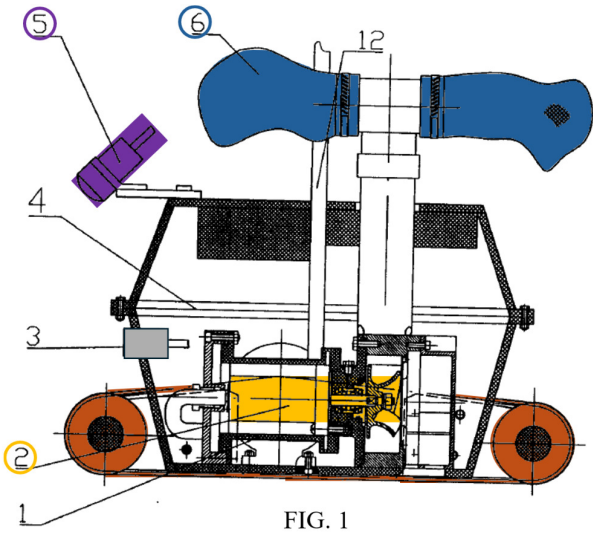


FIG. 1

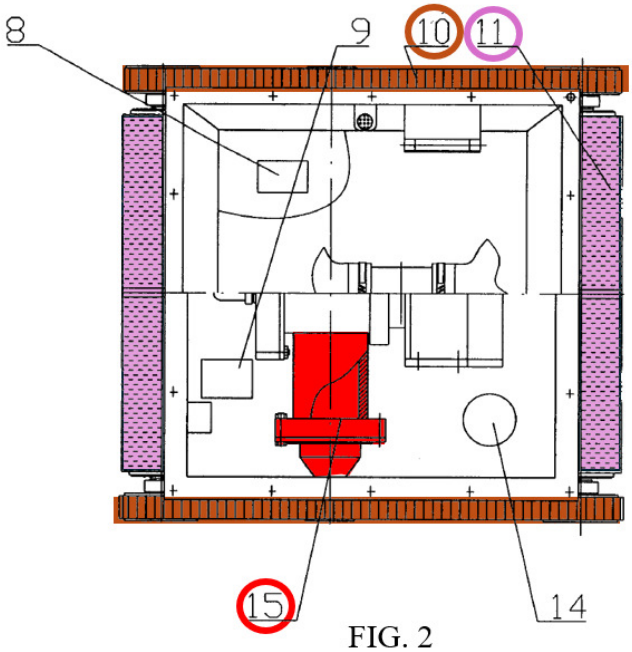


FIG. 2

Cui's computer 7 processes images from **camera 5** to detect debris levels/distributions, and generates control signals that adjust speed of **motors 15**, controlling crawling speed and cleaning force. Cui, pp.4-7, FIGS. 5-6 (annotated below).

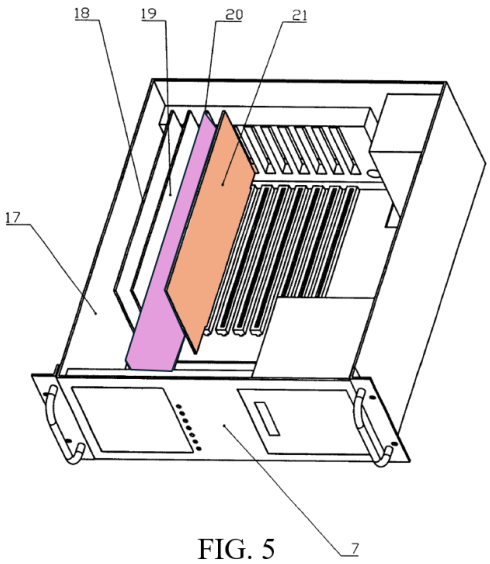


FIG. 5

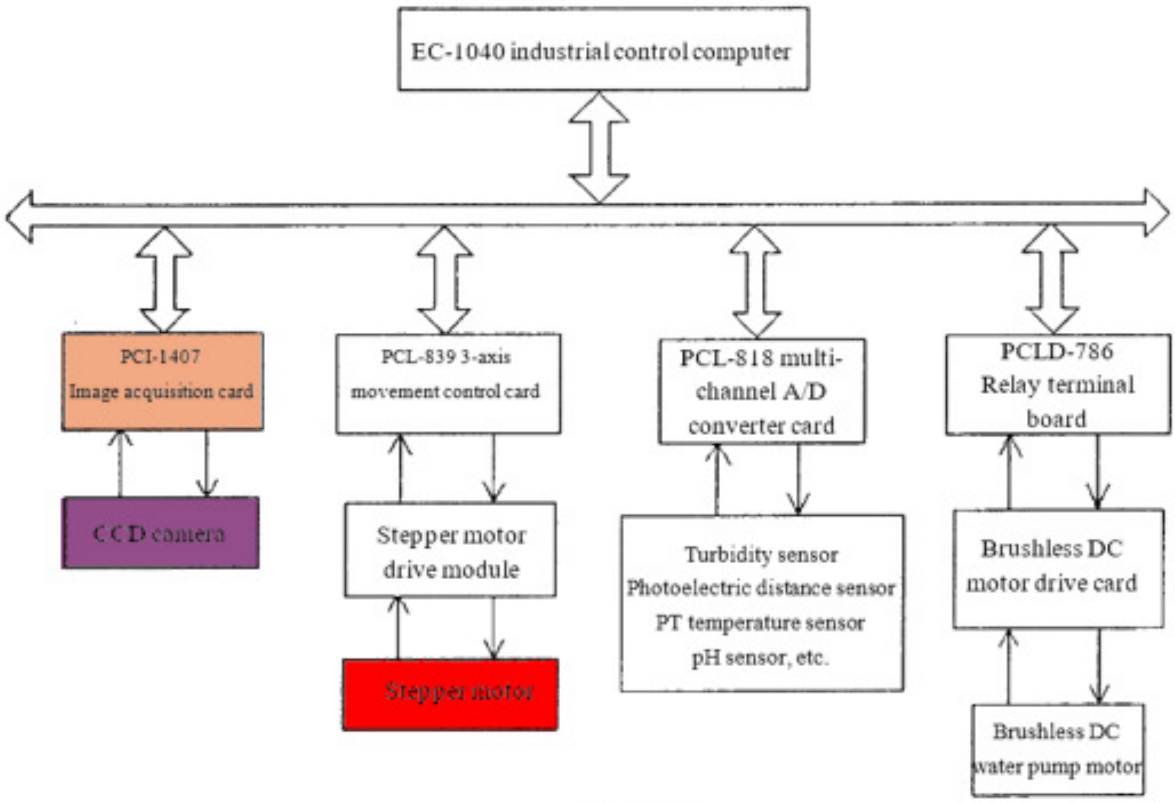


FIG. 6

2. Motivation to Combine

Both Cui and Fu-007 disclose underwater cleaning robots for swimming pools using camera-based control, and both sought to improve autonomous pool cleaning operations. Cui describes a pool cleaner using "intelligent adaptive technology with computer control" to autonomously adjust cleaning force based on debris distribution. Cui, p.5. Fu-007 similarly describes an underwater cleaning robot that can "help and even replace humans to autonomously complete underwater cleaning work." Fu-007, p.11; § IV.A.2. POSITAs would have been

motivated to combine the complementary teachings of Cui and Fu-007 to improve autonomous pool cleaning. Janét, ¶174.

POSITAs would have recognized that the teachings in Cui and Fu-007 are directed to the same pool cleaning technical field, based on recognition of t similar technical issues in pool cleaning, and provide similar technical solutions to address those issues. Janét, ¶175. Specifically, both use a controller to generate, in response to captured images, control signals to cause movement of the pool cleaning body within the swimming pool. *Compare* Cui, pp.5-7, FIGS. 5-7, *with* Fu-007, pp.10, 14-16, Claims 4, 7. Additionally, both teach motorized drive mechanisms to cause and control movement of the pool cleaner during operation. *Compare* Cui, pp.5-6, Claim 1, FIGS. 1-3, *with* Fu-007, pp.8-9, 12-14, Claims 1, 3. Accordingly, POSITAs would have investigated the technical teachings in both to seek guidance when designing a pool cleaning system for specific pool cleaning considerations and applications. Janét, ¶175.

Different from Cui's placement of the controller (computer 7) outside the pool and separate from the vehicle in a tethered configuration via cable assembly 12, Fu-007's controller is within the vehicle. Fu-007, pp.8-9, 12-14, Claim 4. The use of an external controller separated from the pool cleaner in Cui and the use of an onboard controller in Fu-007 had been two known design options. Janét, ¶176.

POSITAs would have been motivated to modify Cui by substituting Cui's external computer 7 with Fu-007's onboard controller structure for at least two reasons. *Id.*

First, Cui relies on an external computer and cable assembly, which constrains autonomy by limiting range and requiring human intervention to manage cable entanglements, but Fu-007 teaches that moving the architecture onboard—specifically positioning the controller, camera connection, and power source within the body—allows the robot to operate autonomously. Fu-007, p.11; Janét, ¶177. POSITAs would have recognized that integrating Fu-007's onboard controller into Cui would have enhanced autonomous operations by generating control signals onboard to perform cleaning tasks, allowing the vehicle to navigate without cable constraints or human supervision. Janét, ¶177.

Second, Cui discloses a tethered configuration connecting industrial control computer 7 via an external "cable assembly 12" (Cui, pp.5-6, Claim 1, FIGS. 1-2), which POSITAs would have recognized introduces safety risks of electrical leakage. Janét, ¶178. POSITAs would have been motivated to make this modification to further improve the safety of Cui's system by removing the cable. *Id.*; §IV.A.3 (explaining Fu-007's teaching of a safer system).

POSITAs would have had a reasonable expectation of success because positioning the controller on the vehicle body was a well-known design choice. Fu-007, pp.8-10, 12-14; Knoll, [0007], [0027]-[0028], FIG.1; §§IV.D.1-IV.D.2;

Renaud (EX1017), [0008]-[0009], [0029]-[0030]; §§IV.G.1-IV.G.2; Janét, ¶180. Additionally, Fu-007's onboard controller is already configured to execute image-based cleaning tasks similar to Cui's—analyzing captured images and generating drive signals (Fu-007, pp.8-10, 14-16)—so POSITAs would have reasonably expected it would implement Cui's specific control logic (e.g., processing images to control crawling speed based on debris levels; Cui, pp.5-7), yielding predictable results. Janét, ¶180.

3. Claim 1 is Unpatentable over Cui and Fu-007

The Cui-Fu-007 combination renders independent claim 1 obvious. Janét, ¶181-211.

a. 1[pre]

Cui discloses or suggests 1[pre]. Janét, ¶182-185.

Cui discloses a system designed for "professional or commercial swimming pools," including an underwater cleaning vehicle with **track-type crawling mechanisms 10** powered by **motors 15** and a computer 7 that processes sensor data and controls the vehicle. Cui, Abstract, Claim 1, pp.5-7, FIGS. 1-2, 6 (annotated below).

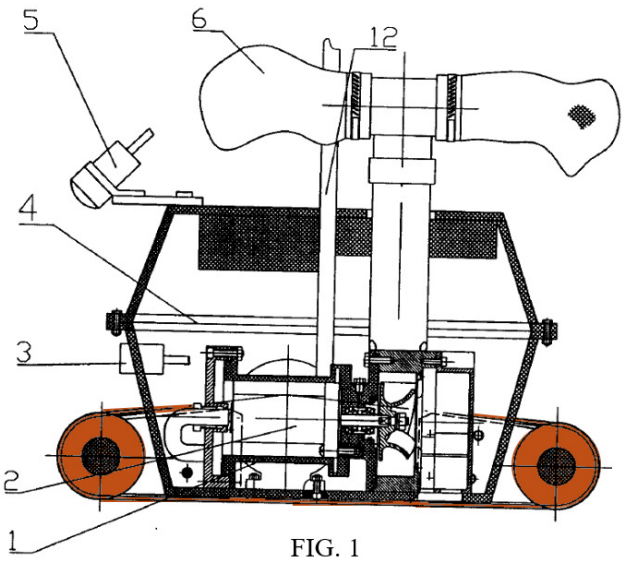


FIG. 1

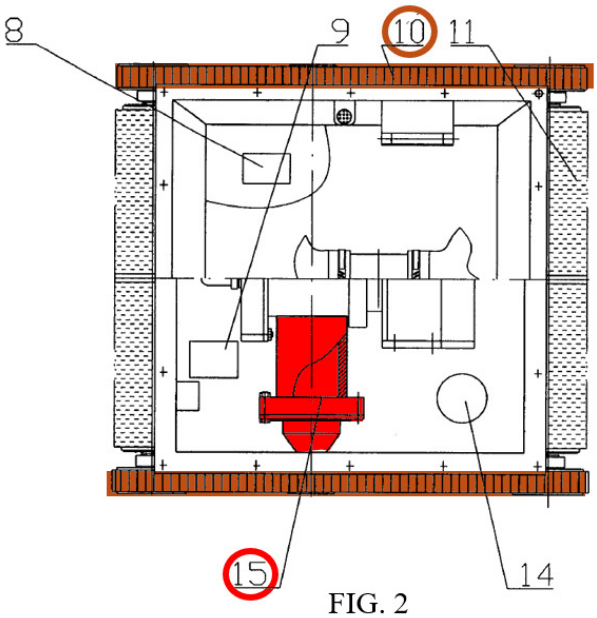


FIG. 2

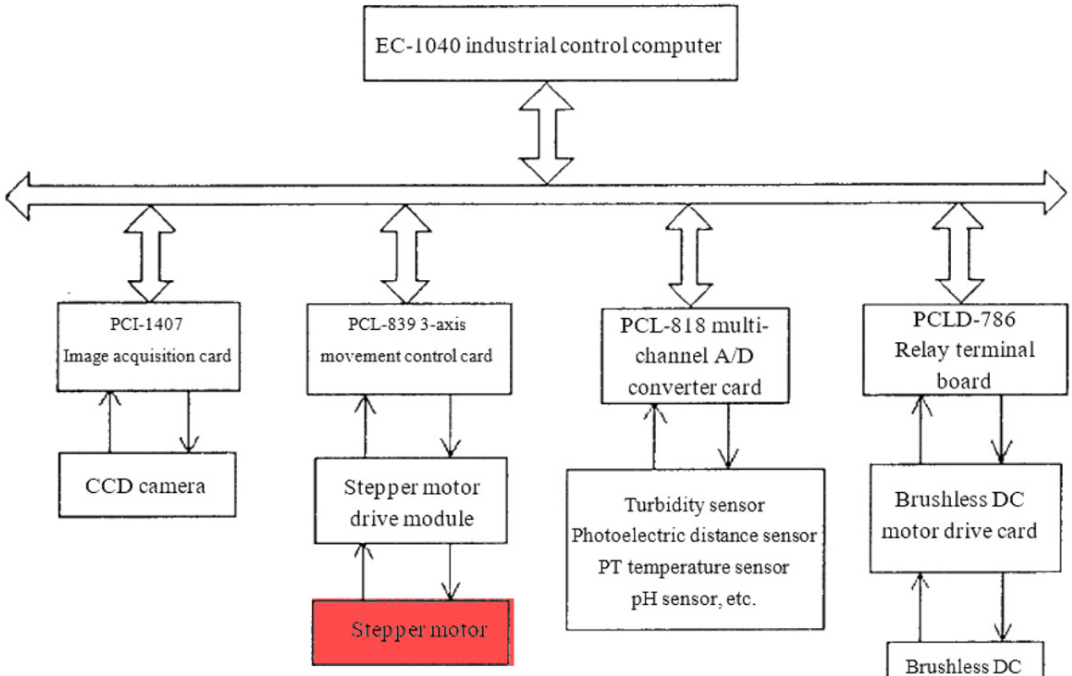


FIG. 6

Cui's cleaning vehicle is self-propelled, because computer 7 controls motors 15 to move the vehicle across pool surfaces. Cui, Claim 1, pp.5-6. Janét, ¶184.

Cui's system detects debris by comparing captured images with "pre-stored standard image information of a clean pool bottom"—"when there is a lot of sediment at the pool bottom, the grayscale level of the real-time captured image(s) is greatly different from the grayscale level of the original standard image(s)." Cui, Abstract, pp.4-7. Cui's system collects and cleans debris using "roller brush (11)," "brushless DC water pump motor (2)," and "filter bag (6)." Cui, Claim 1, pp.5-7; Janét, ¶185.

b. 1[a]

Cui discloses or suggests 1[a]. Janét, ¶186-187.

Cui's pool cleaner includes a vehicle body, i.e., housing 4 with integrated propulsion mechanisms (track-type crawling mechanisms 10, motors 15), cleaning components (motor 2, brushes 11, filter 6), and sensors (camera 5). Cui, Claim 1, pp.5-6, FIG.1 (annotated below). POSITAs would have understood this assembled structure constitutes a "vehicle body." Janét, ¶187.

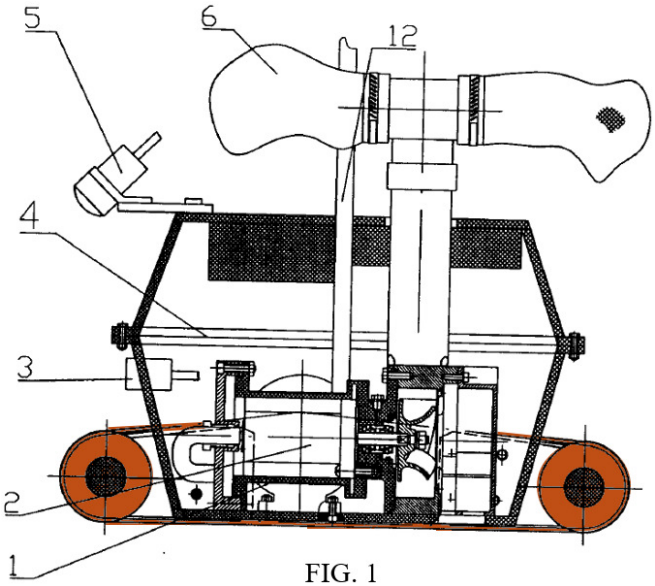


FIG. 1

c. 1[b]

Cui discloses or suggests 1[b]. Janét, ¶188-191.

Limitation 1[b] invokes §112¶6/§112(f); the function is "moving the vehicle body within the swimming pool," and the corresponding structure includes "**tracks**...powered by a motor." *See* §III.E.

Cui discloses this function and structure by disclosing moving the vehicle via **track-type crawling mechanisms 10** powered by **motors 15**. Cui, Claim 1, pp.5-7, FIGS. 1-2 (annotated below); EX1001, 3:33-45; Janét, ¶190-191.

