

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

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

**DECLARATION OF DR. JASON A. JANÉT IN SUPPORT OF 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	[Reserved]
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, Jason A. Janét, of Raleigh, North Carolina, declare that:

I. INTRODUCTION

1. I have been retained by counsel for Petitioner BEATBOT TECHNOLOGY (USA) Co. LTD. (“Petitioner” or “BEATBOT”) as an expert witness to provide my opinion regarding certain prior art references and U.S. Patent No. 11,262,766 (“the ’766 Patent”) in their Petition for *Inter Partes* Review.

2. I make this declaration based upon my own personal knowledge and, if called upon to testify, will testify competently to the matters stated herein.

3. I have been asked to provide my expert opinion in connection with the *Inter Partes* Review of the ’766 Patent to Durvasula *et al.* concerning whether it is unpatentable over certain prior art. This declaration is a statement of my opinions on issues relating to the patentability of claims 1-5 (the “Challenged Claims”) of the ’766 Patent. As I explain more fully below, it is my opinion that all of the Challenged Claims would have been obvious to a person of ordinary skill in the art (“POSITA”) at the time of the alleged invention.

4. I am being compensated for my work in this matter at my standard hourly rate. I am also being reimbursed for reasonable and customary expenses associated with my work and testimony in this investigation. My compensation is not contingent on the outcome of this matter or the specifics of my testimony.

5. I understand that the '766 patent has been assigned to Zodiac Pool Systems LLC.

6. This declaration is based on the information currently available to me. To the extent that additional information becomes available, I reserve the right to continue my investigation and study, which may include a review of documents and information that may be produced, as well as testimony from depositions that have not yet been taken.

A. Qualifications and Professional Experience

7. I have studied, taught, and practiced in the field of robotics for over thirty years, including extensive work in autonomous underwater vehicles, camera-based sensing systems, and computer vision applications. I have a Ph.D. in Electrical & Computer Engineering from North Carolina State University (or “NCSU”), which I earned in 1998. Prior to that I received a M.S. in Integrated Manufacturing Systems Engineering from North Carolina State University in 1994 and a B.S. in Mechanical Engineering from the University of Virginia in 1990.

8. Since 1991, I have been active in the submersible and land-based mobile robots, wall-climbing mobile robots, sensors, pattern analysis, computer vision, image/video processing, and automation fields. My work has specifically included developing autonomous systems that use camera-based image analysis to

detect objects, recognize surface characteristics, and make control decisions. I have authored numerous publications and have co-authored a textbook entitled *Computational Intelligence*.

9. My PhD dissertation is entitled *Pattern Analysis, Tracking and Control for Autonomous Vehicles Using Neural Networks*. It described the use of unsupervised training (i.e., the Hyper-Ellipsoid Clustering Neural Network, or “HECNN”), and supervised training (i.e., the Region-Feature Neural Network, or “RFNN”) for dissimilar mobile robots to learn aspects of their common environments through multiple types of sensors (e.g., imaging, acoustic rangefinding, infrared proximity, and tactile), and then transfer knowledge between for operational use and/or refinement. Among other outputs, the robots learned to recognize surface conditions, spaces, objects and landmarks within those spaces, and then plan and track motion from the accumulated and shared knowledge. The robots demonstrated the ability to use visual and sensor data to autonomously recognize and respond to environmental characteristics.

10. I have designed, built, and marketed robots, automated systems, and components thereof, including submersible and ground mobile robots, unmanned aerial vehicles (UAV), unattended sensors automated storage and retrieval systems (ASRS), proof-of-concept extra-terrestrial robots, manually manipulated

(“twiddled”) submersible foils, wall climbing mobile robots, and augmented reality systems.

11. I have taught the following courses: Introduction to Robotics and Automation (Duke and NCSU); Introduction to Control Theory (Duke and NCSU); Distributed Real-Time Controls (NCSU); and myriad independent studies courses in the areas of robotics, automation, artificial intelligence, autonomy, pattern analysis, and control systems. I have also served on several MS- and PhD-level graduate student committees, designed qualifying exam problems, served on the NCSU IMSEI Board, and participated in curriculum development for undergraduate and graduate level programs.

12. I have also started, sponsored, and advised multiple champion student teams for international robot competitions including, but not limited to, the NASA/ASCE Extra-Terrestrial Robotics Competition, the DARPA Grand Challenge, the AUVSI/ONR Autonomous Underwater Vehicle Competition, and the European CLAWAR Wall-Climbing Robot competition.

13. I have initiated multiple unmanned aerial vehicle (UAV) projects at both academic and industry levels. The AngelFish Cross-Domain Submersible UAV, a DARPA ASW program that I incubated and procured funding for at Teledyne, included a partnership with North Carolina State University. Additionally,

academic UAVs include, but are not limited to, Quadcopters with Hybrid Remote and Autonomous Control, Marsupial UAVs that Deploy and Recover Unmanned Ground Vehicles, and Wall-Climbing UAVs.

14. In 1999, while I was employed by Nekton Research (“Nekton”), I captured and managed multiple programs sponsored by the Department of Defense (DoD) and private-sector companies that focused primarily on autonomous underwater vehicles (AUV), remotely operated vehicles (ROV), TwiddleFish toys, and indirect-fire projectiles. During my tenure, Nekton entered into a joint venture agreement with the founders of what eventually became known as Parata Systems – a pharmacy automation solutions company, which I supported launching.

15. After leaving Nekton in March 2002, I joined a then New Jersey-based company called Avionic Instruments, Inc. (“Avionic”). While at Avionic, I continued developing and marketing robots and supported engineering related to various design, manufacturing, quality and assembly issues on the core aerospace product lines. Avionic product lines include, but are not limited to, ducted fans, transformer rectifier units (TRU), regulated TRU (RTRU), auxiliary power unit (APU) control systems, power distribution systems (PDU), frequency converters, corner clamps, and VRAM attractors/thrusters. Customers included DoD, NASA, Boeing, Sikorsky, Augusta-Westland, Dassault, and Lockheed-Martin.

16. In late 2004, soon after Avionic was sold, I, along with others from Avionic, secured funding to develop an alpha-level multi-dispenser robotic system which afforded me time to write the RxMedic business plan and raise multiple rounds of venture capital. In late 2006, RxMedic (called “APDS” until November 2006) was launched as a stand-alone, sole-focus venture. After the operational launch of RxMedic, I served as General Manager and eventually Chief Technical Officer. Through my roles at RxMedic, I oversaw the development of the RxMedic ADS robot, managed the intellectual property portfolio, coordinated sales and marketing, and provided strategic, fiscal, and operational leadership. In May 2010, J.M Smith Corporation acquired RxMedic, and in an effort to assist in the change of ownership, I served as a director of RxMedic until May 2011.

17. Also in late 2004, after Avionic was sold, I, along with others from Avionic, secured funding for Vortex HC through DoD contracts and robot sales, to continue developing the VRAM Mobile Robot Platform (VMRP – a wall-climbing robot), the ARTEMIS AUV (a holonomic submersible robot for counter-mine and counter-obstacle operations), the submersible crawler, the nuclear-grade boiler water reactor (BWR) inspection robot, and other robot products centered around the VRAM. Some DoD programs were/are classified, for which I maintained a SECRET clearance at both the personal and facilities level, and served as the facilities security

officer (FSO). In late 2006, corresponding to the full launch of RxMedic, Vortex HC technologies were largely licensed to Teledyne SeaBotix, SeaRobotics, and HDT. However, I have continued to support Vortex HC licensees and customers to date. After the sale of RxMedic, and after fulfilling my 12-month employment obligation, I joined Teledyne Technologies in summer 2011. I served as the Senior Manager for the RTP division of Teledyne Scientific, and supported multiple DoD sponsored robotic-focused programs. Some of these programs were/are classified, for which I maintained a personal SECRET clearance. Among these programs, were cargo unmanned ground vehicles (CUGV), squad-level autonomous unmanned ground vehicles (UGV), autonomous underwater vehicles (AUV), unmanned underwater vehicles (UUV), and a cross-domain autonomous vehicle capable of transitioning between air-, surface- and underwater-domains. Cross-domain vehicles that were evaluated, designed and prototyped included, but were not limited to, the AngelFish (later called “EagleRay”) submersible AUV for anti-submarine warfare, and a ball-shaped robot for countermine operations on the ground, in the beach zone and in the surf zone. Sensor design, refinement and signal processing was a major component of each program. Sensors employed include, but are not limited to: proximity sensors; ranging sensors; electro-optical imaging; long-, short- and mid-wave infrared (IR); inertial measurement units (IMU); optical flow; and radiofrequency (RF).

Additionally, control systems were designed, refined and integrated into the aforementioned systems. Most control systems were closed-loop, in that they utilized sensor-based feedback; others were open-loop, where states were estimated with little or no feedback.