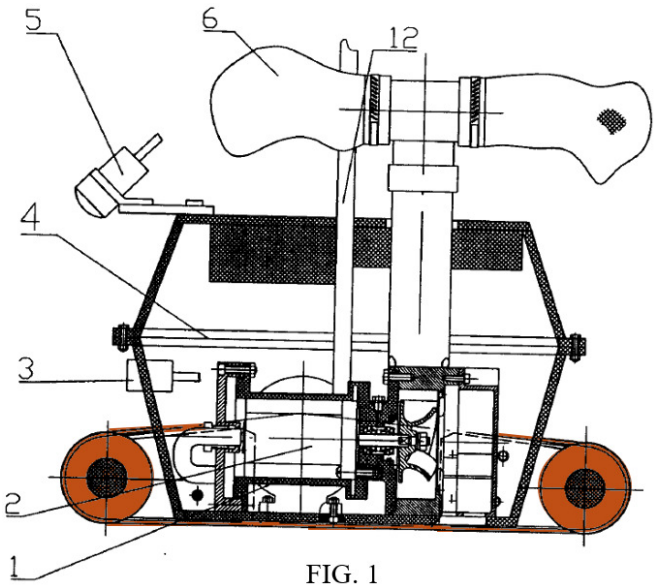


FIG. 1

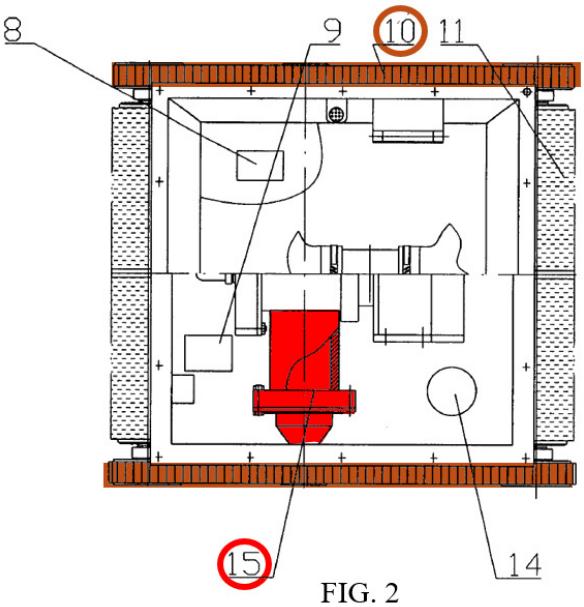


FIG. 2

d. 1[c]

Cui discloses or suggests 1[c]. Janét, ¶192-193.

Cui's system includes a **pump motor 2** and **filter bag 6** (filter) that retains debris collected from the submerged surface. Cui, Claim 1, pp.5-6, FIG.1 (annotated below). POSITAs would have understood Cui's pump motor draws water containing debris from pool surfaces and filter bag retains the debris. Janét, ¶193.

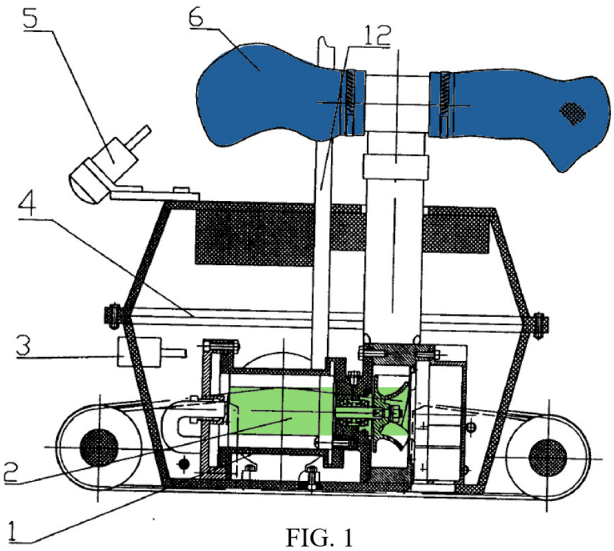


FIG. 1

e. 1[d]

Cui discloses or suggests 1[d]. Janét, ¶194-196.

Cui discloses a **camera 5** "**mounted at** the upper front end of the **housing 4**" to observe pool surfaces. Cui, Claim 2, FIG. 1 (annotated below), pp.5-6; Janét, ¶195.

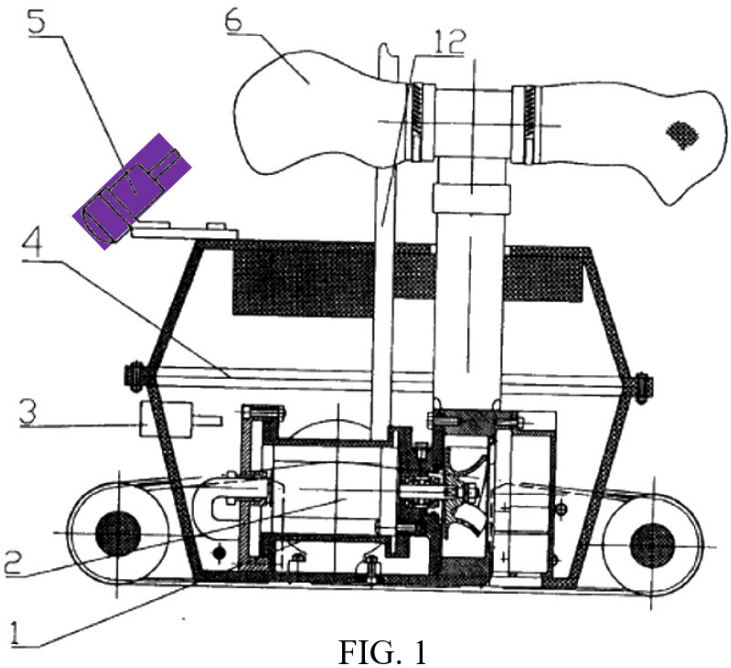


FIG. 1

Cui's camera "continuously captures images of areas to be cleaned located directly in front and below a crawling direction of the cleaner," including "sediment **at the pool bottom**," which are "compared with the original standard image(s) of the pool bottom" to identify debris. Cui, pp.5-7; Janét, ¶196. POSITAs would have understood that Cui's camera captures images of "at least a first portion of the submerged surface" because the camera observes the pool bottom—a submerged surface during cleaning—and debris/sediment thereon, and the area with debris constitutes the claimed "first portion." *Id.*

f. 1[e][i]

The Cui-Fu-007 combination discloses or suggests 1[e][i], because Cui discloses a controller, Fu-007 discloses a controller inside the vehicle body, and POSITAs would have been motivated to modify Cui's system to incorporate Fu-007's teaching of the onboard controller. Janét, ¶197.

Cui's pool cleaner includes **computer 7** (controller) separated from pool cleaner and is connected to the pool cleaner via cable 12. Cui, FIGS. 1-3. Computer 7 is connected to "the pool cleaner through the **cable assembly 12** and the **plug assembly 14**," and to **camera 5** through **image acquisition card 21** and processes captured images to generate control signals that adjust crawling speed based on detected debris levels. Cui, pp.5-7, FIGS. 1-2, 5-6 (annotated below); Janét, ¶198. Cui describes that "[t]he voltage signal is sent to...computer 7 for

processing…A pulse signal command output after processing…to separately control the drive of the two hybrid stepper motors 15." Cui, pp.6-7; §IV.B.3.e (1[d]). POSITAs would have understood that Cui's computer 7 is a "controller." Janét, ¶198.

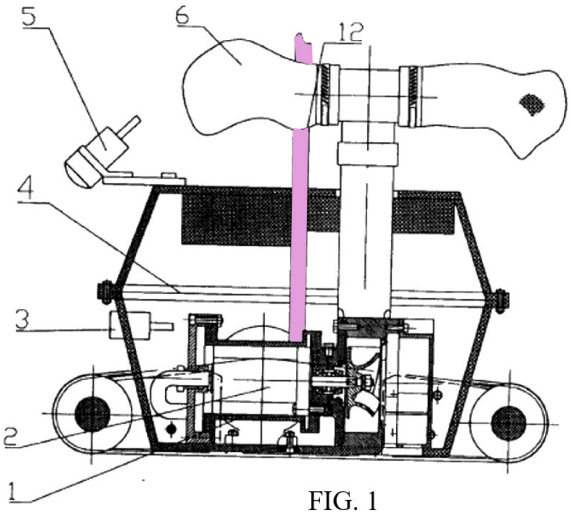


FIG. 1

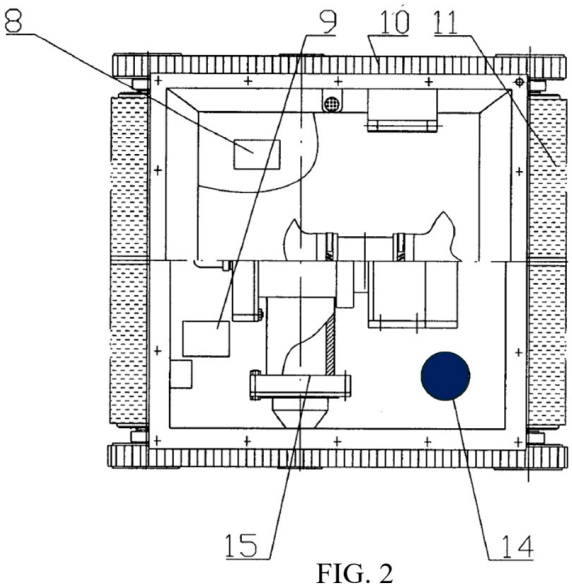


FIG. 2

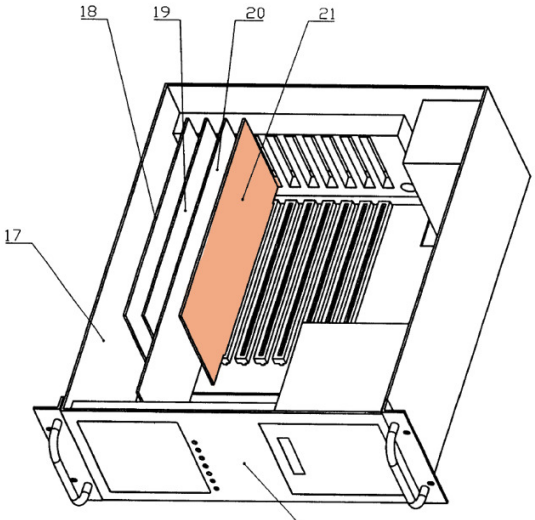


FIG. 5

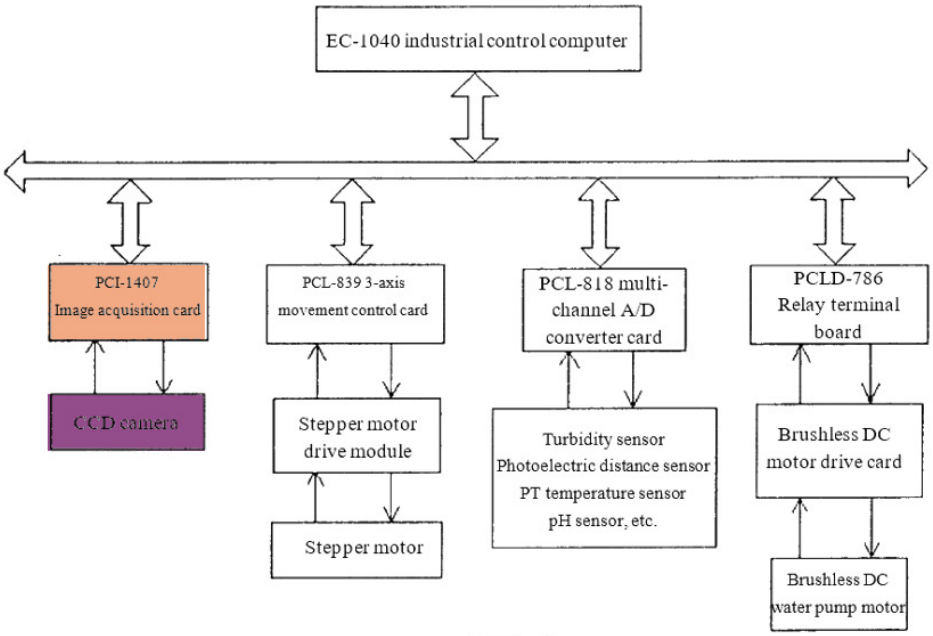


FIG. 6

Like Cui, Fu-007 discloses an underwater cleaning robot for swimming pools using camera-based control through a controller to generate, in response to captured images, control signals to move the pool cleaning body. §IV.A.2; Janét, ¶199.

Fu-007 discloses a controller positioned in the body of its cleaning and moving platform. §§IV.A.2&IV.A.4.f; Fu-007, pp.8-9, 12-14, Claim 4, FIGS.2, 4 (annotated below); Janét, ¶200.

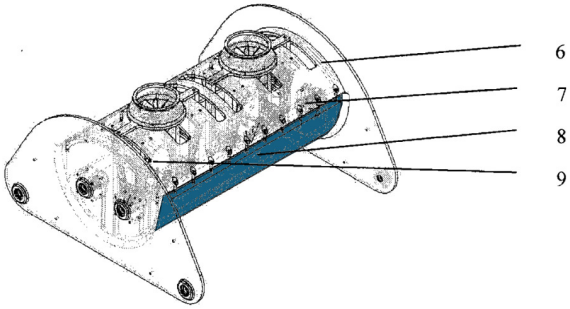


FIG. 2

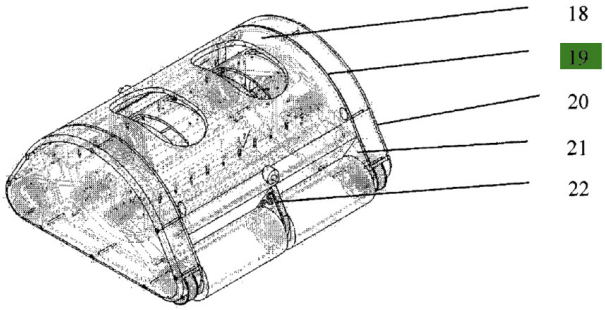


FIG. 4

This onboard controller connects to **monitoring camera 2**. Fu-007, pp.12-14, Claim 4, FIGS.1, 6 (annotated below); §IV.A.4.f. Janét, ¶201.

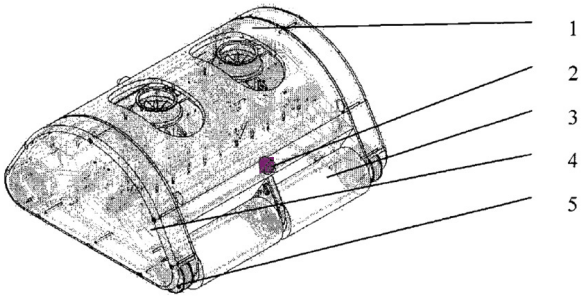


FIG. 1

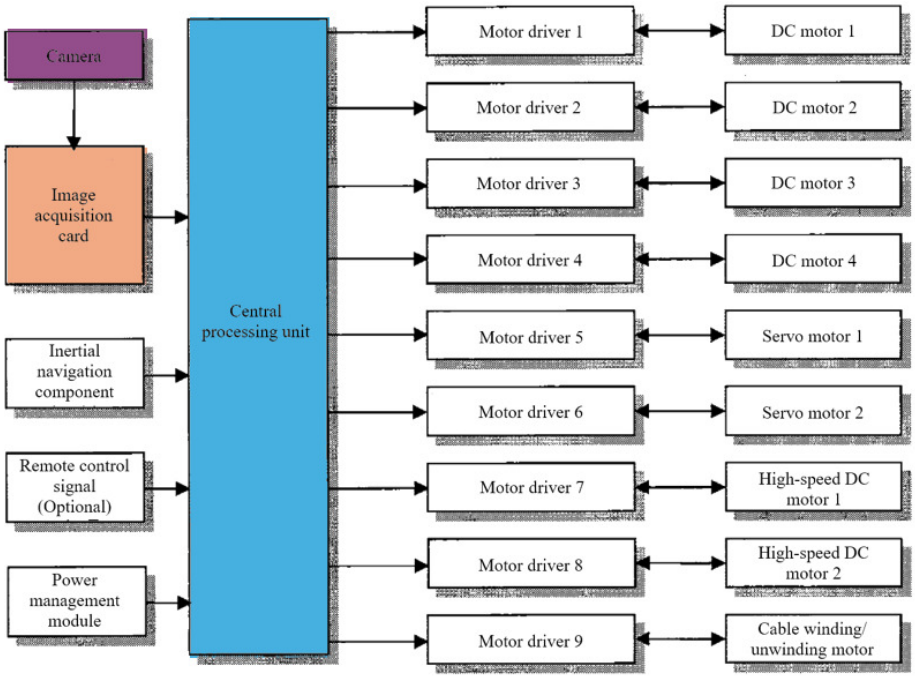


FIG. 6

For the reasons explained in §IV.B.2, POSITAs would have been motivated to modify Cui's system by substituting Cui's external computer 7 with Fu-007's onboard controller structure. Janét, ¶202. The modified system's onboard controller would be: (1) in electronic communication with Cui's camera via an onboard connection (e.g., Fu-007's image acquisition card; Fu-007, pp.12-14), (2) powered by Fu-007's rechargeable battery box (*id.*), and (3) configured to generate control signals for controlling the vehicle movement (e.g., wheel speed) based on captured images to clean the pool per control logics of Cui and/or Fu-007. Cui, pp.5-7; Fu-007, pp.14-16; Janét, ¶202.

g. 1[e][ii]

The Cui-Fu-007 combination discloses or suggests 1[e][ii]. Janét, ¶¶[203-205.

Cui's **computer 7** is connected to camera 5 through **image acquisition card 21**. Cui, Claim 3, pp.5-7, FIGS. 5-6 (annotated below). During cleaning, "camera 5...continuously captures images" and "[t]he video signal undergoes A/D conversion through the high-speed image acquisition card 21" for processing by computer 7. Cui, pp.5-7.

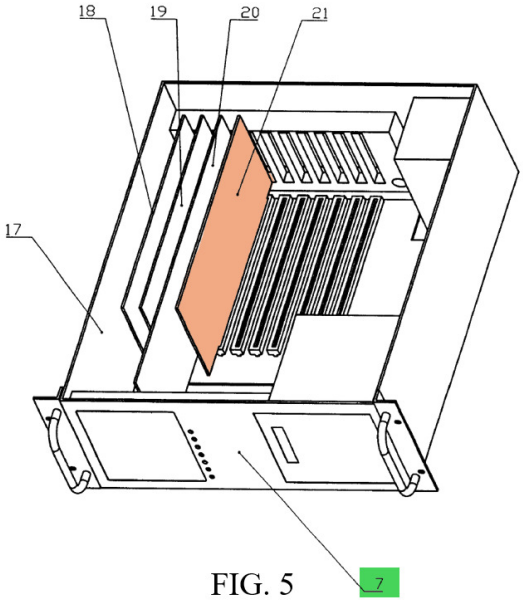


FIG. 5

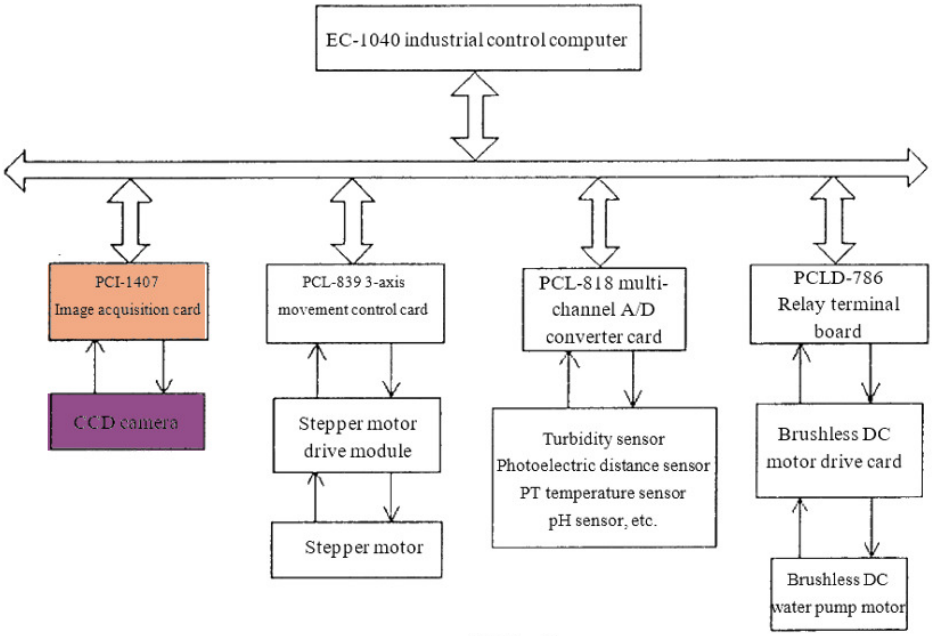


FIG. 6

As explained in §§IV.B.2&IV.B.3.f (1[e][i]), POSITAs would have been motivated, and reasonably expected success, to modify Cui's system by substituting Cui's external computer with Fu-007's onboard controller structure to, e.g., eliminate external tether dependencies. Fu-007, pp.8-10, 12-14, Claim 4; Janét, ¶205. In this modified system, the onboard controller is in electronic communication with the camera (mounted to the vehicle body) via Fu-007's internal connection architecture. Fu-007, pp.12-14, Claim 4, FIGS. 1, 4, 6; Janét, ¶205.

h. 1[e][iii]

Cui's controller compares captured images with stored standard images to identify sediment/debris—"when there is a lot of sediment at the pool bottom, the grayscale level of the real-time captured image(s) is greatly different...resulting in

a high comparison output voltage." Cui, pp.6-7. Based on this image-derived signal, "[a] pulse signal command output after processing...separately control[s] the drive of the two hybrid stepper motors 15." *Id.*, p.7. Thus, these are "control signal[s]" generated "in response to the captured image." Janét, ¶207. As explained in §IV.B.3.e (1[d]), Cui's camera 5 captures images of areas "located directly in front and below a crawling direction of the cleaner." Cui, Abstract, pp.5-7. Therefore, when the controller generates signals to adjust motor speed based on detected debris, the robot continues moving **toward** the debris-laden area identified in the image—i.e., the control signals cause movement "to" the first portion of the submerged surface. Janét, ¶207.