18. In late 2013, Avionic, a Transdigm business unit at that point, requested that I return to turn around a supply-chain issue, and assume management of its Sikorsky S97 Raider helicopter program. The S97 Raider is purported to be the fastest, most maneuverable helicopter, due to its coaxial, counter-rotating variable pitch wings, and an aft-based push-propeller. Avionic also controlled two business units named Acme Aerospace (Acme) and Aerospace Cooling Solutions (ACS). Avionic, Acme and ACS supported the S97 program, which has met milestones and continues to produce multiple successful demonstrations. In 2013, Transdigm expanded my role to include directorship of the Avionic, Acme and ACS sales and marketing team, and to report operational and financial status at six-week intervals. Transdigm required that I move my family to New Jersey in late 2014, which influenced my decision to resign and assume the CEO role of Delta Five Systems in Raleigh, NC.

19. As CEO of Delta Five, I led a private-equity backed, hospitality-focused venture, coordinating the company's launch and strategic path including an

early stage pivot. Initially focused on back-end robotics and automation, Delta Five shifted to address the rampant bed bug problem—a top priority for hoteliers—with a novel unattended sensor and trap, called the Telemetered Pest Monitoring System (TPMS), which is based on computer vision and internet of things (IoT), and has proven capable of scaling to other pests. In addition to the TPMS, Delta Five developed a novel means to mass produce a natural, unscented aggregation pheromone that, in concert with placement and heat, lured invertebrates to the TPMS. After leading Delta Five and serving on its Board for four years, I resigned to join ARA, but continue serving Delta Five as an investor and supportive transition agent.

20. In 2018, I joined ARA as sector CTO. In this role, my primary responsibilities included leading the commercialization and technology transition efforts, which require technical, business and corporate development, as well as the raising of capital and managing matrixed rosters. I assumed my other current role at ARA, Corporate Director of IP and Product Commercialization, in 2020. In this role, I evaluate, quantify, present, and recommend portfolios of IP, product lines, and ventures on the basis of competitive landscapes, addressable markets, sales strategy, resource availability and technology readiness. I also spearhead investments and provide general venture oversight. I maintain active TOP SECRET and SCI (Sensitive Compartmented Information) security clearances.

21. My curriculum vitae is attached as EX1004 to this declaration in support of the IPR petition, and provides further information about my experience, expertise, and presentations.

22. Considering the foregoing, I consider myself to be an expert in the field of autonomous underwater robotics, including camera-based computer vision, image processing for object and surface recognition, autonomous control systems, and robotic operation in aquatic environments such as pool cleaning and monitoring systems. Therefore, I believe that I am qualified to provide an opinion as to what a person of ordinary skill in the art at the time of the invention (“POSITA”) would have understood, known, or concluded regarding the subject matter of the ’766 patent involved in this case.

B. Materials Reviewed

23. My opinions expressed in this declaration are based on documents and materials identified in this declaration, including the ’766 patent, the prior art references and background materials discussed in this declaration, and the other references specifically identified in this declaration. I have considered these materials in their entirety, even if only portions are discussed here. The following is an exemplary list of the materials on which I based on opinion.

Dr. Jason A. Janét Declaration
Inter Partes Review of U.S. Patent 11,262,766 B2
PTAB Case No. IPR2026-00200

No.	Exhibit
1001	U.S. Patent No. 11,262,766 B2 (“’766 Patent”)
1002	File History of the ’766 Patent
1003	[Reserved]
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”)

24. In forming the opinions expressed below, I have considered:

- the documents listed above;
- the relevant legal standards as explained to me by the Petitioner's counsel, including the standard for obviousness, and any additional authoritative documents as cited in the body of this declaration;
- my own knowledge and experience based upon my work in the field of underwater robotics as described above; and
- any other documents not listed above but cited below.

25. I may rely upon these materials, my knowledge and experience, and/or additional materials to rebut arguments raised by the Patent Owner. Further, I may also consider additional documents and information in forming any necessary opinions, including documents that may not yet have been provided to me.

26. My analysis of the materials produced in this proceeding is ongoing and I will continue to review any new material as it is provided. This declaration represents only those opinions I have formed to date. I reserve the right to revise, supplement, and/or amend my opinions stated herein based on new information and on my continuing analysis of the materials already provided.

27. Unless otherwise noted, all emphasis in any quoted material has been added.

II. LEVEL OF ORDINARY SKILL IN THE ART

28. My analysis reflects the views of a person of ordinary skill in the art (POSITA) in the field of the '766 Patent as of July 10, 2012. In my opinion, it would be the same on July 11, 2016 (the filing date of Application No. 15/207,065 (EX1013, field (22))), as explained in §VI.C) as well.

29. I have been advised by the Petitioner's counsel and understand there are multiple factors relevant to determining the level of ordinary skill in the pertinent art, including (1) the levels of education and experience of persons working in the field at the time of the invention; (2) the sophistication of the technology; (3) the types of problems encountered in the field; and (4) the prior art solutions to those problems. I understand that a POSITA is not a specific real individual, but rather is a hypothetical individual having the qualities reflected by the factors above. I understand that a POSITA would also have knowledge from teachings of the prior art, including the art cited below.

30. Taking these factors into consideration, in my opinion, as of July 10, 2012, a POSITA would have been someone knowledgeable and familiar with design or development of autonomous robotic systems, camera-based sensing and image processing, and control systems for aquatic or underwater applications that are pertinent to the '766 Patent. That person would have a bachelor's degree in electrical

engineering, mechanical engineering, physics, or computer engineering, with at least two years' experience in autonomous camera-based robotic cleaning systems. In my opinion, a lack of work experience can be remedied by additional education, and vice versa. In my opinion, it would be the same on July 11, 2016, the filing date of Application No. 15/207,065, as explained in §VI.C).

31. As of July 10, 2012 (or July 11, 2016, the filing date of Application No. 15/207,065, as explained in §VI.C), I met, and in fact exceeded, the qualifications of a person of ordinary skill in the art.

32. For purposes of this Declaration, in general, and unless otherwise noted, my statements and opinions, such as those regarding my experience and the understanding of a POSITA generally (and specifically related to the references I consulted herein), reflect the knowledge that existed in the field as of July 10, 2012. In my opinion, it would be the same on July 11, 2016, the filing date of Application No. 15/207,065, as explained in §VI.C. Unless otherwise stated, when I provide my understanding and analysis below, it is consistent with the level of a POSITA prior to the earliest alleged priority date of the '766 Patent.

III. RELEVANT LEGAL STANDARDS

33. I am not an attorney. In preparing and expressing my opinions and considering the subject matter of the '766 Patent, I am relying on certain basic legal

principles that counsel have explained to me. These principles are discussed below.

34. I understand that for an invention claimed in a patent to be found patentable, it must be, among other things, new and not obvious in view of what was known before the invention was made.

35. I understand the information that is used to evaluate whether an invention is new and not obvious is generally referred to as “prior art” and generally includes patents and printed publications (e.g., books, journal publications, articles on websites, product manuals, etc.).

36. I understand that in this proceeding Petitioner has the burden of proving that the claims of the ’766 Patent are anticipated by or obvious in view of the prior art by a preponderance of the evidence. I understand that “a preponderance of the evidence” is evidence sufficient to show that a fact is more likely true than it is not.

37. I understand that prior art to the ’766 Patent in this proceeding includes patents and printed publications in the relevant art that predate the proper priority date of the alleged invention recited in the ’766 Patent.

38. I understand that terms appearing in the patent claims are to be interpreted according to their “ordinary and customary meaning” in an IPR proceeding. In determining the ordinary and customary meaning, the words of a claim are first given their plain meaning as they would have been understood by a

POSITA at the time of the alleged invention, in light of the specification and file history. I understand that treatises and dictionaries may be consulted, albeit under limited circumstances, to determine the meaning attributed by a POSITA at the time of the alleged invention. I have followed this approach in my analysis and have applied the ordinary and customary meaning of those terms throughout my analysis in this Declaration.

39. I understand that there are two ways in which prior art may render a patent claim unpatentable. First, the prior art can be shown to “anticipate” the claim. Second, the prior art can be shown to have made the claim “obvious” to a person of ordinary skill in the art. In this declaration I focus on “obviousness.” My understanding of the legal standard for “obviousness” is set forth below.

40. I have been informed by counsel that a claimed invention is unpatentable as obvious if the differences between the invention and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which the subject matter pertains. I have also been informed by counsel that the obviousness analysis takes into account factual inquiries including the level of ordinary skill in the art, the scope and content of the prior art, and the differences between the prior art and the claimed subject matter.

41. Specifically, I understand that the obviousness question requires consideration of four factors (although not necessarily in the following order):

- The scope and content of the prior art;
- The differences between the prior art and the claims at issue;
- The knowledge of a person of ordinary skill in the pertinent art;
- and
- Whatever objective factors indicating obviousness or non-obviousness may be present in any particular case.