Additionally, Fu-007's onboard controller generates control signals in response to captured images to cause movement to a targeted portion of the surface. Janét, ¶208. Specifically, Fu-007 describes that its central processing unit (controller) sets "a swimming pool cleanliness image threshold" and uses camera 2 to "take image(s) of the bottom of the swimming pool." Fu-007, pp.10, 14-16. The controller then "determines a cleanliness level of the bottom of the swimming pool by comparing the image(s) with the threshold" and, based on this determination, "plans a cleaning movement" and "adjusts operating conditions of the four cleaning drive wheels 3...to complete the cleaning task." *Id.* And this adjustment involves changing the "rotational speed of each wheel" such that the robot "may

move in a direction determined by" the specific wheel speed combinations (e.g., rotating front wheels rapidly and rear wheels slowly). *Id.* POSITAs would have understood that by planning a cleaning movement based on the determined cleanliness level and adjusting wheel speeds to move in a specific direction, Fu-007's controller generates control signals to cause the body to move "to" the identified portion of the submerged surface (e.g., the dirty area) to "complete the cleaning task." *Id.*; Janét, ¶208.

As explained in §§IV.B.2&IV.B.3.f (1[e][i]), POSITAs would have been motivated to modify Cui's system to replace Cui's external computer with Fu-007's onboard controller structure to implement the control logics of Cui and/or Fu-007, including configuring the onboard controller to implement Fu-007's image-based navigation logic—planning movements based on image thresholds. Janét, ¶209. POSITAs would have recognized that integrating Fu-007's ability to "plan[] a cleaning movement" and execute specific directional movements would result in more effective and efficient cleaning. Fu-007, pp.14-16; Janét, ¶209.

4. Claim 2 Unpatentable over Cui and Fu-007

The Cui-Fu-007 combination renders Claim 2 obvious. Janét, ¶¶212-215.

a. 2[pre], 2[a]-2[c], 2[e]

Limitations 2[pre], 2[a]-2[c], and 2[e] are identical to 1[pre], 1[a]-1[c], and 1[e], respectively. For the reasons in §§IV.B.3.a-d (1[pre], 1[a]-1[c]), Cui discloses

or suggests 2[pre] and 2[a]-2[c]. Additionally, for the reasons in §§IV.B.3.f-h (1[e][i]-[iii]), the Cui-Fu-007 combination discloses or suggests limitation 2[e]. Janét, ¶213.

b. 2[d]

Limitations 2[d] and 1[d] only differ in:

<table>
<tr><td>1[d]</td><td rowspan="2">“camera”</td><td>“mounted directly or indirectly to”</td><td rowspan="2">“the body”</td></tr>
<tr><td>2[d]</td><td>“carried by”</td></tr>
</table>

Cui discloses 2[d] because a camera “mounted directly...to the body” (§IV.B.3.e (1[d])) is also “carried by the body.” Janét, ¶214.

5. Claim 3 Unpatentable over Cui and Fu-007

The Cui-Fu-007 combination renders Claim 3 obvious. Janét, ¶¶216-232.

a. 3[pre], 3[a]-3[c], 3[e][i]

Limitations 3[pre], 3[a]-3[c], and 3[e][i] are identical to 1[pre], 1[a]-1[c], and 1[e][i], respectively. For the reasons in §§IV.B.3.a-IV.B.3.d (1[pre], 1[a]-1[c]), Cui discloses or suggests 3[pre] and 3[a]-3[c]. Additionally, for the reasons in §IV.B.3.f (1[e][i]), the Cui-Fu-007 combination discloses or suggests limitation 3[e][i]. Janét, ¶217.

b. 3[d]

Limitations 3[d] and 1[d] only differ in:

1[d]	"camera"	"mounted directly or indirectly to"	"the body"
3[d]		"positioned on or in, or carried by,"	

Cui discloses 3[d], because a camera "mounted directly...to the body" (§IV.B.3.e (1[d])) is also "positioned on or in, or carried by, the body." Janét, ¶218.

c. 3[e][ii]

The Cui-Fu-007 combination discloses or suggests 3[e][ii]. Janét, ¶¶219-227.

As explained in §IV.B.3.g (1[e][ii]), the Cui-Fu-007 combination discloses or suggests the controller "in electronic communication with the at least one **camera**."

The Cui-Fu-007 combination also discloses or suggests the controller "in electronic communication with...a **portable electronic device**." Janét, ¶221.

Cui's computer 7 includes "a human-machine interface 16" displaying "the cleaned area...denoted by light blue, and the area that has not been cleaned yet...denoted by dark blue so that the working status of the cleaner can be seen at a glance." Cui, pp.6-7, Claim 3, FIG. 4. Importantly, Cui discloses that "[a]utomatic and manual switches are provided on the left of the panel diagram" of this

interface, along with "'start', 'stop', and 'continue' switches." Cui, p.6, FIG. 4. Thus, Cui contemplates a system where the user can intervene, select modes (automatic vs. manual), and control the operation of the cleaner. Janét, ¶222.

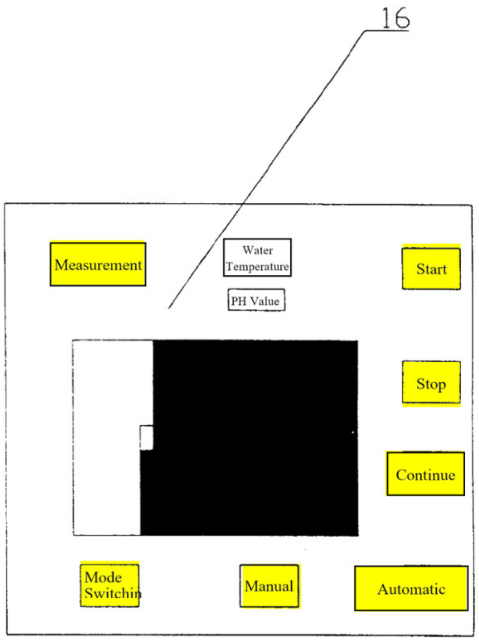


FIG. 4

Fu-007 similarly discloses that two modes of its cleaning robot: "remote control [manual] and autonomous control." Fu-007, Abstract. Fu-007 describes that "[i]n the manual mode, a control signal is sent by manual operation using the **control keyboard (31)**" to "control the underwater cleaning robot via...**buoyant antenna (27)**" that "floats on a water surface to wirelessly communicate with the control keyboard 31" and is "connected to the robot via the **control signal buoyant antenna cable 35**." Fu-007, pp.12-14, FIG. 8 (annotated below); Janét, ¶223.

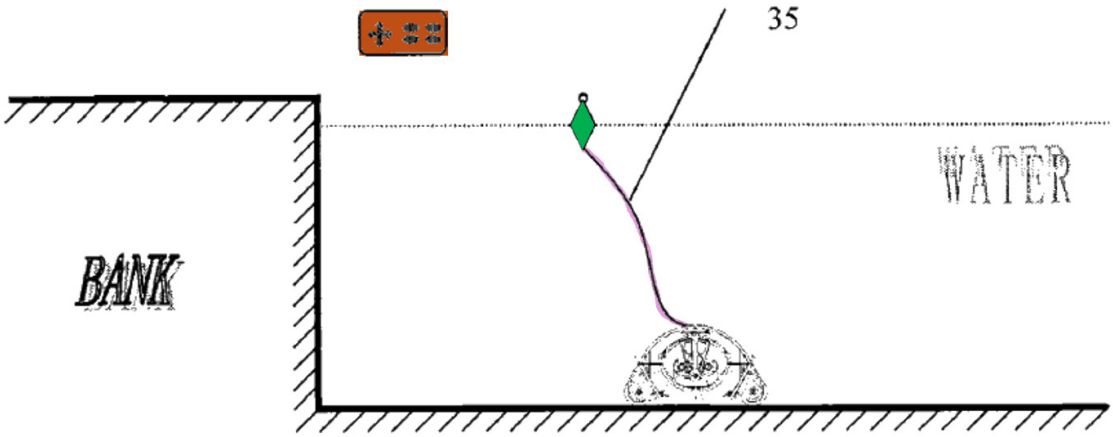


FIG. 8

As explained in §IV.B.3.f (1[e][i]), POSITAs would have been motivated by the disclosure of wireless communication link between portable control keyboard 31 (PED) and the robot in Fu-007 to modify Cui's system to eliminate the external cable and move the controller onboard to improve autonomy and safety. Janét, ¶224. POSITAs would have been further motivated to incorporate Fu-007's "manual mode" functionality (including the control keyboard and buoyant antenna and cable). resulting in a modified system with a dual-mode (wired and wireless) capability, just as Fu-007 disclosed. Fu-007, pp.12-14, FIG. 8; Cui, pp.6-7, Claim 3, FIG. 4; Janét, ¶224.

POSITAs would have made such a modification to preserve Cui's existing manual control capabilities. Cui, pp.6-7, Claim 3, FIG. 4; Janét, ¶225. Cui's system relies on a "human-machine interface" with "manual switches" to allow the user to direct the robot. Cui, p.6. Removing the physical tether (as proposed in 1[e][i])

disconnects this wired interface, and POSITAs would have recognized that utilizing Fu-007's wireless "control keyboard" and "manual mode" provides a functional substitute, restoring the user's ability to manually "start," "stop," or steer the robot. Fu-007, pp.12-14; Cui, pp.6-7; Janét, ¶225.

Additionally, Fu-007 teaches that the wireless antenna mode is specifically advantageous for "short-term local cleaning." Fu-007, p.14. POSITAs would have been motivated to add this capability of Fu-007 to Cui's robot to allow for, e.g., quick cleaning tasks. *Id.*; Janét, ¶226.

POSITAs would have reasonably expected success because Cui already discloses a controller configured to accept "manual" inputs from an interface (Cui, p.6.) and Fu-007 discloses an onboard controller configured to receive "manual mode" signals from a wireless keyboard via an antenna. Fu-007, p.14; Janét, ¶227. Adding Fu-007's wireless input structure to trigger the manual control logic already present in Cui's system would have been a routine integration of known electronic control modules, yielding predictable results. *Id.*

d. 3[e][iii]

The Cui-Fu-007 combination discloses or suggests 3[e][iii]. Janét, ¶¶228-232.

The limitation requires the controller to generate signals in response to at least **one of** the captured **image or the PED**. Janét, ¶229.

The Cui-Fu-007 system satisfies this limitation through the "captured image" prong alone, because as explained in §§IV.B.3.f-h (1[e][i]-[iii]), POSITAs would have been motivated, and reasonably expected success, to incorporate Fu-007's onboard controller and control logic to Cui's system to generate control signals "in response to...the captured image" to steer the vehicle to debris-laden areas (the first portion of the submerged surface). Cui, pp.6-7; Fu-007, pp.14-16; Janét, ¶230.

Additionally, as explained in §IV.B.5.c (3[e][ii]), POSITAs would have been motivated, and reasonably expected success, to modify Cui's system to incorporate Fu-007's "control keyboard" (PED) and "manual mode" functionality to preserve manual control capabilities in the untethered system, allowing the onboard controller is configured to receive information (manual commands) from the PED and accordingly generate control signals to steer the vehicle "to" a specific portion of the submerged surface. Fu-007, pp.12-14, FIG. 8; Cui, pp.6-7, Claim 3, FIG. 4; Janét, ¶231.

6. Claim 4 Unpatentable over Cui and Fu-007

Cui and Fu-007 render Claim 4 obvious. Janét, ¶¶233-236.

a. 4[pre], 4[a]-4[c], 4[e]

Limitations 4[pre], 4[a]-4[c], and 4[e] are identical to limitations 1[pre], 1[a]-1[c], and 1[e], respectively. For the reasons in §§IV.B.3.a-IV.B.3.d (1[pre],

1[a]-1[c]), Cui discloses or suggests 4[pre] and 4[a]-4[c]. Additionally, for the reasons in §§IV.B.3.f-IV.B.3.h (1[e][i]-[iii]), the Cui-Fu-007 combination discloses or suggests limitation 4[e]. Janét, ¶234.

b. 4[d]

Limitation 4[d] is nearly identical to limitation 1[d], differing only in that 4[d] omits the requirement that the camera be "mounted directly or indirectly to the body." Cui discloses 4[d], because a camera "mounted directly...to the body" (§IV.B.3.e (1[d])) satisfies the broader requirement. Janét, ¶235.

C. Ground 2B: Claim 5 is Unpatentable over Cui, Fu-007, and Porat

1. Porat

Porat (EX1016) is prior art under AIA 35 U.S.C.§102(a)(1) and pre-AIA 35 U.S.C.§102(b). Janét, ¶237. Porat is analogous art to the '766 Patent. Janét, ¶238.

Porat discloses an automated robotic pool cleaner 10 with a housing 12, and electrochemical chlorine generator 30 "mounted on the interior of the housing." Porat, Abstract, [0028]-[0029], FIGS. 1-2 (annotated below).

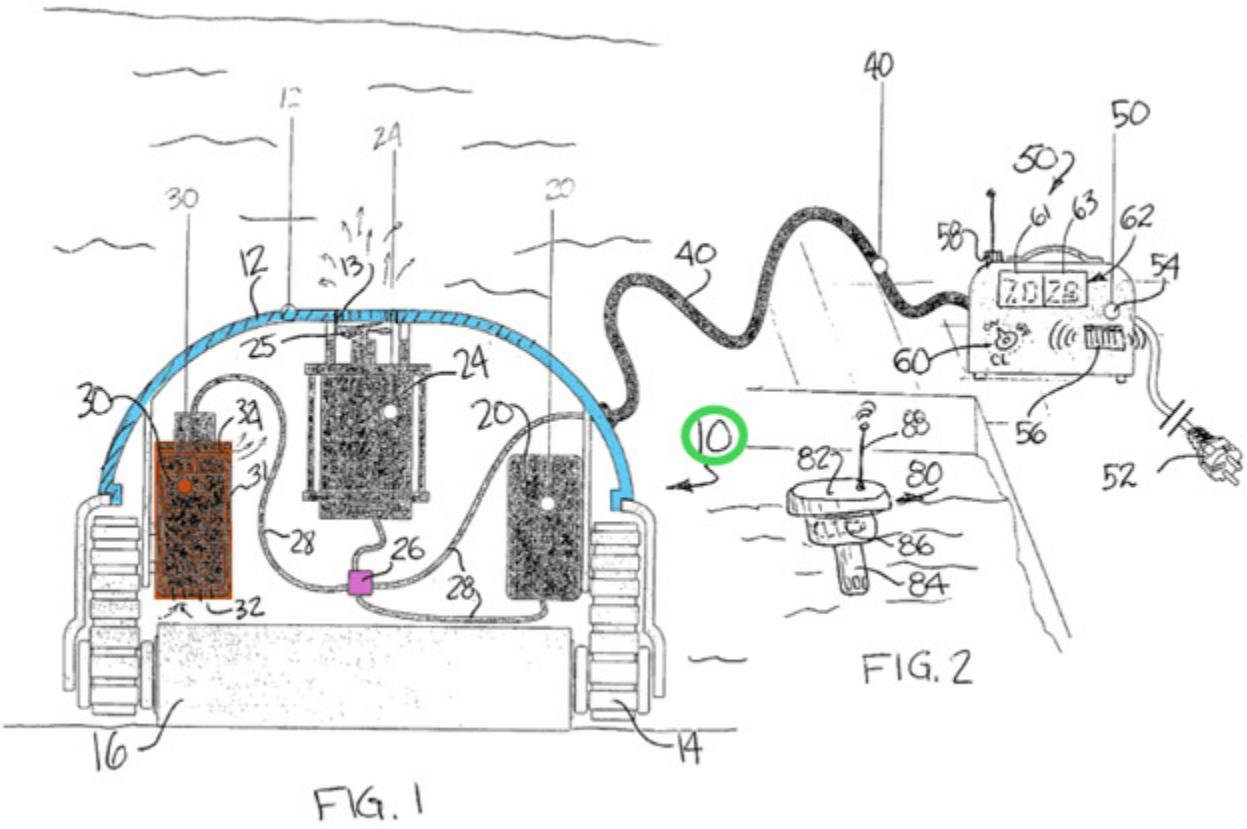


FIG. 2

FIG. 1

Porat's **electronic processor/controller 26** controls electrochemical chlorine generator 30, which includes an outlet to "distribute the chlorine into the water proximate the exterior of the pool cleaner housing." *Id.*, Abstract, [0008], [0010], [0029], Claims 1, 8-9, FIG. 1 (above).

2. Motivation to Combine

Both the Cui-Fu-007 combination and Porat disclose automated self-propelled robotic pool cleaners, and both sought to improve pool maintenance operations. As explained in §IV.B.2, the Cui-Fu-007 combination provides a pool cleaner using camera-based control to autonomously adjust cleaning operations. As explained in §IV.C.1, Porat similarly describes a robotic pool cleaner designed to

improve pool maintenance by providing "a method and apparatus for generating and adding chlorine to pools that is essentially self-contained." Porat, [0005]. POSITAs would have been motivated to combine the complementary teachings of Cui, Fu-007, and Porat to improve autonomous pool maintenance. Janét, ¶242.

POSITAs would have recognized that the teachings in the Cui-Fu-007 combination and Porat provide similar technical solutions to address similar issues. Janét, ¶243. *Compare* Cui, pp.4-6, Claim 1, FIGS. 1-3, *with* Fu-007, pp.7-10, 12-16, Claims 1-3, FIGS.1-3, 4, *and* Porat, [0028], Claims 1-2; §IV.C.1. Accordingly, POSITAs would have investigated the technical teachings in Cui, Fu-007, and Porat to seek guidance when designing a pool cleaning system for specific pool maintenance considerations and applications. Janét, ¶243.

Porat discloses an onboard "electrochemical chlorine generator" (chemical dispenser) distributing chlorine "as the cleaner moves across the pool surfaces." Porat, [0009], [0028], FIGS. 1-2; §IV.C.1. POSITAs would have been motivated to modify the Cui-Fu-007 combination by incorporating Porat's onboard chemical dispenser for at least two reasons. Janét, ¶244.

First, POSITAs would have been guided by Cui, Fu-007, and Porat to make such combination to enhance the cleaning effectiveness of the Cui-Fu-007 pool cleaner by combining mechanical debris removal with Porat's chemical dispenser. Janét, ¶245. POSITAs would have recognized that by incorporating Porat's

chemical dispenser into the Cui-Fu-007 combination, the modified system would have enhanced overall pool maintenance capability—allowing debris removal and chemical application in a single device. *Id.*

Second, POSITAs would have been motivated to adopt this modification to improve convenience and reduce cost. Janét, ¶246. Porat notes conventional generators are expensive and require professional installation, whereas an integrated dispenser is "efficiently and effectively distribut[ing]" chlorine for "uniform concentration," "essentially self-contained," and requires "no installation services...[or] specialized electrical power connections." Porat, [0002], [0005], [0007]; §IV.C.1. POSITAs would have recognized that incorporating Porat's dispenser into Cui-Fu-007 provides these advantages. Janét, ¶246.

POSITAs would have reasonably expected that adding Porat's chemical dispenser into the Cui-Fu-007 cleaner would not require significant modification given their shared components, yielding predictable results. Janét, ¶247.

3. Claim 5 Unpatentable over Cui, Fu-007, and Porat

The Cui-Fu-007-Porat combination renders Claim 5 obvious. Janét, ¶¶248-258.

a. 5[pre], 5[a]-5[c]

Cui discloses or suggests limitations 5[pre] and 5[a]-5[c] for the reasons in §§IV.B.3.a-d (1[pre]-1[c]), because they are identical to 1[pre] and 1[a]-1[c]. Janét, ¶249.

b. 5[d]

The Cui-Fu-007-Porat combination discloses or suggests 5[d]. Janét, ¶¶250-254.

As explained in §IV.B.3.b (1[a]), Cui discloses a pool cleaner comprising a vehicle body including housing 4. Cui, pp.5-6, Claim 1, FIG. 1. Porat describes that **chlorine generator 30** "mounted on the interior of the **housing**" of **pool cleaner 10** and controlled by **integrated circuit device 26**. Porat, [0028], FIGS. 1-2 (annotated below).

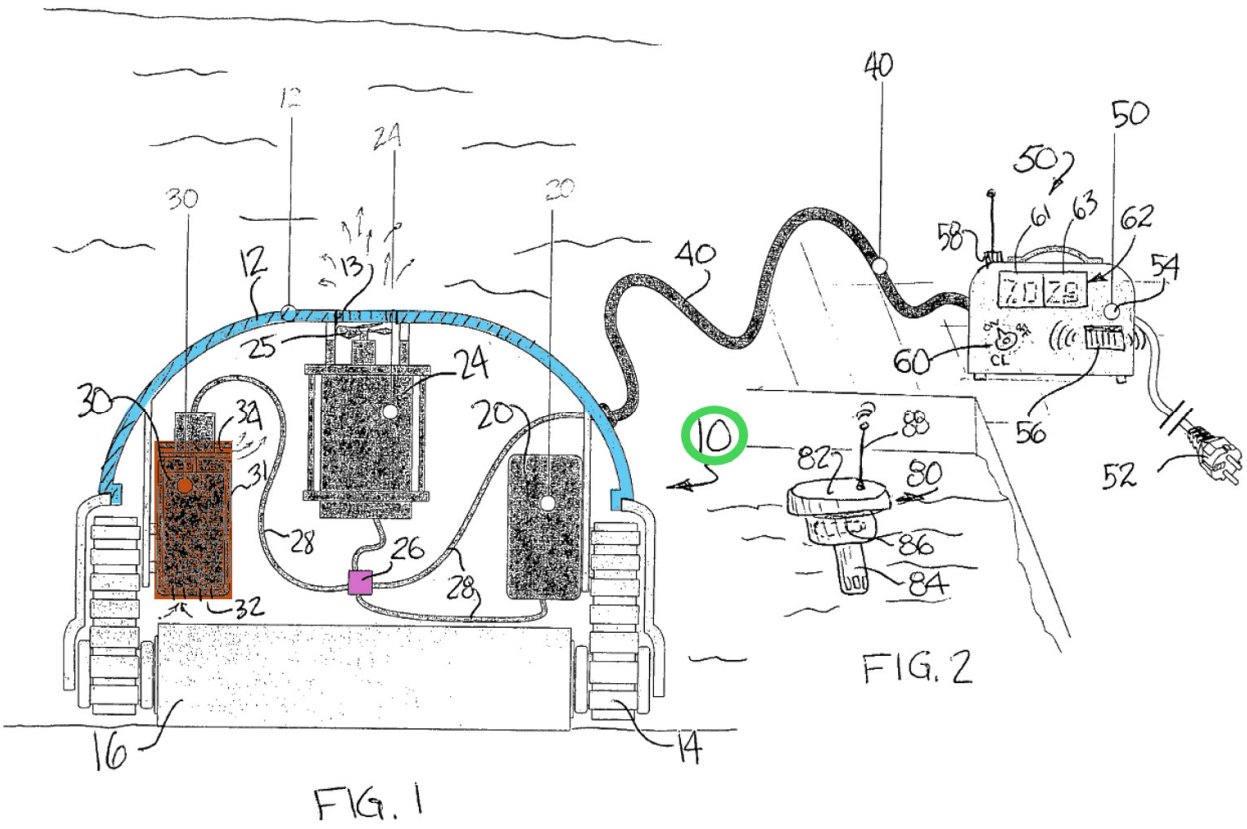


FIG. 2

FIG. 1

As explained in §IV.C.2, POSITAs would have been motivated to add Porat's onboard chemical dispenser to the Cui-Fu-007 combination. Janét, ¶252.

c. 5[e]

Limitations 5[e] and 1[d] only differ in:

1[d]	"camera"	"mounted directly or indirectly to"	"the body"
5[e]		"on, in, or carried by"	"the vehicle body"

Cui discloses 5[e], because a camera "mounted directly...to the body" (§IV.B.3.e (1[d])) is also "on, in, or carried by the vehicle body." Janét, ¶255.

d. 5[f][i]

Limitations 5[f][i] and 1[e][i] only differ in:

1[e][i]	"controller"	"positioned on or in"	"the body"
5[f][i]		"on, in, or carried by"	"the vehicle body"

The Cui-Fu-007 combination discloses 5[f][i], because a controller "positioned on...the body" (§IV.B.3.f (1[e][i])) is also "on, in, or carried by the vehicle body." Janét, ¶256.

e. 5[f][ii]-5[f][iii]

The Cui-Fu-007 combination discloses or suggests limitations 5[f][ii] and 5[f][iii] for the reasons in §§IV.B.3.g-h (1[e][ii]-[iii]), because they are identical to 1[e][ii] and 1[e][iii]. Janét, ¶257.

D. Ground 3A: Claims 1-2 and 4 are Unpatentable under §103 over Knoll

1. Knoll

Knoll (EX1006) is prior art under AIA 35 U.S.C.§102(a)(1) and pre-AIA 35 U.S.C. §102(b). Janét, ¶259.

Knoll discloses an autonomous pool robotic cleaning vehicle with camera-based navigation. Knoll, Title, Abstract, [0001]-[0002], [0007], [0021], [0027], Claims 1-14, FIG. 1 (below). Knoll is analogous art to the '766 Patent. Janét, ¶¶260–262.

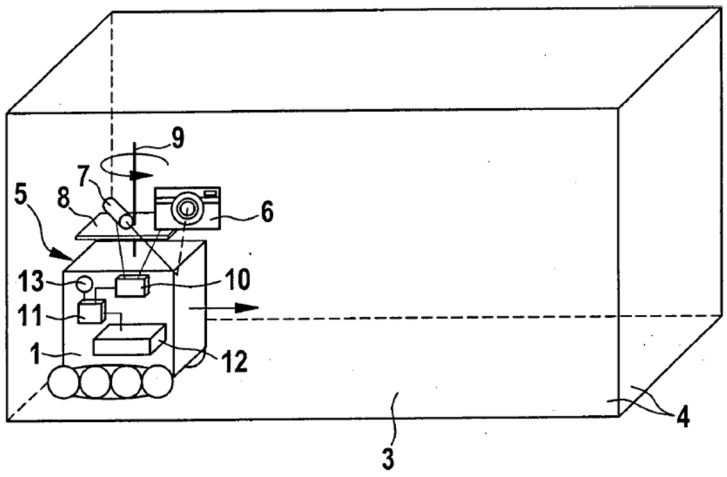


Fig. 1

Knoll's robotic vehicle 1 includes drive means 12, camera 6, light beam source 7, and control unit 11 for controlling the drive means. Knoll, [0007], [0027] [0028], FIGS. 1-2.

Knoll's camera 6 captures images of the boundary surface, which evaluation unit 10 processes to derive "smallest distance measurement values" relative to the boundary. Knoll, [0028]. Control unit 11 uses these image-derived values to "automatically calculate[] a trajectory" and generate control signals that "control[] the drive means 12" to move the vehicle. Knoll, [0028], Claim 2, FIG. 2 (reproduced below).

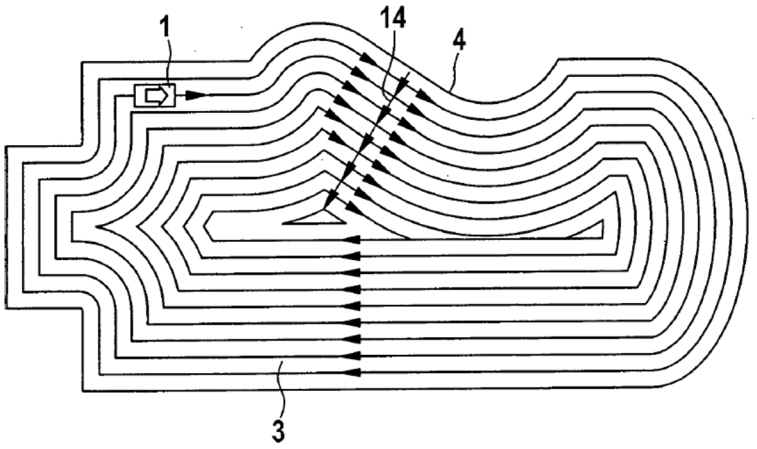


Fig. 2

2. Claim 1 is Unpatentable over Knoll

Knoll renders Claim 1 obvious. Janét, ¶¶263-297.

a. 1[pre]

Knoll discloses or suggests 1[pre]. Janét, ¶¶264-268.

Knoll discloses an "**autonomous robotic** vehicle 1 designed as a pool cleaning vehicle" with "drive means (12) for driving and steering" and a **control unit 11** that controls **drive means 12** and is "designed to **automatically calculate** a trajectory." Knoll, Abstract; [0027]-[0028]; Claims 2, 14, FIG. 1 (annotated below); Janét, ¶267.

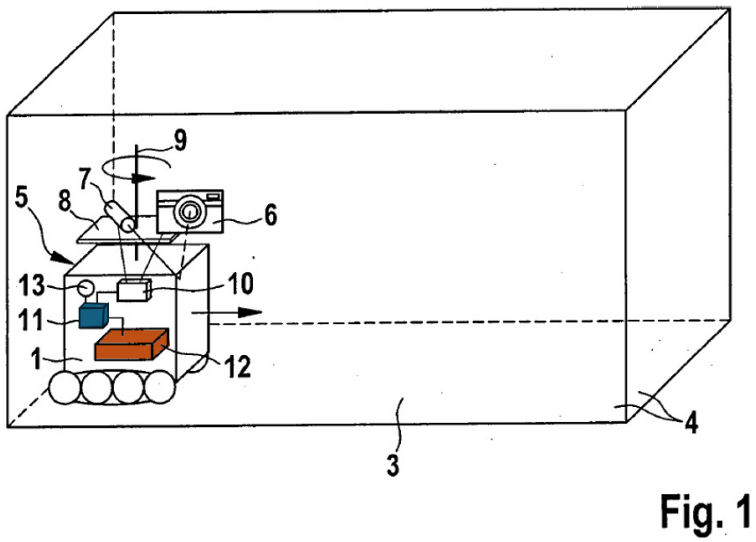


Fig. 1

Knoll, Fig. 1 (annotated)

Knoll's robotic vehicle is a self-propelled pool cleaner that cleans debris from a submerged surface of a swimming pool, because it is a "pool robot with a suction and/or filter and/or cleaning device," its drive means autonomously propels the vehicle under the control of control unit 11, and it operates on "working area 3...formed by the bottom of the pool" and cleans "a pool floor and/or the pool walls." Knoll, [0007], [0027]-[0028], FIG. 1 (below); Janét, ¶268.

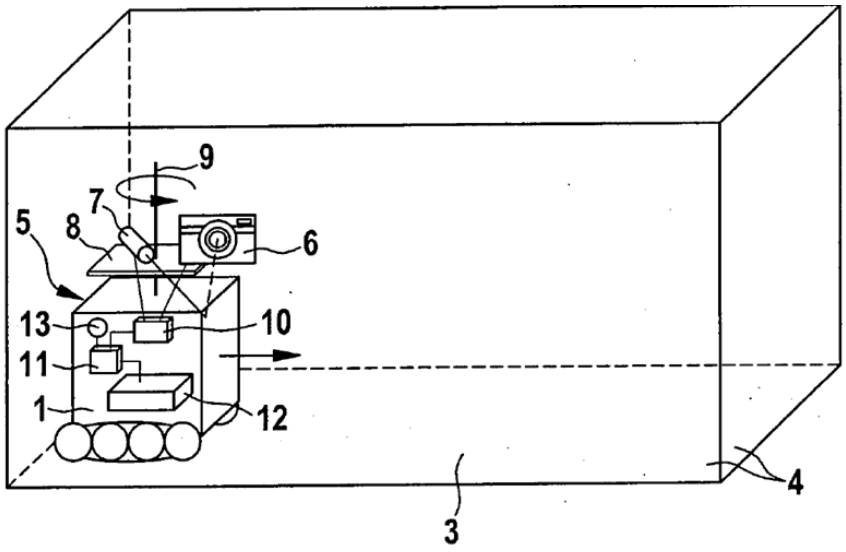


Fig. 1

b. 1[a]

Knoll discloses or suggests 1[a]. Janét, ¶¶269-271.

Knoll's robotic vehicle 1 (system) includes **drive means 12**, **control unit 11**, and suction and/or filter and/or cleaning device. Knoll, Abstract, [0007], [0021], [0027]-[0028], Claims 1-2, 14, FIG.1 (annotated below). POSITAs would have understood that Knoll's robotic vehicle—comprising the integrated physical structure housing these components—includes a "vehicle body." Janét, ¶¶270–271.

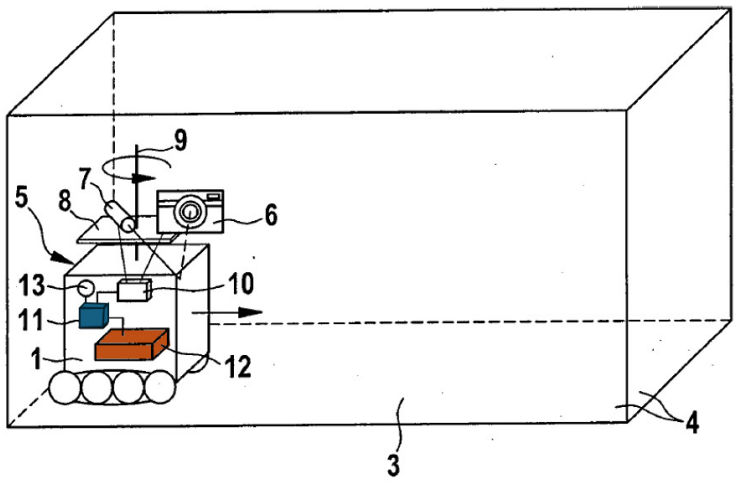


Fig. 1

c. 1[b]

Limitation 1[b] invokes §112¶6/§112(f); the function is "moving the vehicle body within the swimming pool," and the corresponding structure includes "**wheels**...powered by a motor." *See* §III.E.

Knoll discloses this function and structure. Janét, ¶¶272-276. Specifically, Figure 1 shows robotic vehicle 1 with **wheels** contacting the pool bottom, and Knoll describes "**drive means** (12)...for generating propulsion and for steering." Knoll, Abstract, [0028], Claims 1, 14, FIG. 1 (annotated below). POSITAs would have understood "drive means 12" comprises motors powering the wheels, thereby disclosing the corresponding structure. Janét, ¶¶275–276.

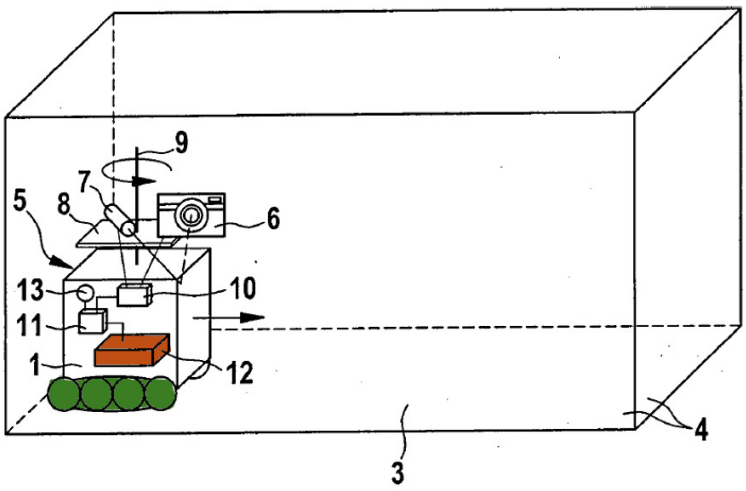


Fig. 1

d. 1[c]

Knoll discloses or suggests 1[c]. Janét, ¶¶277-279.

Knoll discloses 1[c], because its pool cleaning robot includes "a filter device and/or suction device." Knoll, [0007], [0021]. Knoll describes its robot operates on "working area 3...formed by the bottom of the pool" and its control unit is "located inside the robotic vehicle in a waterproof housing." Knoll, [0008], [0027]. POSITAs would have understood that Knoll's suction device draws water containing debris from the pool's submerged surfaces by suction, and the filter device retains this collected debris. Janét, ¶¶278–279.

e. 1[d]

Knoll discloses or suggests 1[d]. Janét, ¶¶280-285.

Knoll discloses 1[d], because Knoll discloses a "distance-determining device 5 (sensor device), which...comprises a...digital **camera 6**" mounted on robotic vehicle 1. Knoll, [0028], FIG. 1 (annotated below); Janét, ¶¶281.

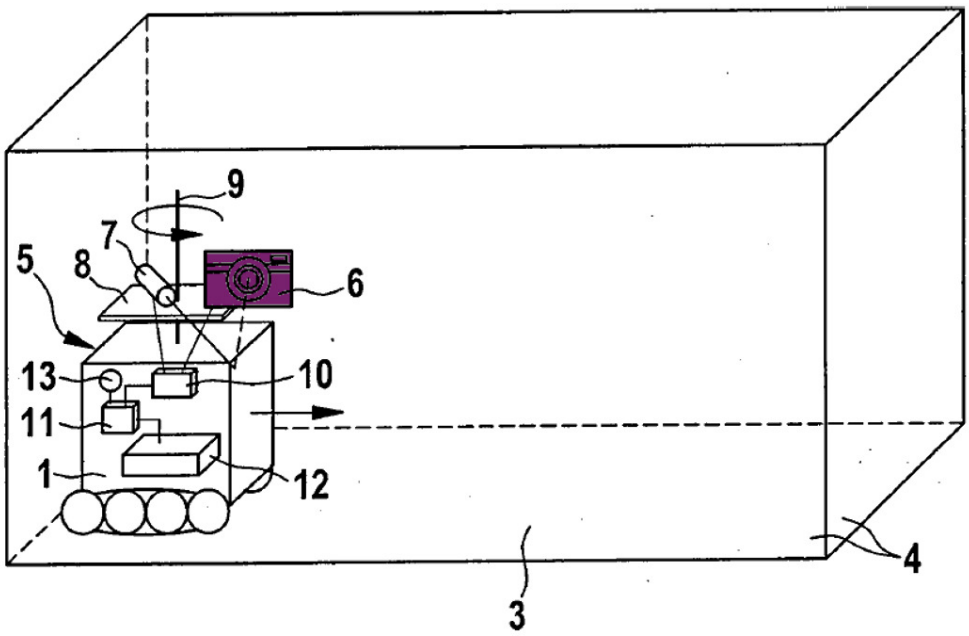


Fig. 1

As explained in §IV.D.2.b (1[a]), Knoll's robotic vehicle includes a "vehicle body," and POSITAs would have understood that camera 6, part of distance-determining device 5 arranged on robotic vehicle 1, is "mounted directly or indirectly to the body." Janét, ¶¶282.