42. I have been informed by counsel that the Supreme Court has recognized several rationales for combining references or modifying a reference to show obviousness of claimed subject matter. Some of these rationales include the following: (a) combining prior art elements according to known methods to yield predictable results; (b) simple substitution of one known element for another to obtain predictable results; (c) use of a known technique to improve a similar device (method, or product) in the same way; (d) applying a known technique to a known device (method, or product) ready for improvement to yield predictable results; (e) choosing from a finite number of identified, predictable solutions, with a reasonable expectation of success; and (f) some teaching, suggestion, or motivation in the prior art that would have led one of ordinary skill to modify the prior art reference or to

combine prior art reference teachings to arrive at the claimed invention. I also understand that, at least in IPR proceedings, admissions in the patent or in the prosecution file history of the patent (referred to as Applicant Admitted Prior Art or “AAPA”) can be used to, among other things, establish background knowledge possessed by a POSITA.

43. I further understand that certain factors may support or rebut the obviousness of a claim. I understand that such secondary considerations include, among other things, commercial success of the patented invention, skepticism of those having ordinary skill in the art at the time of invention, unexpected results of the invention, any long-felt but unsolved need in the art that was satisfied by the alleged invention, the failure of others to make the alleged invention, praise of the alleged invention by those having ordinary skill in the art, and copying of the alleged invention by others in the field. I understand that there must be a nexus—a connection—between any such secondary considerations and the alleged invention. I also understand that contemporaneous and independent invention by others is a secondary consideration tending to show obviousness.

44. I am not aware of any allegations by the named inventor of the ’766 Patent or any assignee of the ’766 Patent that any secondary considerations are relevant to the obviousness analysis of any Challenged Claim of the ’766 Patent.

45. I understand that a petition must identify, for any terms with means-plus-function limitations, the specific portions of the specification that describe the structure, material, or acts corresponding to each claimed function. I also understand a rebuttable presumption exists that without use of the term, “means,” a claim term is not interpreted as means-plus-function, but that other nonce words like “component” have been found to satisfy the rebuttable presumption and invoke a means-plus-function claim construction of such a claim term.

46. I also understand that a petitioner seeking to demonstrate that the prior art discloses a means-plus-function limitation must prove that the corresponding structure—or an equivalent—was present in the prior art and performing the same claimed function.

47. I understand that the standard for determining whether the prior art discloses the corresponding structure or an equivalent is whether there are insubstantial differences, which means that if the assertedly equivalent structure performs the claimed function in substantially the same way to achieve substantially the same result as the corresponding structure described in the specification, it is equivalent.

48. I understand that proving structural equivalence does not require a component-by-component analysis, but rather that it is sufficient to show structure,

materials, or acts that perform the claimed function in substantially the same way to achieve substantially the same result because the claim limitation is the overall structure corresponding to the claimed function and not individual components.

49. I understand that for a claim to be valid, its scope must be definite, and that improperly introducing a term can lead to an unascertainable scope of a term, rendering it indefinite. I understand that any claim element first addressed in the claims by the antecedent basis, “a” may then be identified later in the claims by the antecedent basis, “the.” I understand that failing to follow this convention may lead to ambiguity in the identification of the particular claim element in question, leading to an indefinite scope of the claim’s term. For purposes of this proceeding, I identified and provided my best understanding of any such terms despite such ascertainable scope.

IV. SUMMARY OF OPINIONS

50. During my review, I have evaluated the claims of the challenged patents and it is my opinion that each Challenged Claim is invalid. Specific invalidity grounds are listed in the table below, where the references are prior art under AIA 35 U.S.C. §102(a)(1) or pre-AIA 35 U.S.C. §102(b).

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

51. I reserve the right to supplement these findings should new information be made available.

V. OVERVIEW OF THE TECHNOLOGY

52. The following section summarizes the state of the art in the field of robotic pool cleaners as of the alleged July 10, 2012 priority date. In my opinion, it would be the same on July 11, 2016, the filing date of Application No. 15/207,065, as explained in §VI.C). The technical information and principles discussed herein were well-documented in the public domain and represent the common general knowledge available to a person of ordinary skill in the art (POSITA) at that time.

A. Historical Context: Stochastic Navigation in Early Pool Robotics (1967–2000)

1. The Genesis of the Submersible Chassis: Myers (1967)

53. The foundational architecture of the electric robotic pool cleaner was established by Robert B. Myers in U.S. Patent No. 3,321,787 (“Myers”; EX1008), titled “Swimming Pool Cleaning Means,” filed in 1967. Myers’ invention was significant not for its intelligence, but for its robust interaction with the aquatic environment. The patent describes a device that is “erratically self-propelled over the bottom surface of the swimming pool.” The operational principle was purely stochastic. The device utilized a drive mechanism that induced random turns and reversals. Statistically, given infinite time, a random walk within a bounded domain (the pool) will cover the entire area. However, in practical terms, this resulted in significant inefficiency. The “intelligence” of the Myers device was mechanical, relying on physical interaction with pool walls to trigger directional changes. This established the “bump-and-turn” paradigm that would dominate the industry for decades.

2. The Rasch Architecture (1979)

54. The next quantum leap in mechanical design came from Wilhelm Rasch, whose work culminated in U.S. Patent No. 4,168,557 (filed 1976, granted 1979; EX1009). Rasch’s patent described the canonical form factor of the modern

robotic cleaner:

- A sealed, waterproof body containing the drive motor and pump motor.
- A filter chamber located within the body.
- Endless tracks (caterpillar tracks) for traction on slippery pool liners.
- An impeller system that not only drew water through the filter but also created a thrust force perpendicular to the surface (pressing the cleaner against the floor or walls) to maintain traction on vertical walls.

B. The Rise of Underwater Computer Vision (Before 2012)

55. By the alleged July 10, 2012 priority date, the application of machine vision in the control of unmanned underwater vehicles (UUVs) was a well-established and rapidly maturing field. While early underwater navigation relied heavily on expensive and bulky acoustic sensors, the industry had shifted toward machine vision because cameras provided a lightweight, inexpensive, and flexible alternative that lacked the minimum operating range limitations of sonar. By 2010, machine vision was already considered a “natural” inclusion in underwater control loops, serving as standard payload equipment for both autonomous underwater vehicles (AUVs) and remotely operated vehicles (ROVs) to assist in tasks like inspection, surveying, and data collection.

56. For example, the 2006 review paper by Jonathan Horgan and Daniel

Toal, titled “Review of Machine Vision Applications in Unmanned Underwater Vehicles” (EX1010; “Horgan”) provides a comprehensive overview of the integration of machine vision in underwater robotics. As the authors note, by 2006, machine vision was already a standard sensor in underwater control loops, serving as a lightweight and cost-effective alternative to acoustic sensors. EX1010, p.1. They further note that because cameras were common payloads, they were “naturally” utilized within vehicle control loops to facilitate autonomous navigation and positioning. *Id.*

57. Horgan explicitly describes the closed-loop architecture required to move a vehicle in response to visual data. For instance, in “station keeping” applications, a vehicle uses a downward-facing camera to acquire images of the floor at a range of 1–3 meters. *Id.* The system’s controller then analyzes these captured images to measure the vehicle’s offset and automatically generates “appropriate thruster signals” (i.e., control signals) to cause movement of the vehicle body to a specific orientation or position. *Id.*

58. Furthermore, Horgan details “target tracking” and “feature tracking” where the system is configured to move the vehicle body specifically toward or relative to a first object. *See id.* The paper describes methods where vision is used to “determine the required direction” to an object of interest, allowing the controller to

steer the vehicle based on that identified direction. *Id.*, p. 4.

59. By the alleged July 10, 2012 priority date, a POSITA would have recognized that these established underwater navigation techniques—using captured images to identify objects and generating control signals to guide the vehicle relative to those objects—were directly applicable to the environment of a self-propelled pool cleaner.

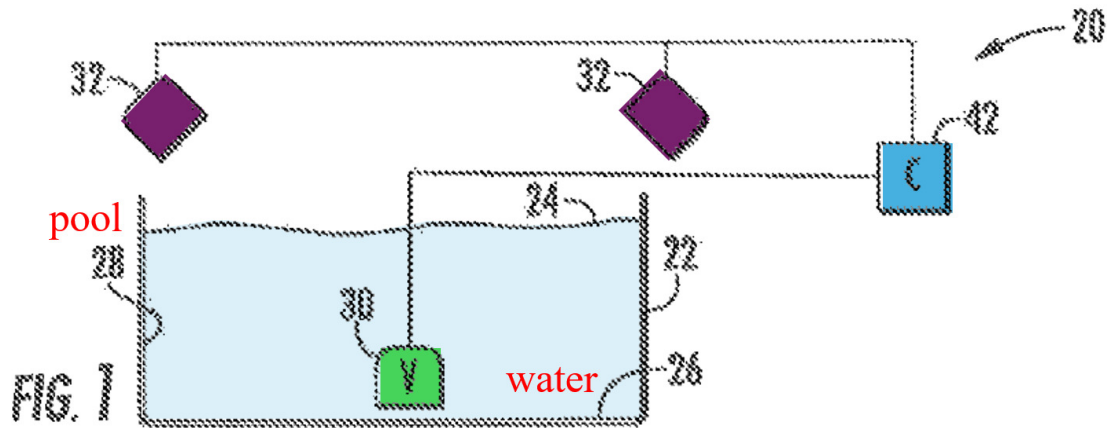
VI. '766 Patent

A. Overview

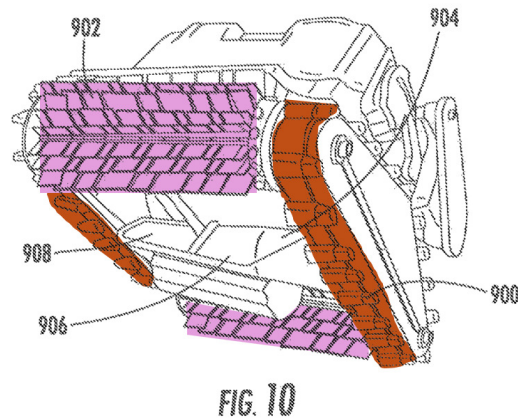
60. The '766 Patent describes a pool system that uses camera-based image analysis to detect pool conditions and generate control responses. EX1001, Abstract.

61. Claims 1-5 of the '766 Patent are directed to self-propelled pool cleaners in the form of independent claims. *Id.*, 10:47-12:31.

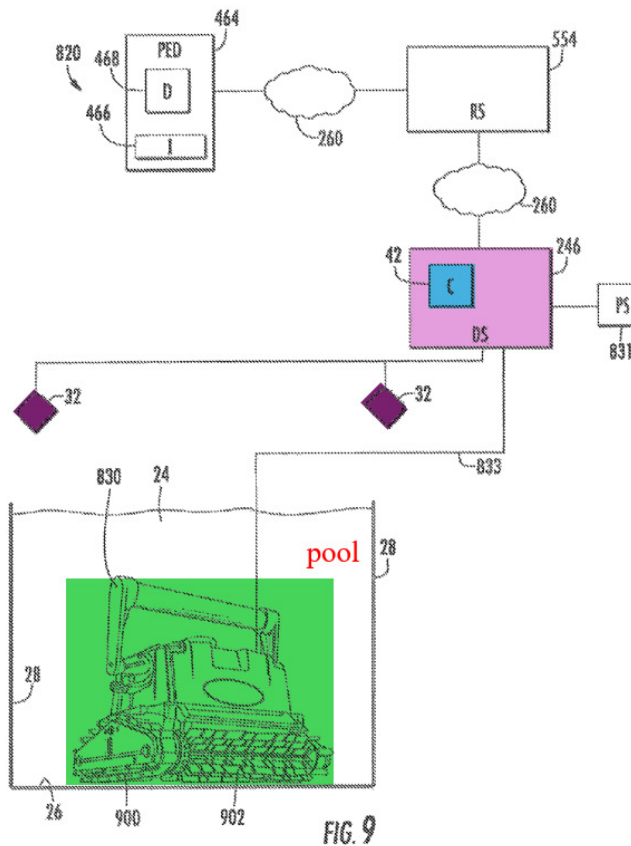
62. The '766 Patent describes a pool cleaning system with one or more cameras for autonomous cleaning of a pool. *Id.*, 2:62-3:53. As illustrated in FIG. 1 (annotated below), the system includes at least one **camera 32** positioned to capture images of a swimming pool 22, a **controller 42** that analyzes the images and generates control responses for operating a pool cleaning equipment shown as vehicle 30 that cleans floor 26 and/or side surfaces 28 of pool 22. *Id.*, 2:62-5:7.



63. For autonomous cleaning applications, the system includes a cleaning device (vehicle 30 as illustrated in FIG. 1 (annotated above)) with a body, a **drive system** such as one or more propulsion devices or drives, e.g. toothed track drive 900 in FIG. 10, coupled to the body for moving the body within the pool, and cleaning equipment (**brushes**, suction mechanisms, chemical dispensers) for removing debris. *Id.*, 3:5-43; 10:8-27, FIG. 10 (annotated below). The cameras 32 capture video or images of the pool, and the controller 42 analyzes the images to determine the cleanliness of submerged pool surfaces and generates control signals to adjust the operation of the cleaning vehicle 30. *Id.*, 3:44-5:8; 8:24-9:56.



64. As illustrated in FIG.9 (annotated below), **controller 42** is located in **dry station 246** outside pool 22, is in electronic communication with **cameras 32**, and is configured to generate control signals to cause movement of **vehicle 830** within the pool. *Id.*, 9:57–10:7. These control signals are transmitted from dry station 246 to vehicle 830. *Id.* Vehicle 830 includes an internal microprocessor that guides the drive motor to systematically clean pool surfaces accordingly. *Id.*, 10:8–27.



65. The '766 Patent also discloses the use of cameras 32 of the pool system with cameras algorithms or codes in either vehicle 30 or controller 42 to serve as part of a home or pool security system to detect the presence of a person at pool 22 satisfying a predefined characteristic and wherein an alert is output upon the person's detected at the pool. *Id.*, 3:54-4:15.

B. Prosecution History

66. The '766 Patent issued from U.S. Application 17/143,624 ("'624 Application"). EX1001, field (21). The '624 Application purported to claim priority, through a series of 4 intermediate continuing applications, to an earliest U.S.

Application No. 13/545,918 (“’918 Application”) filed on July 10, 2012. *Id.*, field (63).

67. Original Claims 1-19 of the ’624 Application were copies of claims from an earlier Application No. 15/973,983 in the priority chain, issued as U.S. Patent No. 10,338,599 (“’599 Patent”). *Compare* EX1002 at 17-19 with EX1012 at 24-26. Applicant concurrently filed a preliminary amendment cancelling original claims 1-19 and adding new independent claims 20-24. EX1002, pp.40-42.

68. During the original examination, no prior art rejections were raised against claims 20-24. The sole issue raised was a non-statutory double patenting rejection that was overcome via a terminal disclaimer. *Id.*, 70-86, 116-118. Claims 20-24 were issued as claims 1-5 of the ’766 Patent. *Id.*, 132-138. In the Notice of Allowability, the Examiner indicated that the references of record, alone or in combination, fail to disclose the features regarding the controller. *Id.*

69. Fu-007 (EX1007), used in this Petition, 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’s use in this Petition is not cumulative over the prior examination at least because Fu-007 is used in combination with other references, including Durvasula and Cui and the Examiner lacked expert testimony regarding the use of Fu-007 in combination with other

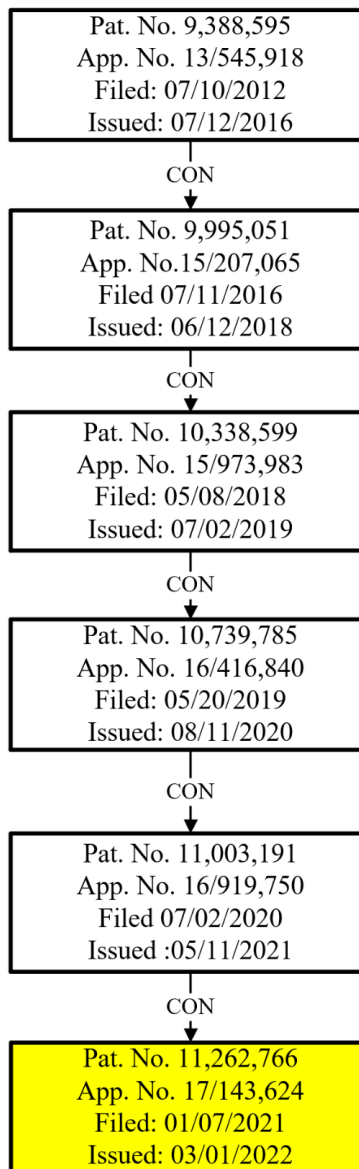
references.

C. '766 PATENT'S PRIORITY DATE

70. I have been advised by Petitioner's counsel and understand that the Board can consider the challenged claims' priority date. *See Parus Holdings, Inc. v. Google LLC*, 70 F.4th 1365, 1373-74 (Fed. Cir. 2023); *Indivior UK Ltd. v. Reddy's Labs. S.A.*, 18 F.4th 1323, 1328-30 (Fed. Cir. 2021). I have also been advised by Petitioner's counsel and understand that 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, first paragraph) under 35 U.S.C. §120. *Parus*, 70 F.4th at 1373-74; *Anascope, Ltd. v. Nintendo of Am., Inc.*, 601 F.3d 1333, 1334-35 (Fed. Cir. 2010).