Knoll also discloses "capturing an image of at least a first portion of the submerged surface." Janét, ¶¶283–285. Knoll's camera 6 observes "boundary surface 4" (pool walls), which are submerged surfaces. Knoll, [0007], [0018] (""a light beam is focused on the boundary line or boundary surface and **observed with**

a camera"), [0027]-[0028], FIG. 1; §IV.D.2.a; Janét, ¶¶285. POSITAs would have understood camera 6 captures images of "at least a first portion of the submerged surface" because it views the pool walls/floor to detect the reflected light within the scene. *Id.*

f. 1[e][i]

Knoll discloses or suggests 1[e][i]. Janét, ¶¶286-289.

Knoll's robotic vehicle 1 includes **control unit 11** (controller) inside the vehicle body that controls movement of the vehicle via **drive means 12**. Knoll, Abstract, [0008] ("the **control unit** is preferably **located inside the robotic vehicle** in a waterproof **housing**"), [0007], [0021], [0027]-[0028], Claims 1-2, 14, FIG.1 (annotated below); Janét, ¶¶289.

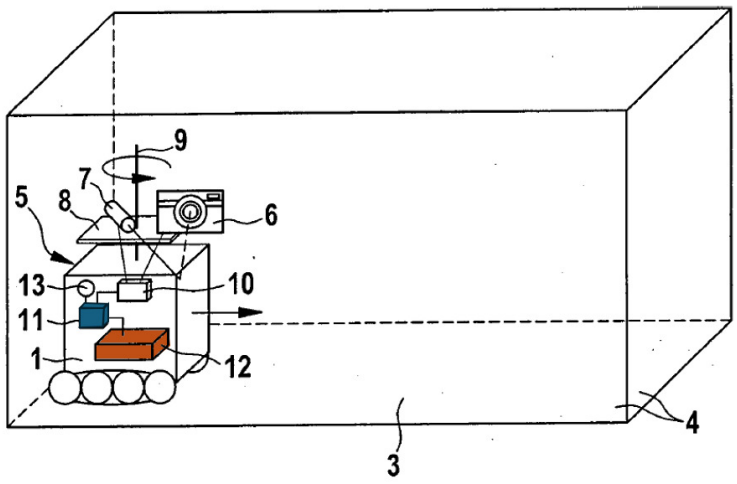


Fig. 1

g. 1[e][ii]

Knoll discloses or suggests its control unit (controller) is in electronic communication with camera 6, because it receives and processes image data from camera 6. Knoll, [0018], [0028], FIG. 1 (annotated below); Janét, ¶¶290–292. Knoll explains that "the distance-determining device uses...the rotating **camera** to determine the distance to the boundary line or boundary surface" and that the device includes an **evaluation unit 10**, part of a **control unit 11**, for determining the measured distance values. *Id.*

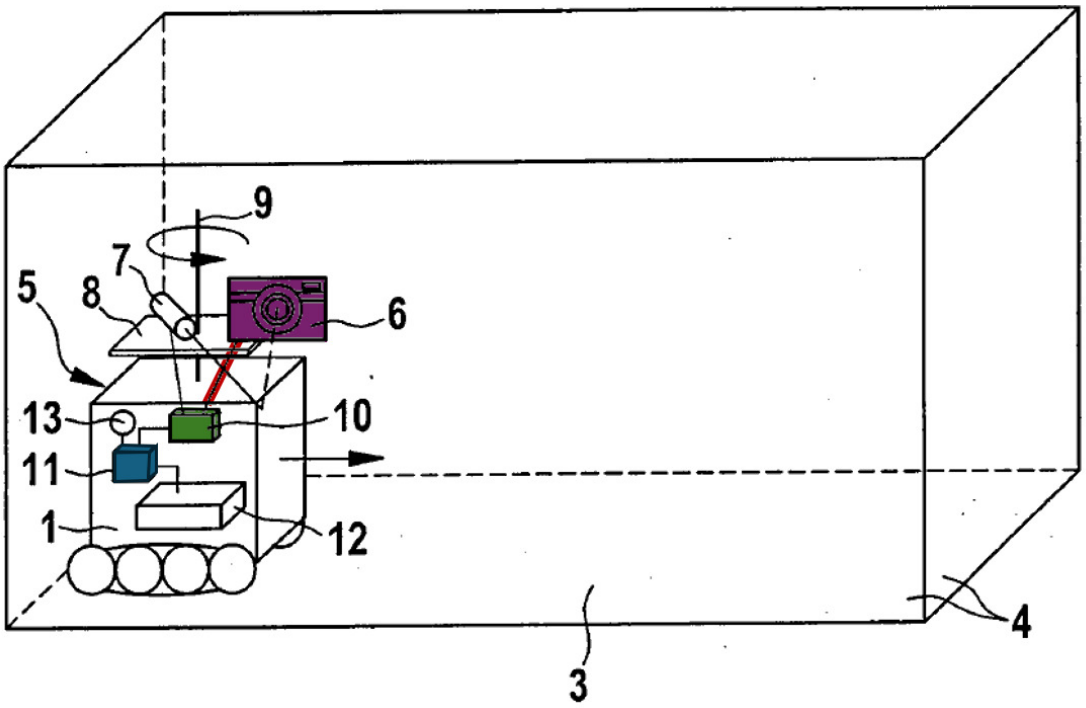


Fig. 1

h. 1[e][iii]

Knoll discloses or suggests 1[e][iii]. Janét, ¶¶293-296.

Knoll discloses generating control signals "in response to the captured image." Knoll's control unit 11 (controller) receives sensor information from distance-determining device 5 (which includes camera 6) and "controls the drive means 12 as a function of...quasi-continuously determined smallest distance measurement values." Knoll, [0028]. POSITAs would have understood that Knoll's control unit generates control signals "in response to the captured image" because the control signals are based on distance measurements derived from images captured by camera 6. Knoll, [0018]; Janét, ¶¶294.

Knoll also discloses generating control signals to cause movement "to, or away from," a portion of boundary surface 4 (first portion of the submerged surface), because Knoll's control unit controls drive means 12 so that "the robotic vehicle maintains a defined distance from the boundary line and/or boundary surface" as the vehicle travels. Knoll, [0011], Claim 4, FIG. 2 (below); §IV.D.2.e; Janét, ¶¶295.

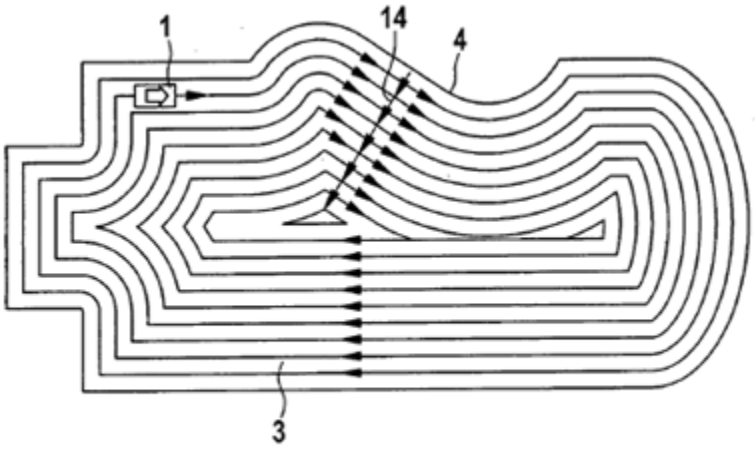


Fig. 2

POSITAs would have understood that, to maintain a defined distance from boundary surface 4, Knoll's control unit generates control signals that move the vehicle body **away** from boundary surface 4 when the distance becomes too small and **toward** it when too large. Janét, ¶296.

3. Claim 2 Unpatentable over Knoll

Knoll renders Claim 2 obvious. Janét, ¶¶298-301.

a. 2[pre], 2[a]-2[c], 2[e][i]-[iii]

Limitations 2[pre], 2[a]-2[c], and 2[e][i]-[iii] are identical to 1[pre], 1[a]-1[c], and 1[e][i]-[iii], respectively. For the reasons in §§IV.D.2.a-d, f-h (1[pre], 1[a]-1[c], 1[e][i]-[iii]), Knoll discloses or suggests 2[pre], 2[a]-2[c], 2[e][i]-[iii].

b. 2[d]

Limitations 2[d] and 1[d] only differ in:

<table>
<tr><td>1[d]</td><td rowspan="2">“camera”</td><td>“mounted directly or indirectly to”</td><td rowspan="2">“the body”</td></tr>
<tr><td>2[d]</td><td>“carried by”</td></tr>
</table>

Knoll discloses 2[d], because Knoll’s camera “mounted directly...to the body” (§IV.D.2.e (1[d])) is also “carried by the body.” Janét, ¶300.

4. Claim 4 Unpatentable over Knoll

Knoll renders Claim 4 obvious. Janét, ¶¶302-305.

a. 4[pre], 4[a]-4[c], 4[e][i]-[iii]

Limitations 4[pre], 4[a]-4[c], and 4[e][i]-[iii] are identical to 1[pre], 1[a]-1[c], and 1[e][i]-[iii], respectively. For the reasons in §§IV.D.2.a-d, f-h (1[pre], 1[a]-1[c], 1[e][i]-[iii]), Knoll discloses or suggests 4[pre], 4[a]-4[c], and 4[e][i]-[iii].

b. 4[d]

Limitation 4[d] is nearly identical to limitation 1[d], differing only in that 4[d] omits the requirement the camera be “mounted directly or indirectly to the body.” Janét, ¶304. Knoll discloses 4[d], because a camera “mounted directly...to the body” (§IV.D.2.e (1[d])) satisfies the broader requirement. *Id.*

E. Ground 3B: Claim 3 Is Unpatentable over Knoll and Fu-957

1. Fu-957

Fu-957 (EX1015), which is analogous art, discloses a pool cleaning robot comprising a cleaning robot main unit with a filter, housing body, transmission systems, cleaning rollers, and control circuit board. Fu-957, Abstract, Claim 1-2, pp.6-7[5], FIGS. 1-2 (below); Janét, ¶¶306-310.

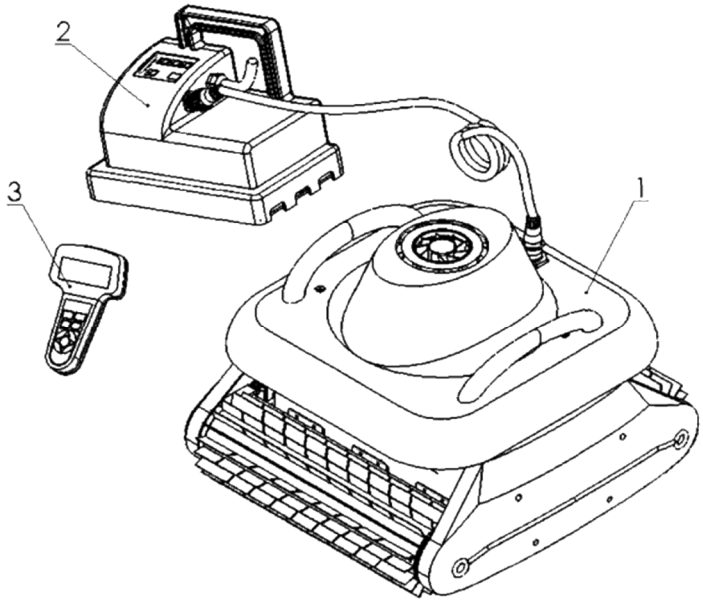


Figure 1

[5] [5] Page citations to Fu-957 are to the original pagination in the bottom center of each page.

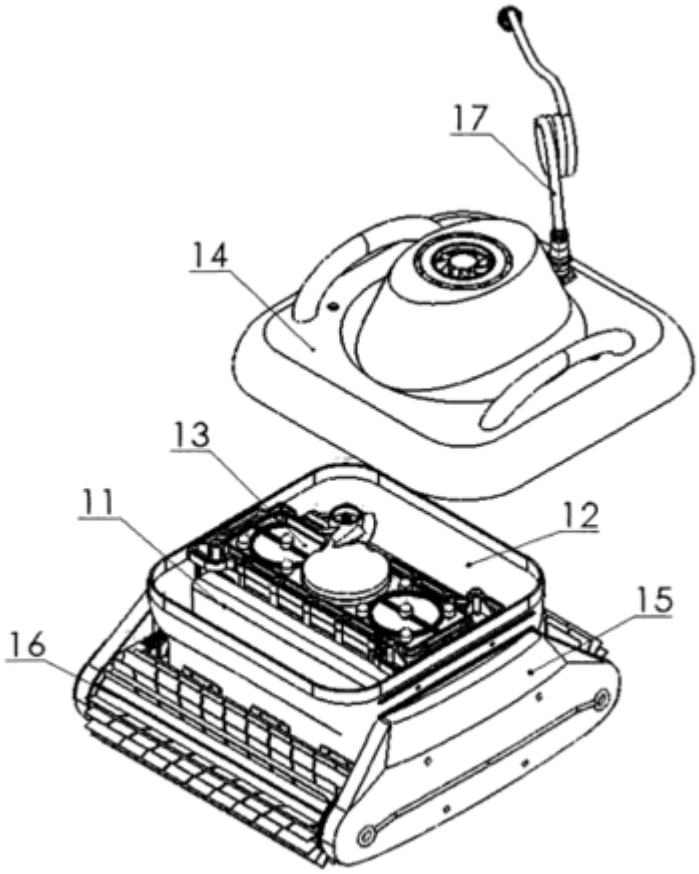


Figure 2

Fu-957's underwater controller includes a microcontroller (MCU) that processes sensor data and generates control signals to control the drive motors 139A and thereby the transmission systems 15. *Id.*, pp.7-9, 16-18, FIGS. 13, 15-16.

Fu-957's system also includes a **remote controller 3** is a portable handheld device comprising a display screen 33, membrane keys 39, communication circuit board 34, and battery box 35. *Id.*, p.14, Claim 6, FIG. 4 (below). The remote controller provides two-way communication with the cleaning robot main unit via the **power control box 2** and **self-buoyant cable 17**, enabling the display screen to

show "an operating status of the cleaning robot main unit" and the keys to "set an automatic work mode and manual operations." *Id.*, Abstract, Claim 6, pp.10, 14, FIGS.12-13 (annotated below).

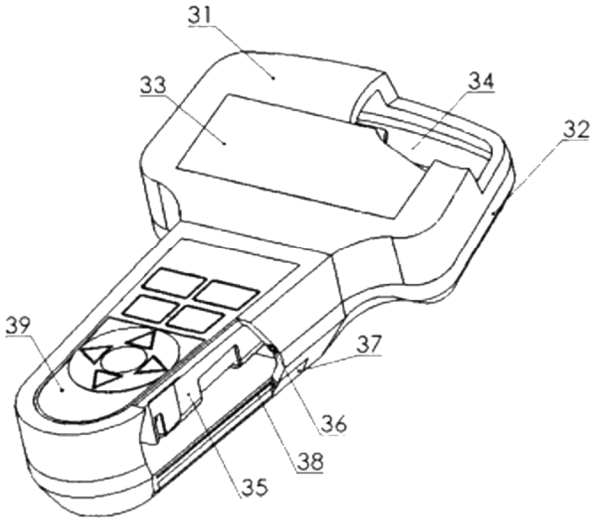


Figure 4

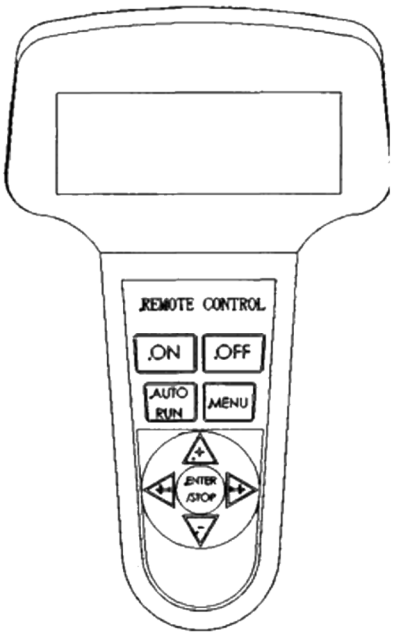


Figure 12

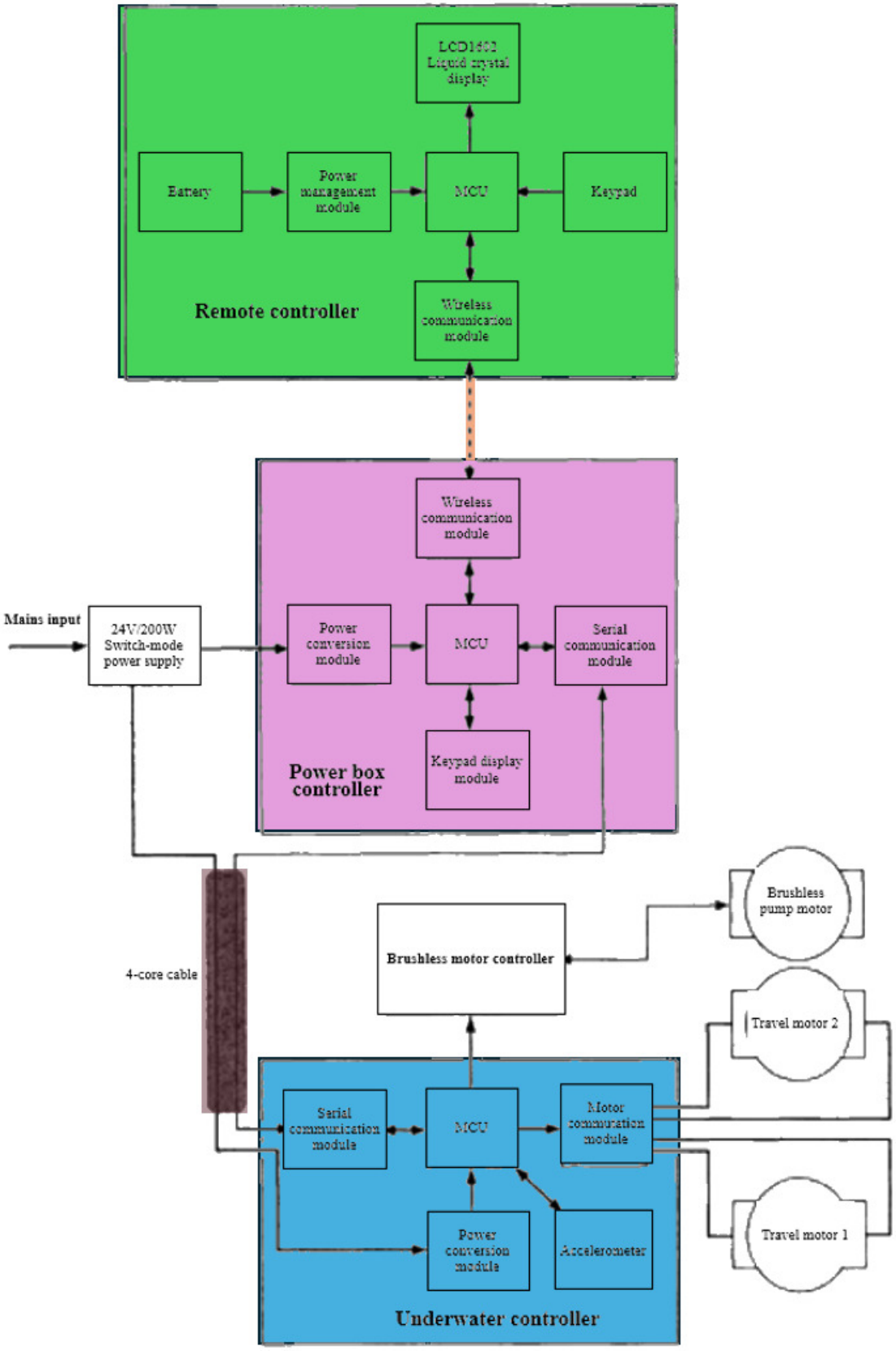

LCD1602 Liquid crystal display
Battery
Power management module
MCU
Keypad
Remote controller
Wireless communication module
Wireless communication module
Mains input
24V/200W Switch-mode power supply
Power conversion module
MCU
Serial communication module
Keypad display module
Power box controller
4-core cable
Brushless motor controller
Brushless pump motor
Travel motor 2
Serial communication module
MCU
Motor communication module
Power conversion module
Accelerometer
Travel motor 1
Underwater controller

Figure 13

When the keys are pressed, the cleaning robot main unit "crawl[s] and clean[s] along the path controlled by the operator's intention." *Id.*, p.18.