71. The '766 Patent claims priority through a series of 4 intermediate, purported continuation applications to the '918 Application filed on July 10, 2012 as shown by the patent family tree below:

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PTAB Case No. IPR2026-00200



72. Therefore, the priority chain of the '766 Patent includes the '918 Application, filed on July 10, 2012, which predates the March 16, 2013 effective date of the America Invents Act (AIA) and is subject to pre-AIA 35 U.S.C. §§102-103, and the remaining earlier applications, filed after the AIA effective date, which are subject to AIA 35 U.S.C. §§102-103, as explained below.

73. The '766 Patent includes five independent Claims 1-5. Taking Claim 1 as 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 *Id.*, 10:57, 59-62. Claims 2-5 recite similar limitations. *See id.*, 11:6-11, 22-29; 12:7-13, 26-31.

74. It is my opinion, as explained below, none of the above-quoted limitations in Claims 1-5 were disclosed as part of the specification of the '918 Application as originally filed.

75. I have been informed by Petitioner’s counsel and understand that 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” in order to have the benefit of priority of the earlier filed application. As such, the disclosure in the earlier filed application must meet both the written description and enablement requirements under 35 U.S.C. §112(a) in disclosing the invention claimed in the later

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

filed application. *Chiron Corp. v. Genentech, Inc.*, 363 F.3d 1247, 1253 (Fed. Cir. 2004).

76. I have been informed by Petitioner’s counsel and understand that under the written description requirement in 35 U.S.C. §112(a), the specification must “reasonably convey[] to the artisan that the inventor had possession at that time of the later claimed subject matter.” *Vas-Cath Inc. v. Mahurkar*, 935 F.2d 1555, 1563 (Fed Cir. 1991). I have also been informed by Petitioner’s counsel and understand that the specification would demonstrate such possession by describing the claimed invention and all of its limitations. *Ariad Pharms., Inc. v. Eli Lilly & Co.*, 598 F.3d 1336, 1352 (Fed. Cir. 2010) (en banc) (citing *Lockwood v. Am. Airlines, Inc.*, 107 F.3d 1565, 1572 (Fed. Cir. 1997) (“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.”)).

77. It is my opinion, as further explained below, the ’918 Application does not provide a written description for each and every feature of Claims 1-5 of the ’766 Patent. 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.

78. Moreover, in my opinion, because the ’918 Application contains no disclosure of the above-identified claim limitations, the specification also fails to

satisfy the enablement requirement under 35 U.S.C. §112(a) for Claims 1–5. I have also been informed by Petitioner’s counsel and understand that “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, Inc. v. Novo Nordisk A/S*, 108 F.3d 1361, 1366 (Fed. Cir. 1997). Where, as here, the specification is entirely silent as to the above-identified claim limitations as explained below—including features of the controller identified as absent from the prior art of record in the Notice of Allowability (EX1002, pp.132-138)—it necessarily fails, in my opinion, to teach a skilled artisan how to make and use an invention encompassing those features, and the knowledge of skilled artisans cannot fill this void. This provides an independent basis under 35 U.S.C. §120 for concluding that Claims 1–5 are not entitled to the benefit of the July 10, 2012 filing date of the ’918 Application.

79. In my opinion, each of Claims 1-5 is entitled to a priority date in the priority chain after the ’918 Application and can be no earlier than July 11, 2016, the filing date of the ’918 Application’s next immediate child application No. 15/207,065 that issued as U.S. Patent No. 9,995,051. Each of Claims 1-5 is subject to AIA 35 U.S.C. §§102-103.

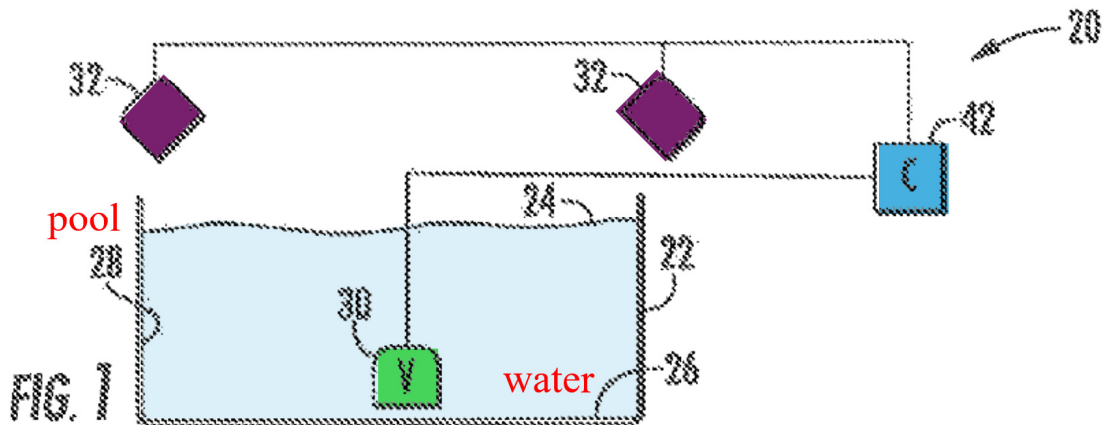
80. More detailed explanations of the lack of written description support in

the '918 Application for claimed limitations in Claims 1-5 of the '766 Patent are provided below.

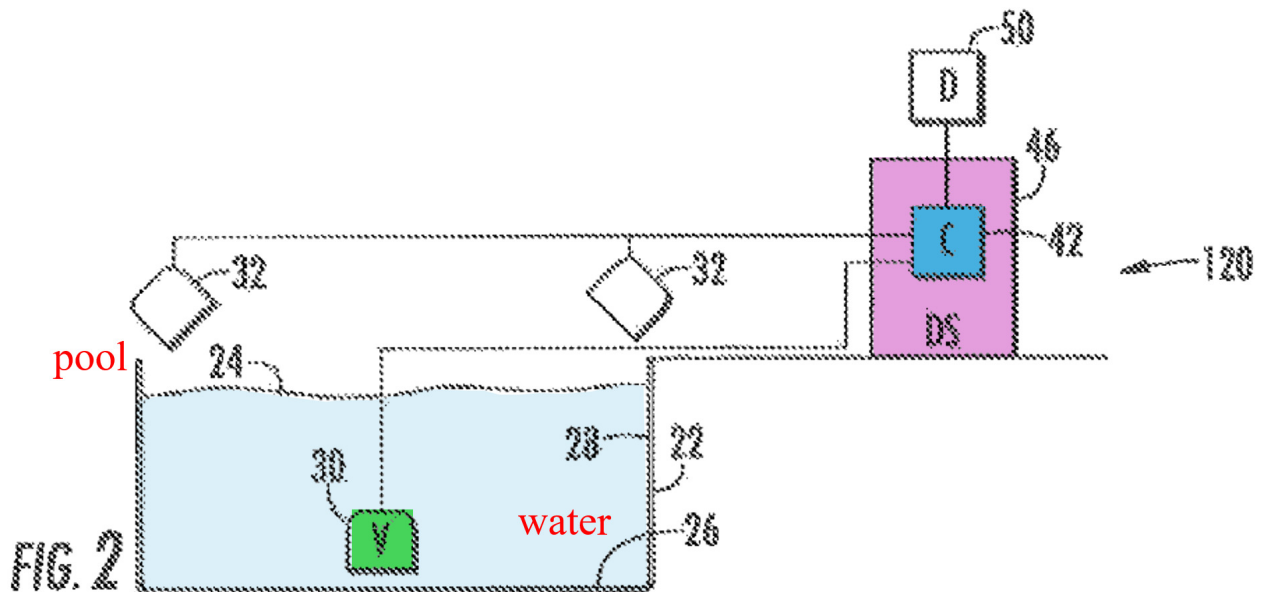
1. The '918 Application does not disclose “a controller...positioned on or in the body”

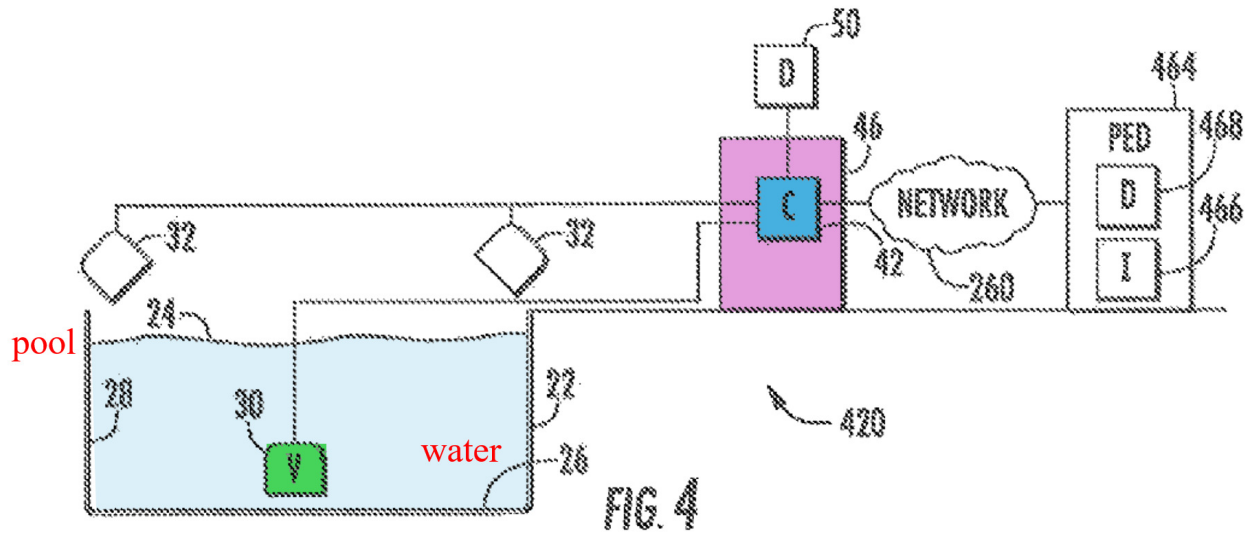
81. In my opinion, the '918 Application fails to describe that its controller “positioned on or in the body,” as recited in Claim 1 and similarly recited in Claims 2-5 of the '766 Patent. The '918 Application, however, consistently describes, in its textual description and drawings, including the claims, that a controller is located **outside the pool**, physically **remote** from the vehicle body which is submerged 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 only through a wired or wireless communication link. EX1011, pp.23-28, 32. Therefore, in the '918 Application, the disclosed controller is **physically separated and remote from the vehicle** and does not describe that its controller is **on or in** the vehicle body which is inside the pool.

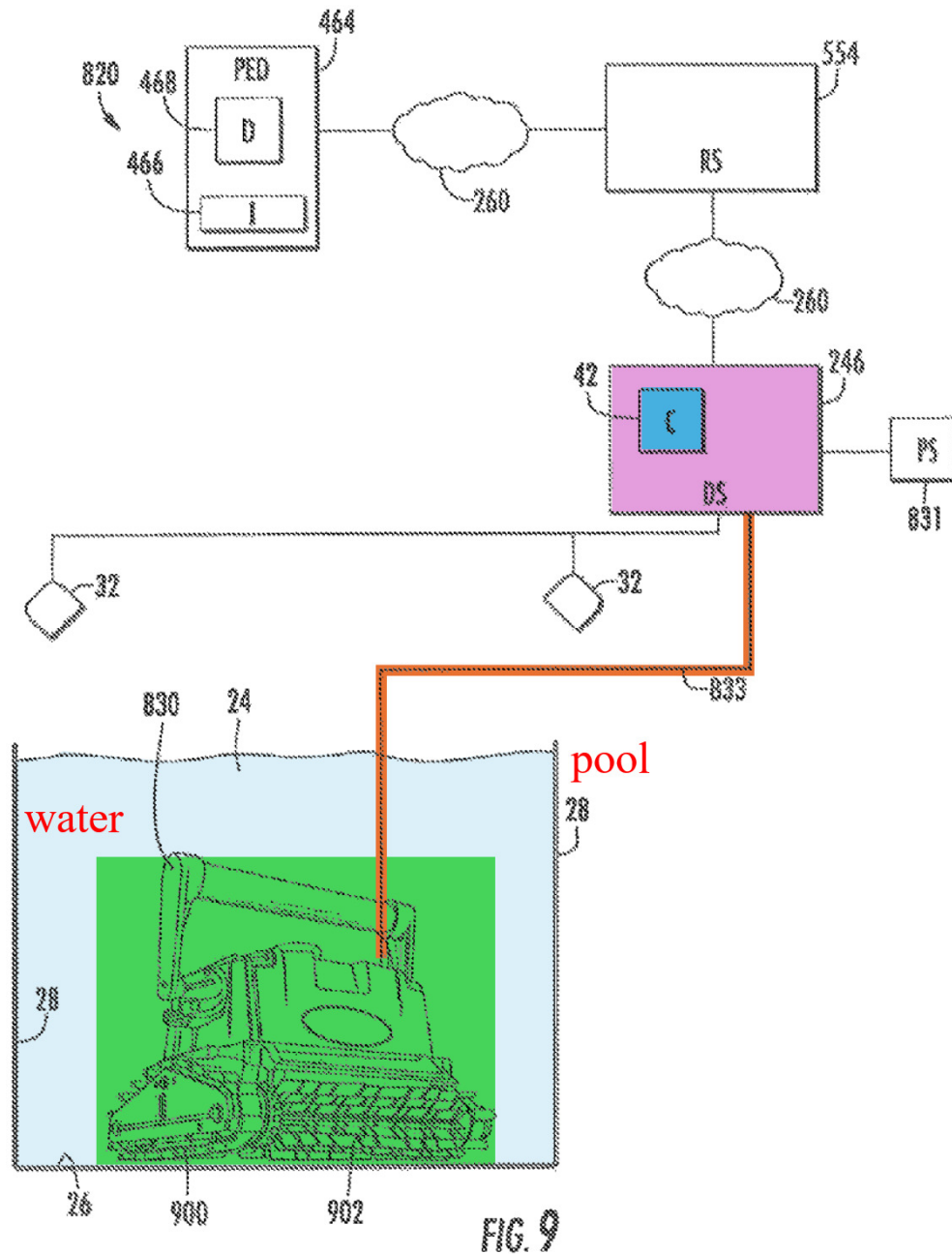
82. Specifically, FIG. 1 of the '918 Application (annotated below) illustrates an embodiment where **controller 42** is located outside pool 22 and remote from **vehicle 30**. *Id.*, p.38.



83. 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, located outside pool 22 and remote from vehicle 30/830. *Id.*, pp.24-25, 27-28, 32, 34, 38, 40.







84. FIGS. 3 and 5 (annotated below) show embodiments where **controller 42** is part of **remote server 254/554**, located outside pool 22 and remote from **vehicle 30**. *Id.*, 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

85. Accordingly, the '918 Application repeatedly describes and depicts its controller as a **remote** component from the vehicle and as being **located outside the pool** (e.g., as part of a dry station, a portable electronic device, or a remote server), communicating with the vehicle over a network and/or through a dry station. *See, e.g., id.*, pp. 38-40 (FIGS. 1-5, 9), 21-29, 32-35 (descriptions of FIGS. 1-5, 9, Claims 2-4, 10). The '918 Application does not describe or suggest any alternative controller configuration, such as positioning the controller on or in the vehicle body.

86. I have been advised by Petitioner's counsel and understand that the written description requirement mandates that "the specification must show the inventor actually invented the invention claimed." *Ariad Pharms.*, 598 F.3d at 1351. I have been advised by Petitioner's counsel and understand that "[o]ne 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. It is my opinion that, in light of the teachings in the '918 Application discussed 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 the claimed limitation under 35 U.S.C. §120. Accordingly, in my opinion, Claim 1 of the '766 Patent, as well as Claims 2-5—each reciting a limitation identical or substantially similar to the above-discussed

limitation of Claim 1—is not entitled to the July 10, 2012 filing date of the '918 Application.

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

87. In my opinion, 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.

88. The '918 Application describes controller 42 generating control signals, in response to images captured by camera 32, to steer vehicle 30 *to* or towards 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. The '918 Application further discloses that “controller 42 uses signals from cameras 32 to steer vehicle 34 [sic] such areas to re-clean such portions until such portions have been satisfactorily cleaned.” *Id.*; see also *id.*, p.25 (“causing controller 42 to generate control signals using signals from camera 32 to steer vehicle 30 back to such identified portions where such portions

may be cleaned”), pp.31-32 (“controller 42 generates control signals steering vehicle 30 to re-clean portions of pool 22, such as portions 638”; “As illustrated in FIG. 8, different portions 638 may be visibly distinguished from one another through color, text or markings indicating either differences in the cleanliness of such portions 638 or indicating different recommended cleaning strategies or approaches that may be selected by a person using input 466 when **vehicle 30 is steered back to such portions 638 for re-cleaning using signals from camera 32.**”). In each above description, the ’918 Application describes steering vehicle 30 to or towards a portion of pool 22 for cleaning.

89. The ’918 Application’s disclosure of image-based control signals is limited to directing vehicle 30 toward areas requiring cleaning. *Id.*, pp.24-25, 31-32. Notably absent is any disclosure of generating a control signal, in response to a captured image of a portion of the submerged surface, to cause the vehicle to move away from the portion—for example, to avoid a clean area or bypass an obstacle.