2. Motivations to Combine

Both Knoll and Fu-957 disclose autonomous pool cleaning robots, and both sought to improve pool cleaning operations. *See* Knoll, [0005], [0007]; Fu-957, Abstract; Janét, ¶315. POSITAs would have been motivated to add complementary teachings of Fu-957 to Knoll to improve pool cleaning with, e.g., enhanced user control Fu-957 teaches (Fu-957, pp.10, 14). Janét, ¶315.

POSITAs would have recognized that both are directed to the same pool cleaning technical field and provide similar technical solutions to address similar issues. Janét, ¶316. Specifically, both disclose self-propelled pool cleaners having an onboard controller that processes sensor data and generates control signals for navigation. *Compare* Knoll, [0007]-[0008], [0027]-[0028], FIG. 1 *with* Fu-957, Abstract, Claim 1, pp.6-10, 16-18; §IV.E.1. Thus, POSITAs would have investigated the technical teachings in both to seek guidance when designing a pool cleaning system. Janét, ¶316.

Knoll's robotic vehicle 1 operates autonomously under the control of control unit 11. Knoll, [0028], Claim 2. Fu-957 discloses a portable remote controller 3 that enables two-way communication with the pool cleaner and allows user control of cleaning operations. *See* §IV.E.1.

POSITAs would have been motivated to add Fu-957's remote control functionalities into Knoll to enable users to manually direct Knoll's cleaner to specific areas or override automatic operation when desired, complementing Knoll's autonomous cleaning capabilities. Knoll, Abstract, [0027]-[0028]; Fu-957, p.18; Janét, ¶318.

POSITAs would also have been motivated to make this modification to add Fu-967's remote monitoring (Fu-957, p.10, Claim 6) to Knoll, providing users with real-time monitoring into Knoll's cleaning operations and alert users to potential problems, thereby improving user experience and facilitating timely maintenance. Janét, ¶319.

POSITAs would reasonably expected success because Fu-957 demonstrates a working implementation of two-way communication between a portable remote controller and an underwater pool cleaning robot via a power control box relay. §IV.E.1; Fu-957, pp.10, 18, Claim 6, FIG. 13; Janét, ¶320. Because Fu-957's communication architecture—including portable remote controller 3, power control box relay 2, and cable connection 17—is already designed for integration with a pool cleaning robot having an onboard controller, POSITAs would have reasonably expected that Fu-957's communication architecture could be integrated with Knoll, yielding predictable results. Janét, ¶320.

3. Claim 3 Unpatentable over Knoll and Fu-957

The Knoll-Fu-957 combination renders Claim 3 obvious. Janét, ¶¶321-333.

a. 3[pre], 3[a]-3[c], 3[e][i]

Knoll discloses 3[pre], 3[a]-3[c], and 3[e][i] for the reasons in §§IV.D.2.a-d, f (1[pre]-1[c], 1[e][i]), because they are identical to 1[pre], 1[a]-1[c], and 1[e][i]. Janét, ¶322.

b. 3[d]

Limitation 3[d] is nearly identical to 1[d], differing only:

<table>
<tr><td>1[d]</td><td rowspan="2">“camera”</td><td>“mounted directly or indirectly to”</td><td rowspan="2">“the body”</td></tr>
<tr><td>3[d]</td><td>“positioned on or in, or carried by,”</td></tr>
</table>

Knoll discloses 3[d], because a camera “mounted directly...to the body” (§IV.D.2.e (1[d])) is also “positioned on or in, or carried by, the body.” Janét, ¶323.

c. 3[e][ii]

The Knoll-Fu-957 combination discloses or suggests 3[e][ii]. Janet, ¶¶324-330.

As explained in §IV.D.2.g (1[e][ii]), Knoll discloses the controller “in electronic communication with the at least one **camera**.”

The Knoll-Fu-957 combination discloses the controller “in electronic communication with...a **portable electronic device**.” Janét, ¶326.

Fu-957 discloses a portable remote controller 3 (portable electronic device, "PED") for user control of pool cleaning operations. Fu-957, Title, Abstract, Claims 1, 6, FIGS. 1, 4, 12; §IV.E.1; Janét, ¶327. Fu-957 further discloses electronic communication between remote controller 3 (PED) and the underwater controller inside the cleaning robot main unit via power control box 2. As shown in FIG. 13 (annotated below), Fu-957's remote controller 3 communicates wirelessly with power control box 2, which communicates with the underwater controller via self-buoyant cable 17. Fu-957, Claim 6, p.14, FIG. 13.

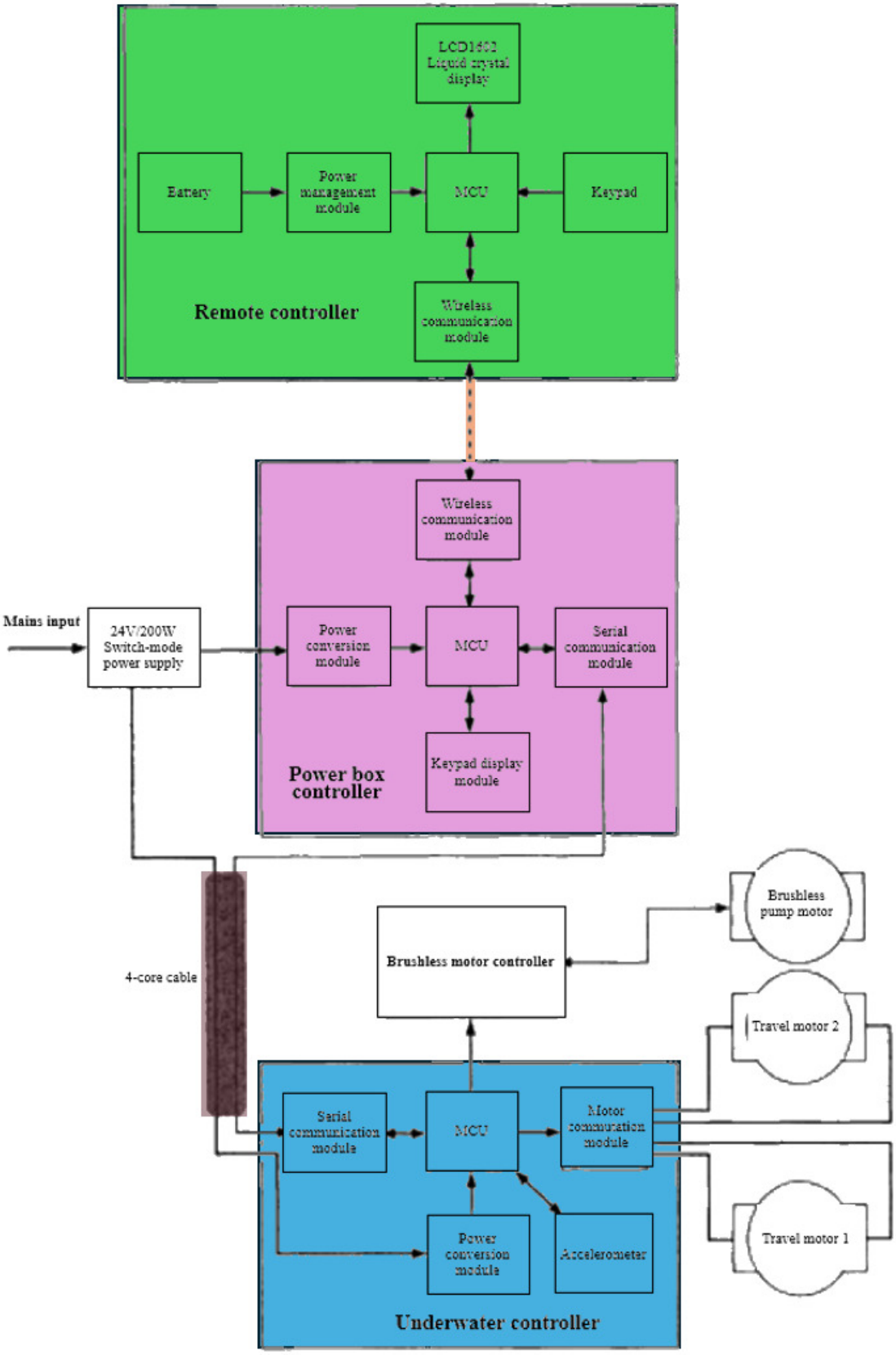

LCD1602 Liquid crystal display
Battery
Power management module
MCU
Keypad
Remote controller
Wireless communication module
Wireless communication module
Mains input
24V/200W Switch-mode power supply
Power conversion module
MCU
Serial communication module
Keypad display module
Power box controller
4-core cable
Brushless motor controller
Brushless pump motor
Travel motor 2
Serial communication module
MCU
Motor communication module
Power conversion module
Accelerometer
Travel motor 1
Underwater controller

Figure 13

As explained in §IV.E.2, POSITAs would have been motivated to combine Knoll with Fu-957's remote controller (PED) and communication/control mechanism between an onboard controller and the remote controller. Janét, ¶329.

In the Knoll-Fu-957 combination, Knoll's control unit 11 (controller) would be: (1) in electronic communication with camera 6 (as explained in §IV.D.2.g) and a PED (per Fu-957's remote controller 3); (2) configured to receive control commands from Fu-957's PED via power control box 2; and (3) configured to generate control signals to control the vehicle to "crawl and clean along the path controlled by the operator's intention" based on signals indicating the pressed manual control keys. §IV.E.2; Knoll, [0008], [0028]; Fu-957, Claim 6, pp.10, 14, 18, FIG. 13; Janét, ¶330. As explained in §IV.E.2, POSITAs would have a reasonable expectation of success in implementing this combination. Janét, ¶330.

d. 3[e][iii]

Knoll discloses or suggests 3[e][iii] because as explained in §IV.D.2.h (1[e][iii]), Knoll discloses control unit 11 configured to generate, "in response to...the captured image," at least one control signal to cause movement "to, or away from, the first portion of the submerged surface. Knoll, [0011], [0018], [0028]; Janét, ¶¶331-332.

F. Ground 3C: Claim 5 Is Unpatentable over Knoll and Porat

1. Motivation to Combine

Both Knoll and Porat disclose autonomous pool cleaning robots. *See* §IV.D.1, §IV.C.1. POSITAs would have been motivated to combine the teachings of Knoll and Porat to improve pool cleaning. Janét, ¶334.

POSITAs would have recognized that both provide complementary technical solutions to address pool maintenance issues. Janét, ¶335. Both references disclose self-propelled pool cleaners having drive means for moving the pool cleaner and an onboard controller for navigation. *Compare* Knoll, [0007]-[0008], [0027]-[0028], FIG. 1, *with* Porat, Abstract, [0029], FIGS. 1-2. Accordingly, POSITAs would have investigated both to seek guidance when designing a pool cleaning system. Janét, ¶335.

Porat discloses an integrated electrochemical generator 30 (chemical dispenser) for "produc[ing] and distribut[ing] chlorine ions...as the cleaner moves". Porat, [0009], [0028], Claim 1. POSITAs would have been motivated to including Porat's chemical dispenser to Knoll to create a single autonomous device capable of performing both mechanical cleaning and chemical sanitization in one pass. Janét, ¶¶336-337. Additionally, POSITAs would have recognized that because Knoll's vehicle traverses the pool surfaces along calculated trajectories, equipping it with Porat's dispenser would "efficiently and effectively distribute[] the

chlorine" into the water as the cleaner travels. Knoll, [0005], [0010]-[0012]; Porat, Abstract, [0009], [0028], Claim 1; Janét, ¶338.

POSITAs would have reasonably expected success because incorporating a chemical dispenser into a robotic pool cleaner like Knoll's had been well-known, and such modification to Knoll would have yielded predictable results. Porat, [0028]; Durvasula, [0015]; Knoll, [0007], [0027]-[0028]; Janét, ¶339.

2. Claim 5 Unpatentable over Knoll and Porat

The Knoll-Porat combination renders Claim 5 obvious. Janét, ¶¶340-350.

a. 5[pre], 5[a]-5[c], 5[f][ii]-5[f][iii]

Limitations 5[pre], 5[a]-5[c], 5[f][ii], and 5[f][iii] are identical to limitations 1[pre], 1[a]-1[c], 1[e][ii], and 1[e][iii], respectively. For the reasons in §§IV.D.2.a-d and IV.D.2.g-h (1[pre], 1[a]-1[c], 1[e][ii]-[iii]), Knoll discloses or suggests 5[pre], 5[a]-5[c], and 5[f][ii]-5[f][iii]. Janét, ¶341.

b. 5[d]

The Knoll-Porat combination discloses or suggests 5[d]. Janét, ¶¶342-346.

As explained in §IV.D.2.b (1[a]), Knoll discloses robotic vehicle 1 comprising a vehicle body including housing 2. Janét, ¶343.

As explained in §IV.C.1, Porat discloses a robotic pool cleaner with an **onboard electrochemical generator 30** (chemical dispenser) that "produc[es] chlorine" and "distributes chlorine ions...as the cleaner moves." Porat, Abstract,

[0009], [0028]; Janét, ¶344. Porat, Abstract, [0009], [0028], Claims 1, 11, 16, FIGS. 1-2 (annotated below).

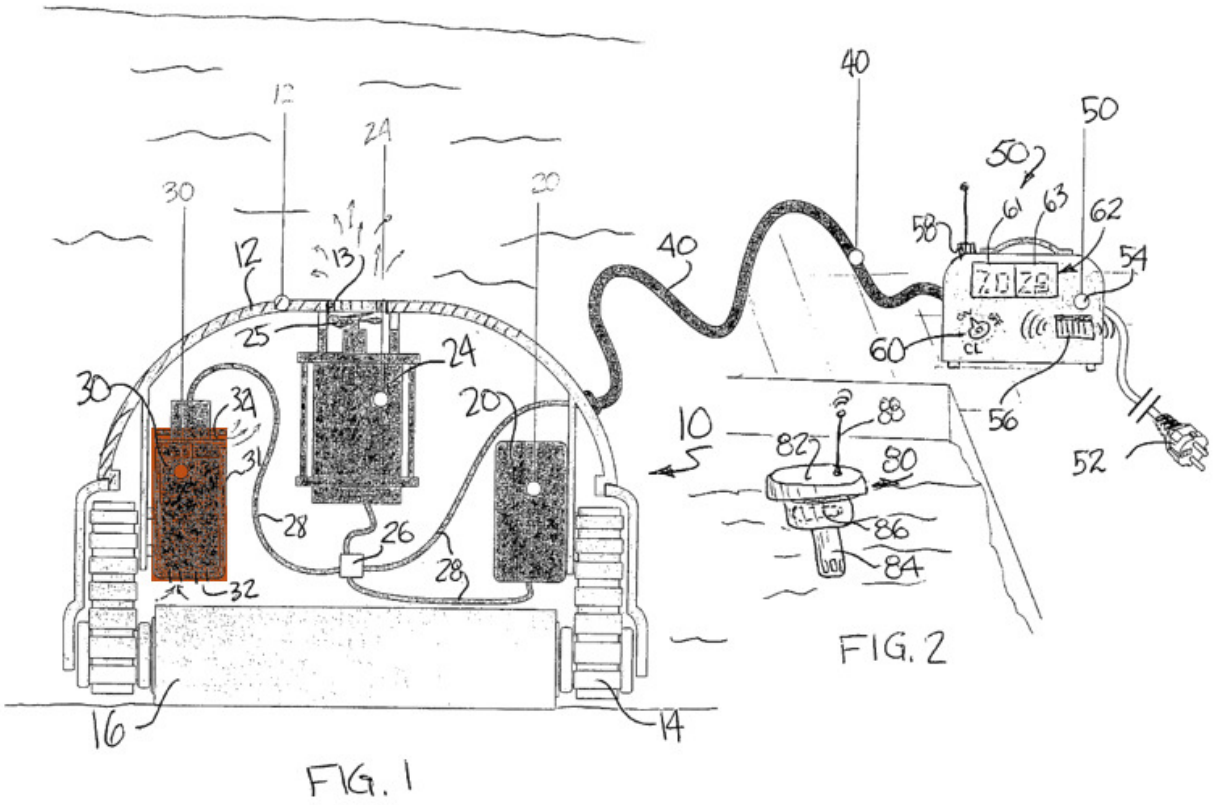


FIG. 2

FIG. 1

As explained in §IV.F.1, POSITAs would have been motivated to incorporate Porat's chemical dispenser into Knoll's housing 2 (vehicle body) with a reasonable expectation of success.

c. 5[e]

Limitations 5[e] and 1[d] only differ in:

1[d]	"camera"	"mounted directly or indirectly to"	"the body"
5[e]		"on, in, or carried by"	"the vehicle body"

As explained above in §IV.D.2.e (1[d]), Knoll discloses "at least one camera mounted directly...to the body." Thus, Knoll also discloses limitation 5[e], because a camera that is "mounted directly...to the body" is also "on, in, or carried by the vehicle body." Janét, ¶347.

d. 5[f][i]

Limitations 5[f][i] and 1[e][i] only differ in:

1[e][i]	"controller"	"positioned on or in"	"the body"
5[f][i]		"on, in, or carried by"	"the vehicle body"

Knoll discloses 5[e], because a camera "mounted directly...to the body" (§IV.D.2.f (1[d])) is also "on, in, or carried by the vehicle body." Janét, ¶348.

e. 5[f][ii]-5[f][iii]

Limitations 5[f][ii] and 5[f][iii] are identical to limitations 1[e][ii] and 1[e][iii], respectively. For the reasons in §§IV.D.2.g-h (1[e][ii] and 1[e][iii]), Knoll discloses or suggests 5[f][ii] and 5[f][iii]. Janet, ¶349.

G. Ground 4A: Claims 1-4 Are Unpatentable under §103 over Renaud

1. Renaud

Renaud (EX1017) is prior art and is analogous art. Janet, ¶¶351-352.