90. The ’918 Application’s image-driven control is steering the vehicle *to* identified missed/insufficiently cleaned areas for cleaning or re-cleaning, and it addresses getting stuck via mechanical features (e.g., rollers), not image-based avoidance logic. *Id.*, pp.24–25, 31–33.

91. In my opinion, in light of the teachings in the ’918 Application

discussed above, the '918 Application does not provide written description support for the claimed 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 the claimed limitation under 35 U.S.C. §120. Accordingly, it is my opinion that Claim 1, as well as Claims 2-5—each reciting a limitation identical or substantially similar to the above-discussed limitation of Claim 1—is not entitled to the July 10, 2012 filing date of the '918 Application.

92. In sum, because the '918 Application lacks written description support, and fails to meet the enablement requirement in its disclosure, for the claimed limitations “on or in the body” and “away from” in Claims 1-5 of the '766 Patent, in my opinion, 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 EX1013, field (22).

² I understand that 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).

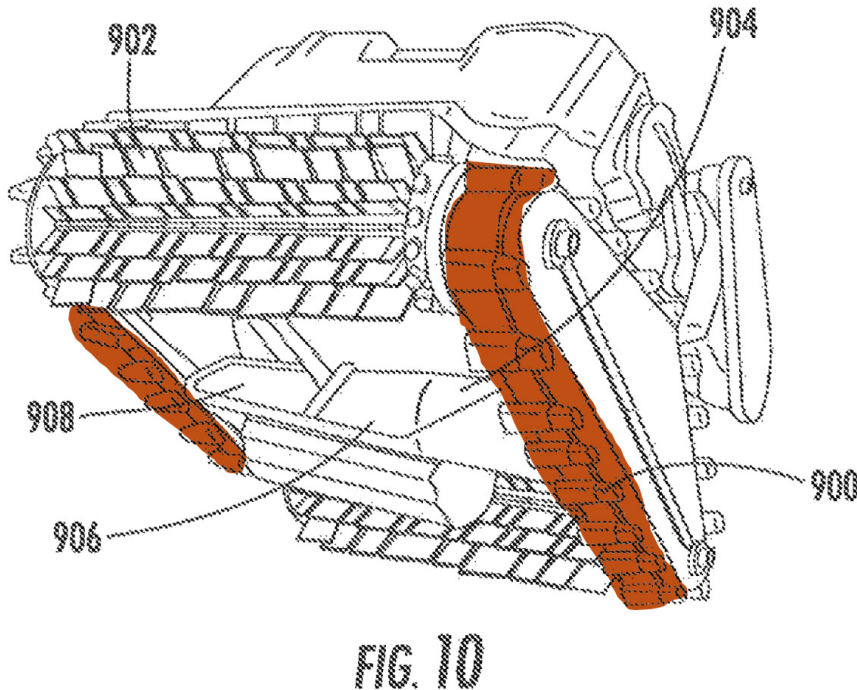
D. Claim Construction

93. I have been advised by Petitioner’s counsel and understand that, for determining invalidity in this Petition, no constructions are necessary except for the means-plus-function (MPF) limitation “means for moving the vehicle body” in Claims 1-5.

94. I have been advised by Petitioner’s counsel and understand that 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. *See* 35 U.S.C. § 112(f) or 6th paragraph; MPEP §2181; *TriMed, Inc. v. Stryker Corp.*, 514 F.3d 1256, 1259-60 (Fed. Cir. 2008).

95. Claims 1-5 each recite a claim limitation in the form of “*means for moving....*” and recites a claimed function of “moving the vehicle body within the swimming pool.” EX1001, 10:47-12:31. In my opinion, the corresponding structure described in the specification of 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. *Id.*, 3:31-43, 10:12-14, FIGS. 9-10. The ’766 Patent also discloses that vacuum or liquid jets “facilitate loosening of debris for collection by vehicle 30.” *Id.* 3:20-43.

96. In my opinion, the above described structures in the specification of the '766 Patent are the corresponding structures for the “means for moving the vehicle body.”



VII. INVALIDITY GROUNDS

A. Ground 1: Claims 1-5 Are Unpatentable under AIA 35 U.S.C. §103 over Durvasula with Fu-007.

1. Durvasula

97. Durvasula (EX1014) is U.S. Patent Application Publication No. US20140015959A1 of Patent Owner's '918 Application that was published on January 16, 2014. Durvasula is prior art under AIA 35 U.S.C. §102(a)(1) and is not subject to exceptions under AIA 35 U.S.C. §102(b)(1) because it was published more

than one year before its effective filing date which is no earlier than July 11, 2016. *See* §VI.C, *supra*. Additionally, Durvasula is also prior art under pre-AIA 35 U.S.C. §102(b).

98. Durvasula discloses a pool cleaning system and contains technical features that, in my opinion, are identical or similar to those of the '766 Patent and is analogous art with respect to Claims 1-5 of the '766 Patent.

2. Fu-007

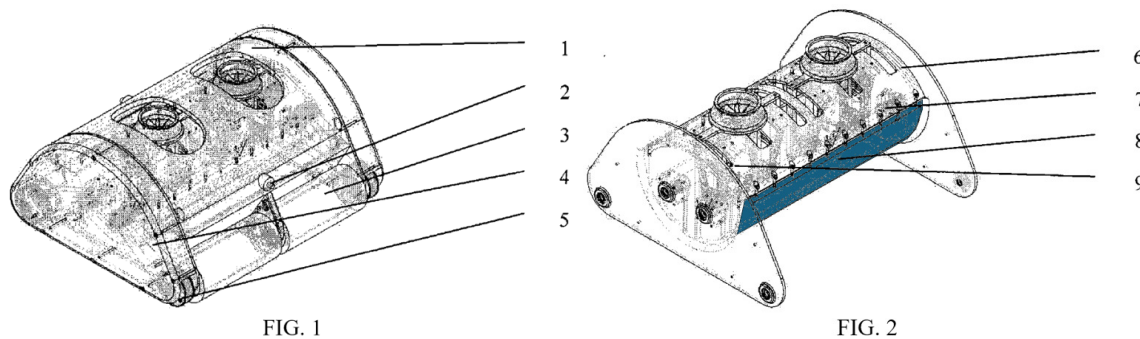
99. Fu-007 (EX1007) is Chinese Patent Application Publication No. CN 101139007A published on March 12, 2008 and is prior art under AIA 35 U.S.C. §102(a)(1) and is not subject to exceptions under AIA 35 U.S.C. §102(b)(1) because it was published more than one year before its effective filing date which is no earlier than July 11, 2016. *See* §VI.C, *supra*. In addition, Fu-007 is also prior art under pre-AIA 35 U.S.C. §102(b).

100. Fu-007 discloses an underwater cleaning robot for swimming pools using camera-based control. Fu-007, Abstract, pp.8-10³, 14-16, Claims 1, 4. In my opinion, Fu-007 is analogue art with respect to the subject matter of Claims 1-5 of

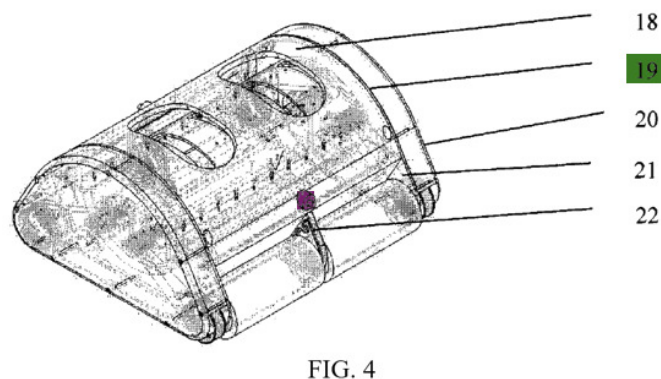
³ Page citations to Fu-007 are to the original pagination in the bottom center of each page.

the '766 Patent.

101. Fu-007's robot includes a control system with a central processing unit (controller) housed in **control system enclosure 8**. Fu-007, pp.8-9, 12-14, Claim 4, FIGS. 1-2 (annotated below).



102. Control system enclosure 8 is housed within a sealed drive control enclosure, which is “installed on and fixed to 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, FIG. 4 (annotated below).



103. Fu-007's robot also includes **monitoring camera 2** “installed on two front panels of the **robot main shell 19**” and connected to the **central processing**

unit via image acquisition card. Fu-007, pp.8-9, 12-14, Claim 4, FIGS. 1, 4, 6 (annotated).