Renaud discloses a "pool cleaner." Renaud, Abstract, [0002], [0022]-[0023], [0037], [0039], FIGS. 1-3 (**cleaners 200/200a'/200b'/200c'/200**"; annotated below).

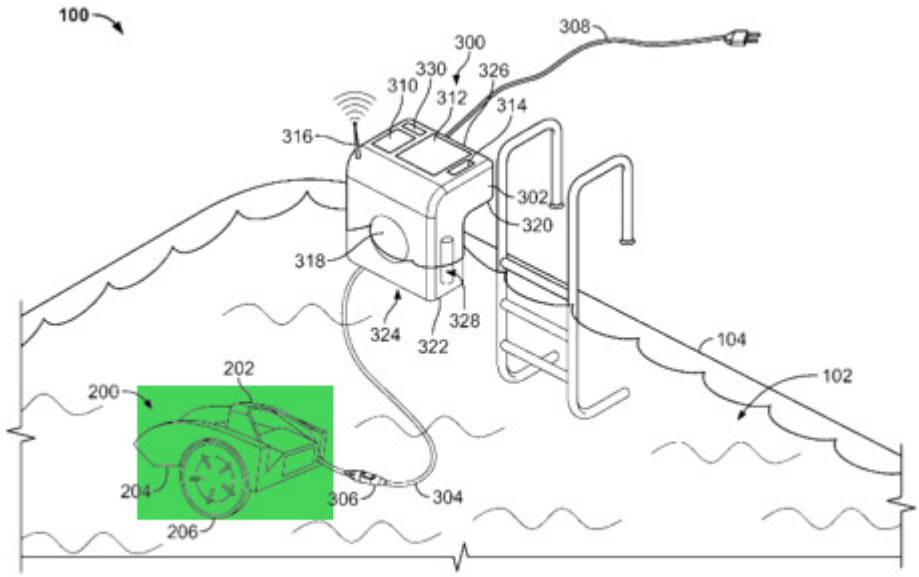


FIG. 1

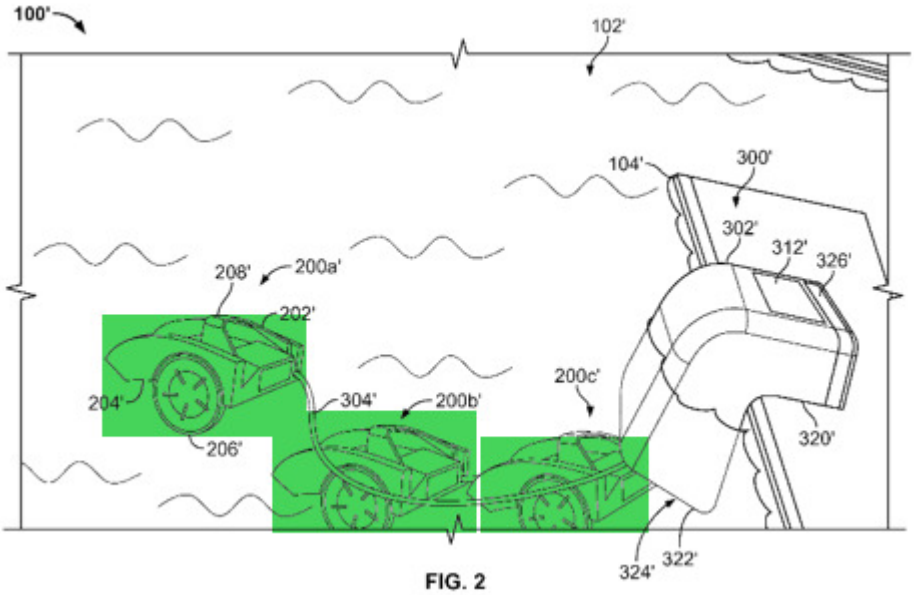


FIG. 2

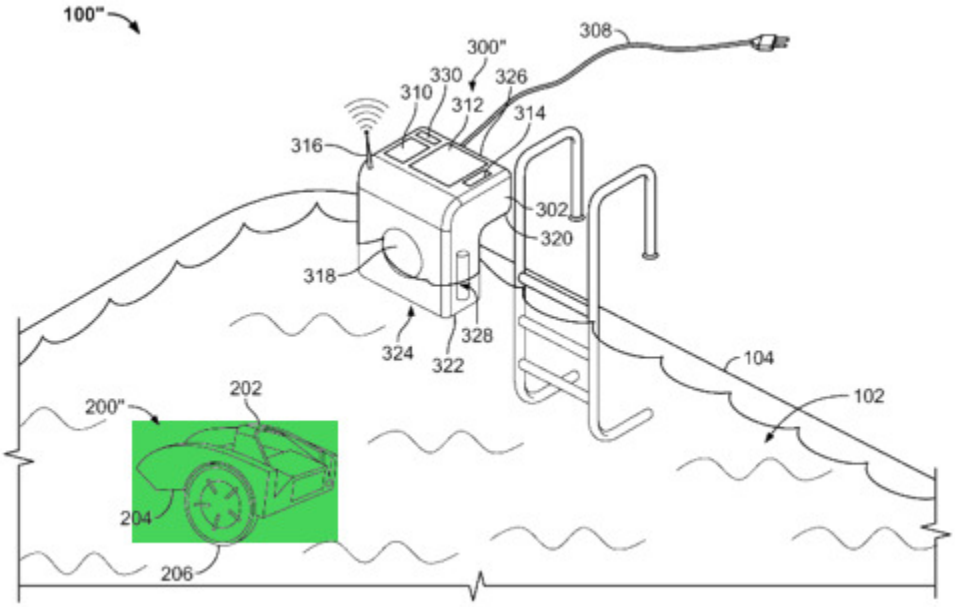


FIG. 3

2. Claim 1 Unpatentable over Renaud

Renaud renders Claim 1 obvious. Janét, ¶¶353-381 .

a. 1[pre]

Renaud discloses or suggests 1[pre]. Janét, ¶¶354-357.

Renaud discloses a "pool cleaner." Renaud, Abstract, [0002], [0022]-[0023], [0037], [0039], FIGS. 1-3 (**cleaners 200/200a'/200b'/200c'/200**"; annotated below). Renaud describes that its robotic pool cleaners move along the pool floor and/or walls to clean debris from the pool surfaces. Renaud, [0003].

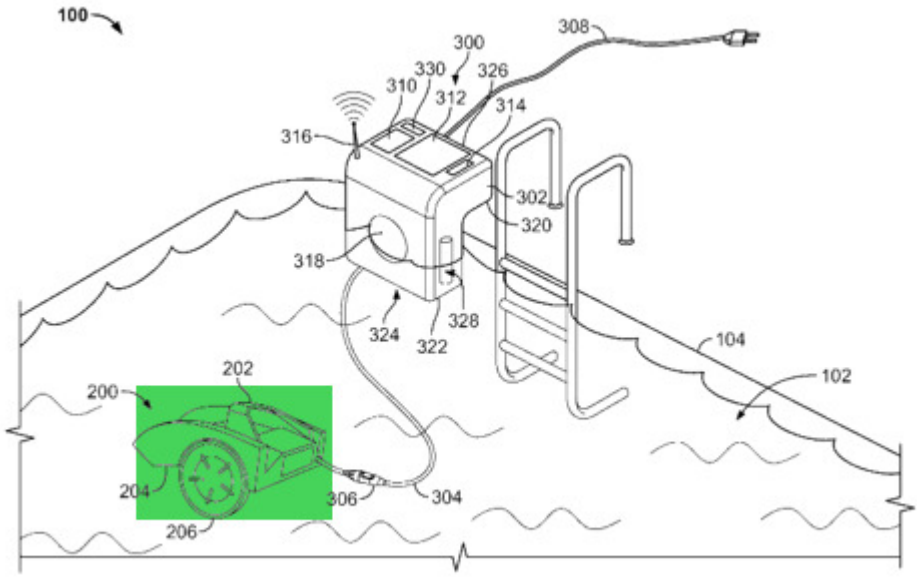

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FIG. 1

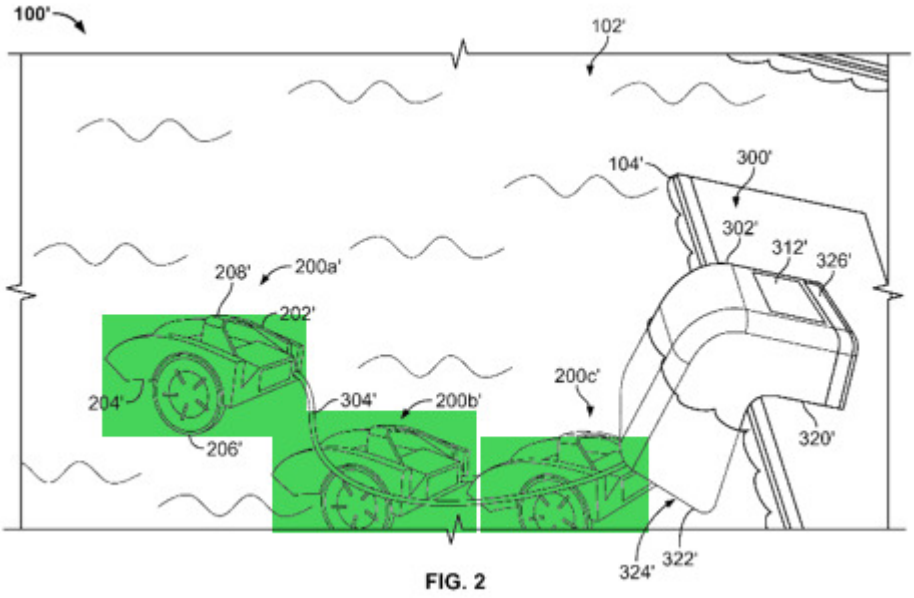

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322'

FIG. 2

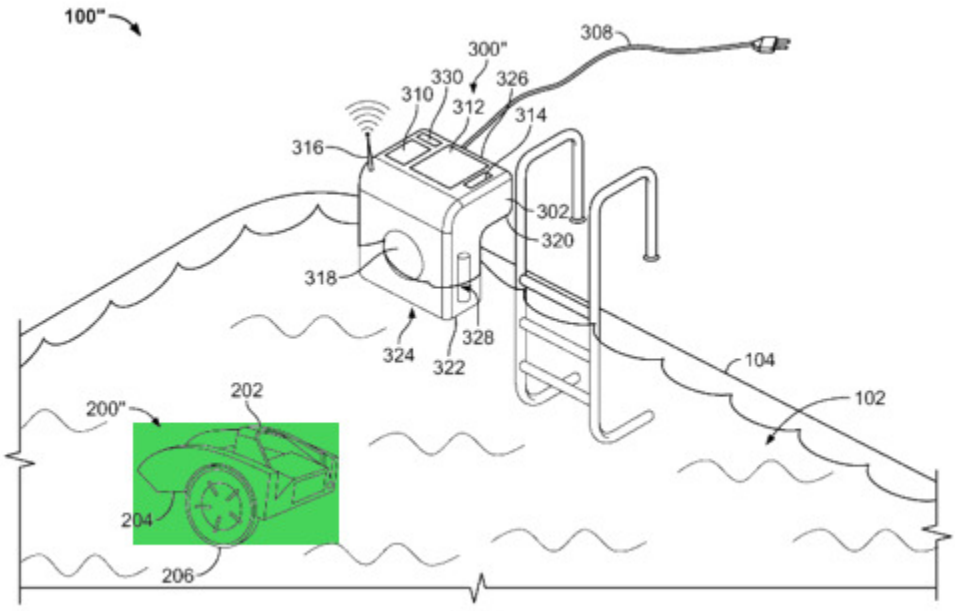


FIG. 3

Renaud's pool cleaner is "self-propelled" because it includes "an electronically commutated motor," "wheels 206...for moving the cleaner 200 in the swimming pool," and a "vision system...communicat[ing] with the cleaner 200 to drive...wheels 206...in the direction of the area of debris." Renaud, [0023], [0025], [0030]; Janét, ¶356.

Renaud's pool cleaner also "clean[s] debris from a submerged surface of a swimming pool" because it "cleans near, the walls...of the pool" in "bottom mode" and uses "a suction pump impeller" to "collect the debris in the swimming pool" and collects "debris collected from the swimming pool 102" into "a debris container" located in housing 202. Renaud, [0022]-[0023], [0030]; Janét, ¶357.

b. 1[a]

Renaud discloses or suggests 1[a], because Renaud's cleaner 200 "includes a housing 202 which includes a plurality of components," such as a motor, a storage device, and a processing device, a debris container, and wheels 206, and POSITAs would have understood that the assembled structure of cleaner 200 constitutes the "vehicle body." Renaud, [0023], [0025], FIGS. 1-3; Janét, ¶359.

c. 1[b]

Renaud discloses or suggests 1[b]. Janét, ¶¶360-363.

Limitation 1[b] invokes §112¶6/§112(f); the function is "moving the vehicle body within the swimming pool," and the corresponding structure includes "wheels...powered by a motor." *See* §III.E.

Renaud discloses this function and structure by describing cleaner 200 including **wheels 206** powered by a motor to move the cleaner within the pool. Renaud, [0009], [0023], [0025], [0030], FIGS. 1-3 (annotated below); Janét, ¶362-363.

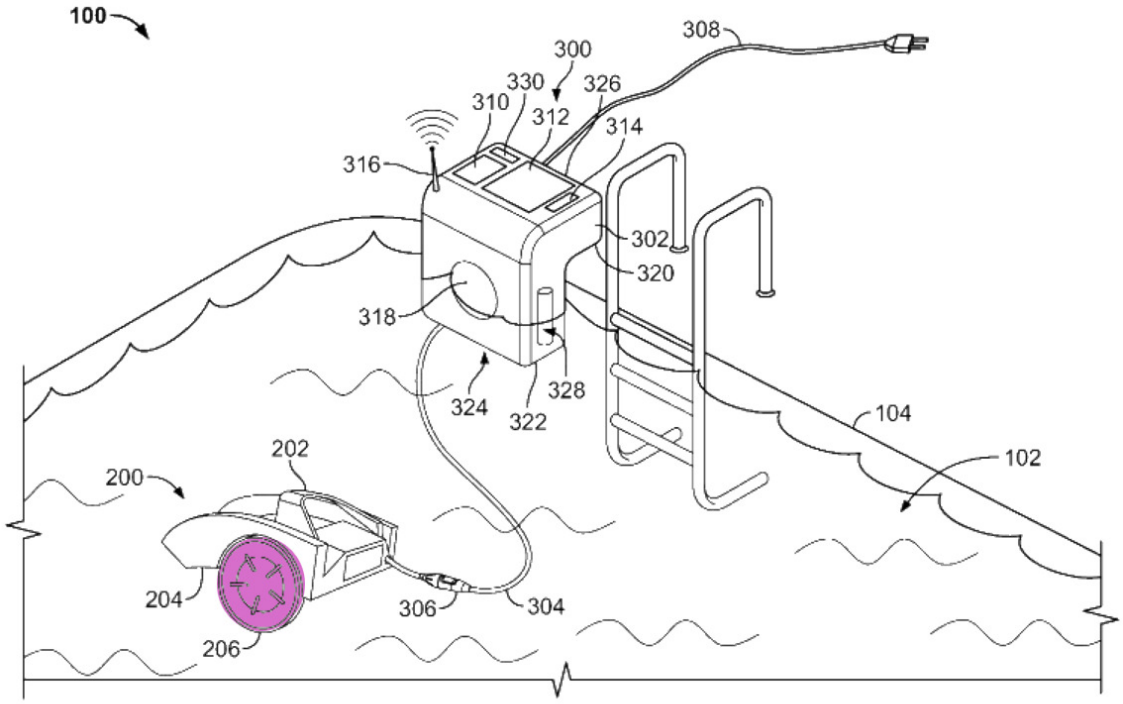

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FIG. 1

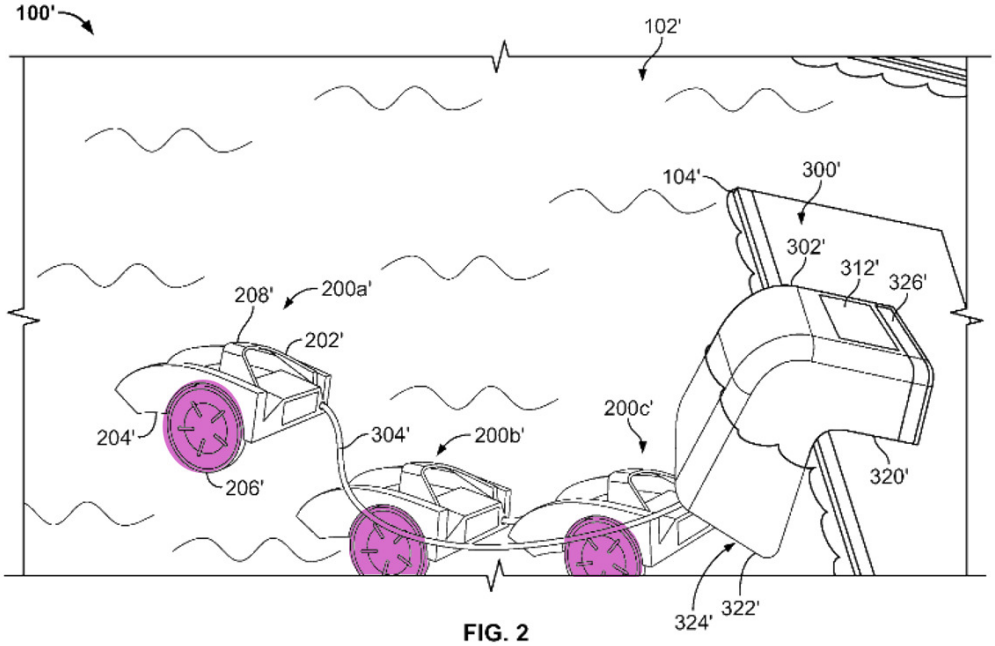

100'
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FIG. 2

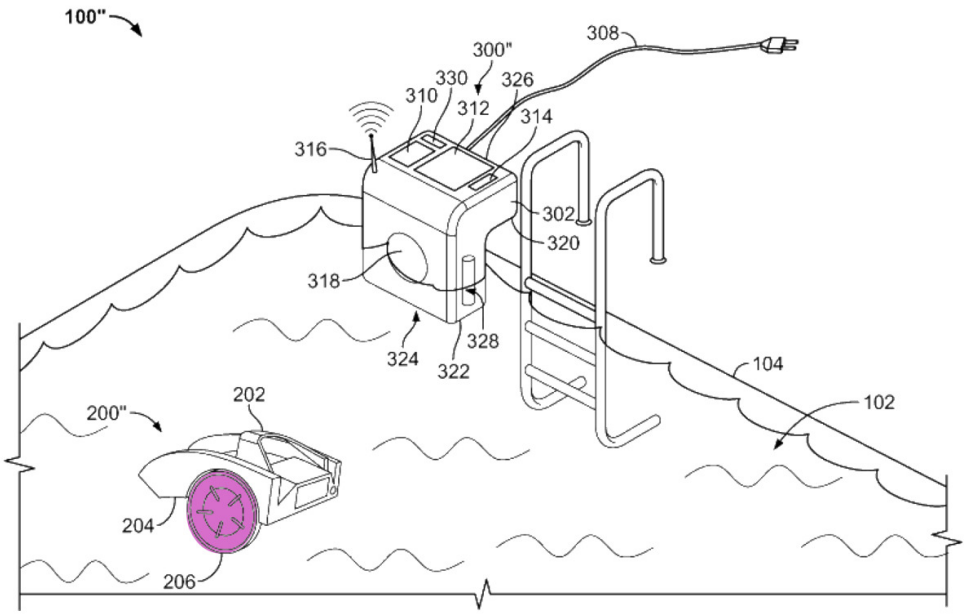


FIG. 3

d. 1[c]

Renaud discloses or suggests "a filter configured to retain debris" because Renaud's cleaner 200 includes a debris container/bag and uses "a suction pump impeller to collect the debris" in the pool into the debris container located in housing 202. Renaud, Abstract, [0006], [0015], [0022], [0023], [0030], [0033], [0036], Claim 20; Janét, ¶364-367.

e. 1[d]

Renaud discloses or suggests 1[d]. Janét, ¶368-370.

Renaud discloses "at least one camera mounted directly or indirectly to the body" because Renaud describes cleaner 200 includes a housing and a vision system, which includes a camera, and the vision system is inside "inside the cleaner 200." Renaud, [0008]; *see also id.*, [0029], Claim 1; Janét, ¶369-370.

Renaud discloses the camera "for capturing an image of at least a first portion of the submerged surface" because its vision system "identify[ies] areas on the pool floor, walls...where debris or dirt exists..., such as at the bottom" by "sensing areas of optical contrast." Renaud, [0029], [0031]; Janét, ¶369. POSITAs would understand Renaud's camera captures images to identify these "areas of debris" (first portion) on the floor and walls (submerged surfaces). *Id.*

f. 1[e][i]

Renaud discloses or suggests 1[e][i] because it includes a "processing device..., such as a microprocessor, **inside...cleaner 200**" which interacts with the camera to control the cleaner. Renaud, [0008]-[0009], [0029]-[0030]; Janét, ¶¶371-374.

Specifically, Renaud's processing device "access[es] the programmed data" to "identify areas...where debris or dirt exists" and "actuate the motor to direct the swimming pool cleaner to the debris." Renaud, [0009], [0029]-[0030]; Janét, ¶372. POSITAs would understand that this device—which processes data and generates signals to control the motor—constitutes the claimed "controller." Janét, ¶373. Further, Renaud's processing device is inside cleaner 200 and thus is "positioned...in" cleaner 200 (body). Janét, ¶374; IV.G.2.b. Renaud describes cleaner 200 includes "a vision system" with "sensors (e.g., camera) and

programming stored on the storage device for processing by the **processing device**." Renaud, [0008].

g. 1[e][ii]

Renaud discloses or suggests that its processing device (controller) is in electronic communication with the camera, because it describes that "the sensors [e.g., camera] of the vision system can **interact with** the...processing device [controller] to identify areas on the pool floor." Renaud, [0008], [0029]; Janét, ¶¶XXXX.

h. 1[e][iii]

Renaud discloses or suggests 1[e][iii]. Janét, ¶¶376-380.

Renaud discloses or suggests that its processing device (controller) generates control signals "in response to the captured image." Janét, ¶¶377-379.

Specifically, Renaud's vision system "includes sensors (e.g., camera) and programming stored on the storage device for processing by the processing device," and the processing device "access[es] the programmed data related to the vision system for actuating the motor." Renaud, [0008], [0029]. The vision system "identifies areas of debris by sensing areas of optical contrast…generated by a foreign object, debris and/or dirt" on pool floor and walls (submerged surfaces), and sensors "provide location information to the processor...for directing the swimming pool cleaner to the debris." Renaud, [0008], [0031]; Janét, ¶378.

Renaud also describes that its processing device controls a controller to actuate the motor for movement of the cleaner." Renaud, [0025].

POSITAs would have understood that Renaud's processing device (the claimed "controller") processes the programming and image data to generate the control signals that actuate the motors, causing the vehicle body to **move to** the debris area (the first portion), because it identifies debris based on "optical contrast"—i.e., based on visual/image data from the camera. Janét, ¶379.

Renaud also discloses the processing device generating control signals to cause movement "to...the first portion." Specifically, "[u]pon identifying debris...the vision system [via the processing device] can actuate the motor to direct the swimming pool cleaner to the debris." Renaud, [0009], Claim 3, [0030] (steer wheels "in the direction of the area of debris"), [0025]. POSITAs would understand that the processing device generates these signals to actuate the motor and steer the vehicle specifically to the "area of debris" (first portion). Janét, ¶380.

3. Claim 2 is Unpatentable over Renaud

Renaud renders Claim 2 obvious. Janét, ¶¶382-385.

a. 2[pre], 2[a]-2[c], 2[e]

Limitations 2[pre], 2[a]-2[c], and 2[e][i]-[iii] are identical to limitations 1[pre], 1[a]-1[c], and 1[e], respectively. For the reasons in §§IV.G.2.a-d, IV.G.2.f-

h (1[pre], 1[a]-1[c], 1[e][i]-1[e][iii]), Renaud discloses or suggests 2[pre] and 2[a]-2[c]. Janét, ¶383.

b. 2[d]

Limitations 2[d] and 1[d] only differ in:

1[d]	"camera"	"mounted directly or indirectly to"	"the body"
2[d]		"carried by"	

Renaud discloses 2[d], because a camera "mounted directly...to the body" (§IV.G.2.e (1[d])) is also "carried by the body." Janét, ¶384.

4. Claim 3 Unpatentable over Renaud

Renaud renders Claim 3 obvious. Janét, ¶¶386-397.

a. 3[pre], 3[a]-3[c], 3[e][i]

Limitations 3[pre], 3[a]-3[c], and 3[e][i] are identical to limitations 1[pre], 1[a]-1[c], and 1[e][i], respectively. For the reasons in §§IV.G.2.a-d, f (1[pre], 1[a]-1[c], 1[e][i]), Renaud discloses or suggests 3[pre], 3[a]-3[c], and 3[e][i]. Janét, ¶387.

b. 3[d]

Limitations 3[d] and 1[d] only differ in:

1[d]	"camera"	"mounted directly or indirectly to"	"the body"
3[d]		"positioned on or in, or carried by,"	

Renaud discloses 3[d], because a camera "mounted directly...to the body" (§IV.G.2.e (1[d])) is also "positioned on or in, or carried by, the body." Janét, ¶388.

c. 3[e][ii]

Renaud discloses or suggests 3[e][ii]. Janét, ¶¶389-394.

As explained in §IV.G.2.g (1[e][ii]), Renaud discloses the controller "in electronic communication with the at least one camera." Renaud also discloses that its controller is "in electronic communication with…a portable electronic device." Janét, ¶390.

Renaud discloses a docking station 300 that communicates with the cleaner 200 via a wireless antenna 316 and transceiver to send/receive signals. Renaud, [0026], [0033], FIG. 1 (below).

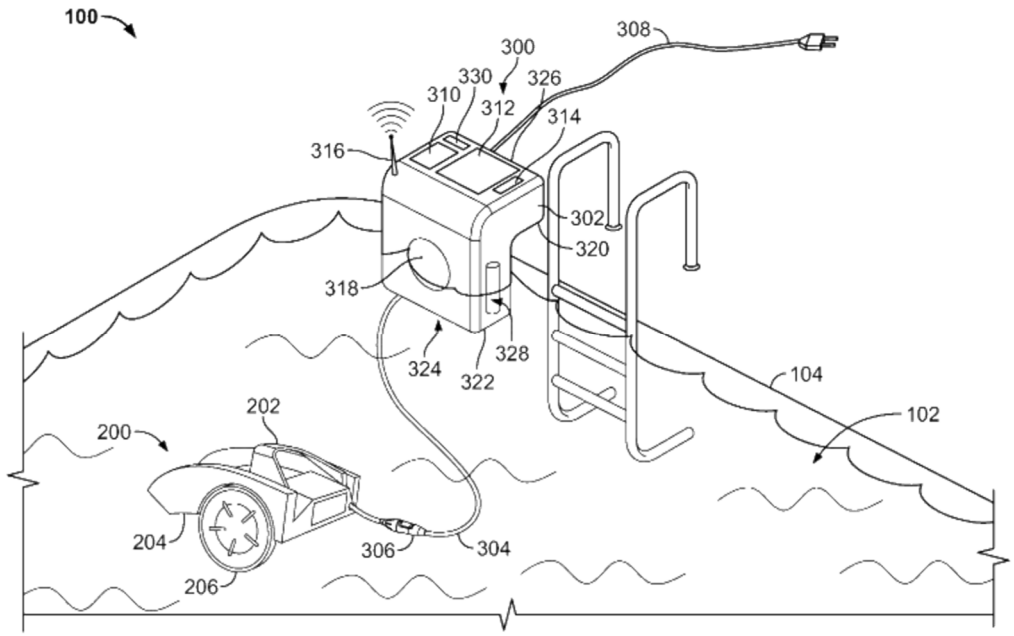


FIG. 1

Renaud further discloses the station is self-powered via a battery pack and includes a user interface 330 for accessing "cleaning paths" to control the cleaner. Renaud, [0032]-[0032].

POSITAs would have understood or found it obvious that Renaud docking station 300 is the "portable electronic device" in communication with the controller of cleaner 200 via wireless antenna 316, because the explicit disclosure of a "battery pack located in the docking station 300" (Renaud, [0033]) demonstrates a design choice for portability, allowing operation independent of fixed wall outlets. Janét, ¶393.

Additionally, Renaud discloses "a remote control... and/or joystick...allow[ing] a user to manually control the position" of cleaner 200.

Renaud, [0032]. POSITAs would have understood or found it obvious that these devices are "portable electronic devices," at least because these terms—remote control and joystick—describe handheld, carried by a user to operate cleaner 200 from a distance. Janét, ¶394. Furthermore, these devices are "in electronic communication" with the controller of cleaner 200 because Renaud discloses they are used to "manually control the position" of the cleaner (Renaud, [0032]), a function that necessarily requires transmitting control signals to the cleaner's internal controller to actuate the motors. Janét, ¶394.

d. 3[e][iii]

The limitation requires the controller to generate signals in response to **one of** the captured image **or** the PED. Janét, ¶¶395-396. As explained in §IV.G.2.h (1[e][iii]), Renaud discloses the controller configured to generate, "in response to...the captured image," at least one control signal to cause movement "to, or away from, the first portion of the submerged surface."

5. Claim 4 Unpatentable over Renaud

Renaud renders Claim 4 obvious. Janét, ¶¶398-401.

a. 4[pre], 4[a]-4[c], 4[e][i]-[iii]

Limitations 4[pre], 4[a]-4[c], and 4[e][i]-[iii] are identical to limitations 1[pre], 1[a]-1[c], and 1[e][i]-[iii], respectively. For the reasons in §§IV.G.2.a-c and

IV.G.2.f-h (1[pre], 1[a]-1[c], 1[e][i]-[iii]), Renaud discloses or suggests 4[pre], 4[a]-4[c], and 4[e][i]-[iii]. Janét, ¶399.

b. 4[d]

Limitation 4[d] is nearly identical to limitation 1[d], differing only in that 4[d] omits the requirement that the camera be "mounted directly or indirectly to the body." Renaud discloses or suggests 4[d], because Renaud's camera "mounted directly...to the body" (§IV.G.2.e (1[d])) satisfies the broader requirement. Janét, ¶400.

H. Ground 4B: Claim 5 Is Unpatentable over Renaud and Durvasula

1. Motivation to Combine

Both Renaud and Durvasula disclose autonomous robotic pool cleaners. *See* §§IV.A.1, IV.G.1. POSITAs would have been motivated to combine the teachings of Renaud and Durvasula to improve pool cleaning and sanitization. Janét, ¶402.

POSITAs would have recognized that the teachings in Renaud and Durvasula are directed to the same pool cleaning technical field and provide complementary technical solutions to address similar issues. Janét, ¶403. Specifically, both disclose self-propelled pool cleaners having a housing, drive means for moving the pool cleaner over pool surfaces, a filter or debris container for collecting debris, and a controller for navigation. *Compare* Renaud, [0008], [0023], [0025], FIGS. 1-3, *with* Durvasula, [0014]-[0016], [0020]-[0022], FIGS. 1,

9-10. Accordingly, POSITAs would have investigated the technical teachings in both Renaud and Durvasula to seek guidance when designing a pool cleaning system for specific pool cleaning considerations and applications. Janét, ¶403.

Both Renaud and Durvasula contemplate sanitization in addition to mechanical debris removal, but differ in their approach. Janét, ¶404. Renaud discloses a UV light on the bottom surface of the cleaner "for disinfecting and/or killing bacteria and other undesired organisms in the swimming pool." Renaud, [0010], [0040]. Durvasula discloses "a chemical dispenser to closely apply pool cleaning chemicals to the pool surfaces as the vehicle 30 traverses such surfaces." Durvasula, [0015].

POSITAs would have been motivated to modify Renaud by incorporating Durvasula's chemical dispenser. Janét, ¶¶405-406.

First, POSITAs would have been motivated to enhance the sanitization functionalities already taught by Renaud. Janét, ¶405. Renaud already contemplates a clear design intent to integrate sanitization with debris removal, disclosing a UV light "for disinfecting and/or killing bacteria and other undesired organisms." Renaud, [0010], [0040]. POSITAs would have recognized that incorporating Durvasula's chemical dispenser would provide a complementary chemical treatment, thereby achieving multi-modal sanitization (UV and chemical) alongside mechanical cleaning. Durvasula, [0015]; Renaud, [0040]; Janét, ¶405.

Second, POSITAs would have recognized that because Renaud's cleaner traverses pool surfaces using its vision system to identify and navigate to debris, equipping it with Durvasula's chemical dispenser would efficiently and effectively distribute pool cleaning chemicals throughout the pool as the cleaner moves. Renaud, [0029]-[0031]; Durvasula, [0015]; Janét, ¶406.

POSITAs would have reasonably expected success, because incorporating a chemical dispenser into a robotic pool cleaner like Renaud's had been well-known, and incorporating Durvasula's chemical dispenser into Renaud's cleaner body would have yielded predictable results. Porat, [0028]; Durvasula, [0015]; Renaud, [0010], [0023], [0040]; Janét, ¶407.

2. Claim 5 Unpatentable over Renaud and Durvasula

The Renaud-Durvasula combination renders Claim 5 obvious. Janét, ¶¶ 408-417.

a. 5[pre], 5[a]-5[c], 5[f][ii]-5[f][iii]

Limitations 5[pre], 5[a]-5[c], 5[f][ii], and 5[f][iii] are identical to limitations 1[pre], 1[a]-1[c], 1[e][ii], and 1[e][iii], respectively. For the reasons in §§IV.G.2.a-c and IV.G.2.g-h (1[pre], 1[a]-1[c], 1[e][ii]-[iii]), Renaud discloses or suggests 5[pre], 5[a]-5[c], and 5[f][ii] and 5[f][iii]. Janét, ¶409.

b. 5[d]

As explained in §IV.G.2.b (1[a]), Renaud discloses cleaner 200 comprising a vehicle body. Renaud, [0022]-[0023], [0037], [0039], FIGS. 1-3.

As explained in §IV.A.8.b (5[d]), Durvasula discloses a chemical dispenser to "closely apply pool cleaning chemicals to the pool surfaces as the vehicle 30 traverses such surfaces." Durvasula, [0015]. POSITAs would have understood that Durvasula's chemical dispenser constitutes "a chemical dispenser on, in, or carried by the vehicle body" because it is incorporated into vehicle 30 and applies chemicals "as the vehicle 30 traverses" the pool surfaces. *Id.*; Janét, ¶412.

As explained in §IV.H.1, POSITAs would have been motivated to incorporate Durvasula's chemical dispenser into Renaud's cleaner 200 (vehicle body) to enhance the cleaning functionalities taught by Renaud. Janét, ¶413. Renaud already contemplates a clear design intent to integrate sanitization with debris removal, disclosing a UV light on the bottom surface "for disinfecting and/or killing bacteria and other undesired organisms." Renaud, [0010], [0040]. POSITAs would have recognized that incorporating Durvasula's chemical dispenser would provide a complementary chemical residual that persists in the water column long after the cleaner has passed. Durvasula, [0015]; Janét, ¶413. Also as explained in §IV.H.1, POSITAs would have had a reasonable expectation of success to implement this combination.

In the Renaud-Durvasula combination, Renaud's cleaner 200 would include Durvasula's chemical dispenser carried by Renaud's housing 202 (vehicle body), thereby disclosing "a chemical dispenser on, in, or carried by the vehicle body." §IV.H.1; Renaud, [0022]-[0023], FIGS. 1-3; Durvasula, [0015]; Janét, ¶¶414.

c. 5[e]

Limitations 5[e] and 1[d] only differ in:

1[d]	"camera"	"mounted directly or indirectly to"	"the body"
5[e]		"on, in, or carried by"	"the vehicle body"

Renaud discloses or suggests 5[e], because a camera "mounted directly...to the body" (§IV.G.2.e (1[d])) is also "on, in, or carried by the vehicle body." Janét, ¶415.

d. 5[f][i]

Limitations 5[f][i] and 1[e][i] only differ in:

1[e][i]	"controller"	"positioned on or in"	"the body"
5[f][i]		"on, in, or carried by"	"the vehicle body"

Renaud discloses or suggests 5[f][i], because Renaud's controller "positioned on or in the body" (§IV.G.2.f (1[e][i])) is also "on, in, or carried by the vehicle body." Janét, ¶416.

V. CONCLUSION

The Board should institute IPR and cancel Claims 1-5.

VI. MANDATORY NOTICES

A. Real Party in Interest

All real parties in interest for this Petition includes Petitioner, Deepwater Innovation Technology (Hong Kong) Limited and Xingmai Innovation Technology (Suzhou) Co., Ltd.

B. Related Matters

To the best of Petitioner's knowledge, the '766 Patent has been involved in the following cases:

- *Beatbot Technology (USA) Co. Ltd. et al v. Zodiac Pool Systems LLC*, No. 3:25-cv-01946 (S.D. Cal.).
- *Zodiac Pool Sys. LLC v. Wybotics, Co. Ltd.*, Case No. 2:25-cv-00582 (E.D. Tex).
- *Wybotics Inc. et al v. Zodiac Pool Systems LLC*, Case No. 2-25-cv-08526 (C.D. Cal.).
- *Wybotics Inc. et al v. Zodiac Pool Systems LLC*, IPR2026-00159 (PTAB).

Petitioner is also concurrently filing Petitions for *Inter Partes* Review of U.S. Patent Nos. 11,880,207 and 11,003,191, which are related to the '766 Patent challenged herein.

C. Notice of Counsel and Service Information

Petitioner consents to electronic service. All communications to the attorneys listed below may be sent to: Perkins-Service-Xingmai-Zodiac-IPRs@perkinscoie.com.

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D. Power of Attorney

A power of attorney is filed herewith according to 37 C.F.R. §42.10(b).

Respectfully submitted,

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Date: January 26, 2026

CERTIFICATE OF WORD COUNT UNDER 37 CFR §42.24(D)

Pursuant to 37 C.F.R. §42.24(a), Petitioner hereby certifies that portions of the above-captioned Petition for *inter partes* review of U.S. Patent No. 11,262,766, in accordance with and reliance on the word count provided by the word-processing system used to prepare this Petition, that the number of words in this paper is 13,979. Pursuant to 37 C.F.R. §42.24(a), this word count is in compliance and excludes the table of contents, table of authorities, mandatory notices under §42.8, certificate of service, certificate of word count, appendix of exhibits, and any claim listing. This word count was prepared using Microsoft Word.

Respectfully submitted,

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CERTIFICATE OF SERVICE

The undersigned hereby certifies that true copies of the Petition for *inter partes* review of U.S. Patent No. 11,262,766 and supporting materials (Exhibits and Power of Attorney) were served via FedEx delivery on the Patent Owner at the correspondence address of record as listed on PAIR:

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Respectfully submitted,

/Meghan Bright/

Meghan Bright
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