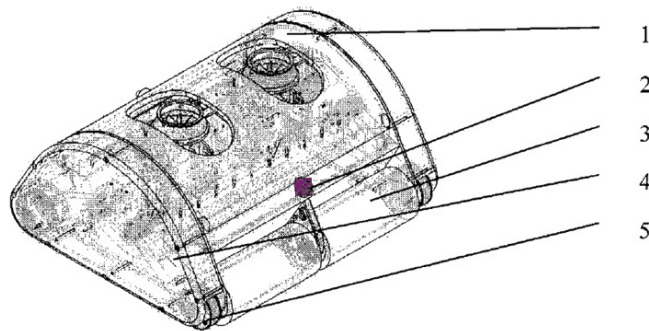


FIG. 1

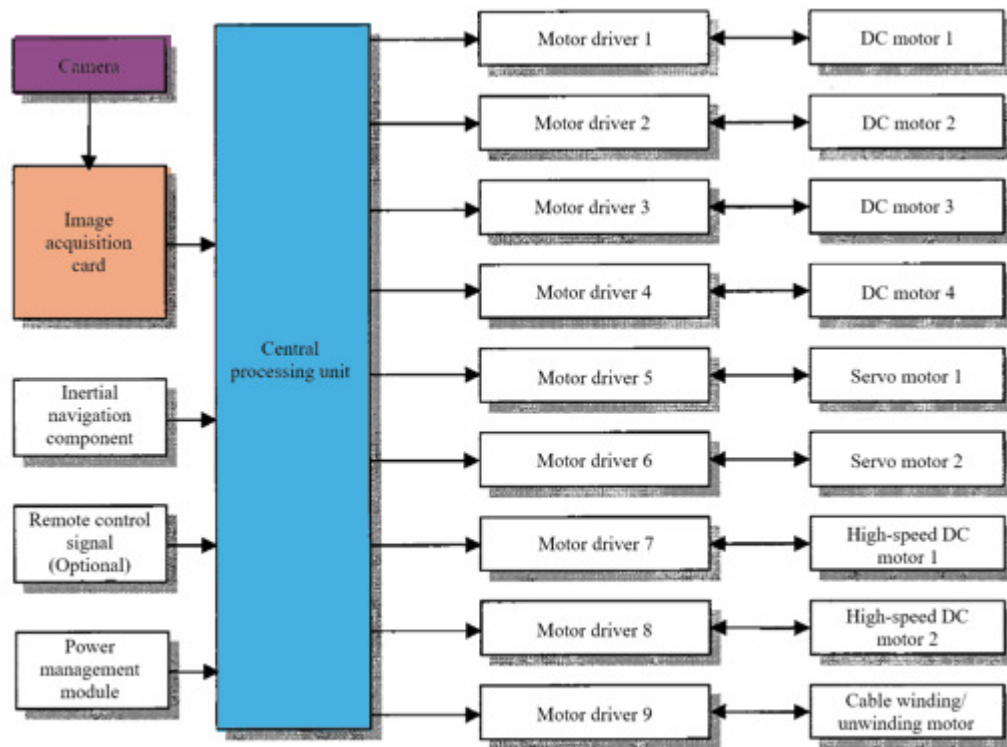


FIG. 6

104. Fu-007's control system enclosure 8 is "provided with both a power input interface and a rechargeable battery box, allowing the robot to be powered either externally or by the battery box." Fu-007, pp.8-9, 12-14, Claim 4. During

autonomous cleaning, Fu-007's central processing unit generates control signals based on images from monitoring camera 2—the robot “determines a cleanliness level of the bottom of the swimming pool by comparing the image(s) with the threshold, and plans a cleaning movement...to complete the cleaning task.” Fu-007, p.10, 14-16, Claim 7. Fu-007's robot may operate “powered by the battery box,” enabling untethered operation. Fu-007, pp.8-10, 12-14, Claims 4-5.

3. Reasons for Combining Durvasula and Fu-007

105. Both Durvasula and Fu-007 disclose underwater cleaning robots for swimming pools using camera-based control, and both sought to improve autonomous pool cleaning operations. 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. A POSITA would have been motivated to combine the complementary teachings of Durvasula and Fu-007 to achieve improved autonomous pool cleaning operations.

106. A POSITA would have recognized that the teachings in Durvasula and Fu-007 are directed to the same pool cleaning technical field, are based on recognition of the same or similar technical issues in pool cleaning, and provide

similar technical solutions to address those issues. Specifically, both references 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* Durvasula, [0020], [0022]-[0023], *with* Fu-007, pp.10, 14–16, Claims 4, 7. Accordingly, a POSITA would have investigated the technical teachings in both Durvasula and Fu-007 to seek guidance when designing a pool cleaning system for specific pool cleaning considerations and applications.

107. Durvasula teaches placing the controller in a dry station outside the pool in a tethered configuration, or a remote server or portable electronic device (PED) in a wireless configuration (Durvasula, [0013]-[0039], [0045]-[0046], FIGS. 1-5, 9, Claims 2-4, 10). Fu-007 teaches placing its controller within the cleaning and moving platform as part of a sealed drive control enclosure suitable for underwater operation. Fu-007, pp.8–9, 12–14, Claim 4. A POSITA would have been motivated to modify Durvasula by substituting Durvasula’s external controller with Fu-007’s onboard controller structure for at least two reasons.

108. First, a POSITA would have been guided by Durvasula and Fu-007 to make such a combination to advance Durvasula’s goal of autonomous pool cleaning by eliminating physical dependencies on external infrastructure. Durvasula’s reliance on an external controller and tether constrains autonomy by limiting range

and often requiring human intervention to manage cable entanglements. Fu-007 explicitly 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. A POSITA would have recognized that by integrating Fu-007’s onboard controller, the modified system would have enhanced autonomous operations—generating control signals onboard to plan paths and complete cleaning tasks without requiring human supervision or corresponding transmission of data (e.g., images, control signals) between the underwater cleaner and an external controller located outside the water (in a dry station, a remote server, or a portable electronic device (Durvasula, [0013]-[0039], [0045]-[0046], FIGS. 1-5, 9, Claims 2-4, 10)). Additionally, removing the external tether would allow the vehicle to navigate freely without cable management constraints. Durvasula’s cable can become tangled with pool features such as ladders, drains, and return fittings during cleaning operations, potentially interrupting the cleaning cycle and requiring user intervention. Fu-007’s tetherless design avoids these complications, allowing the robot to navigate complex pool geometries without obstruction. Fu-007, pp.9-10, 14. Even if a power tether were retained, relocating the controller onboard would eliminate or reduce the need for signal transmission through the tether, reducing its diameter and mass and resulting in less hydrodynamic drag and impedance to

movement.

109. Second, a POSITA would have been motivated to adopt this modification to further improve the safety of Durvasula's system. Durvasula discloses a tethered configuration that transmits both control signals and power to the vehicle through an external cable. Durvasula, [0045], FIG.9. See also *id.*, [0025] ("dry station 46 further provides electrical power to vehicle 30 in a wired fashion"), [0029] ("dry station 246 further provides part of vehicle 30 across a wired cable or wired connection"). A POSITA would have recognized that tethered systems introduce safety risks by requiring a physical electrical connection between shore-side components and the submerged cleaner, creating potential pathways for electrical leakage into the swimming pool environment if cable insulation wears down or connections become compromised. A POSITA would have further recognized that this risk is exacerbated in swimming pool environments, where dissolved chemicals (e.g., chlorine, calcium, pH balancers, algaecides) increase water conductivity and thus the potential for electrical current to reach pool users.

110. Fu-007 teaches a safer architecture that eliminates the external tether, including the power cable. Fu-007 discloses a "sealed drive control enclosure" with "waterproof properties" that houses the controller entirely inside the robot, and a "rechargeable battery box" that allows the robot to operate "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. A POSITA 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 external cables entering the water—including power cables—thereby removing the primary pathway for electrical leakage and enhancing the overall safety profile of the device for pool users.

111. A POSITA would have had a reasonable expectation of success in making this combination because positioning the controller on the vehicle body was a well-known design choice in autonomous pool cleaning robots, as shown by the teachings in Fu-007. *See, e.g.*, Fu-007, pp.8–10. *See also* Knoll, [0007], [0027]-[0028], FIG.1 (showing control unit 11 inside the vehicle that receives images from camera 6, processes the images, and controls the drive means 12 accordingly, as explained in §§VII.D.1-VII.D.2); Renaud (EX1017), [0008], [0009], [0029]-[0030] (disclosing a processing device/microprocessor inside the cleaner that receives images from a vision system, processes the images to identify debris, and actuates the motor to direct the cleaner to the debris, as explained in §§VII.G.1-VII.G.2). Additionally, Fu-007’s onboard controller is already configured to execute image-based cleaning tasks similar to Durvasula’s—analyzing captured images and

generating drive signals to control the vehicle's movement. Fu-007, pp.8–10, 14–16. A POSITA would have reasonably expected that Fu-007's controller could implement Durvasula's specific control logic (e.g., processing images to steer toward missed portions; Durvasula, [0020], [0022]–[0023]), thereby yielding predictable results.

4. Claim 1 Unpatentable over Durvasula and Fu-007

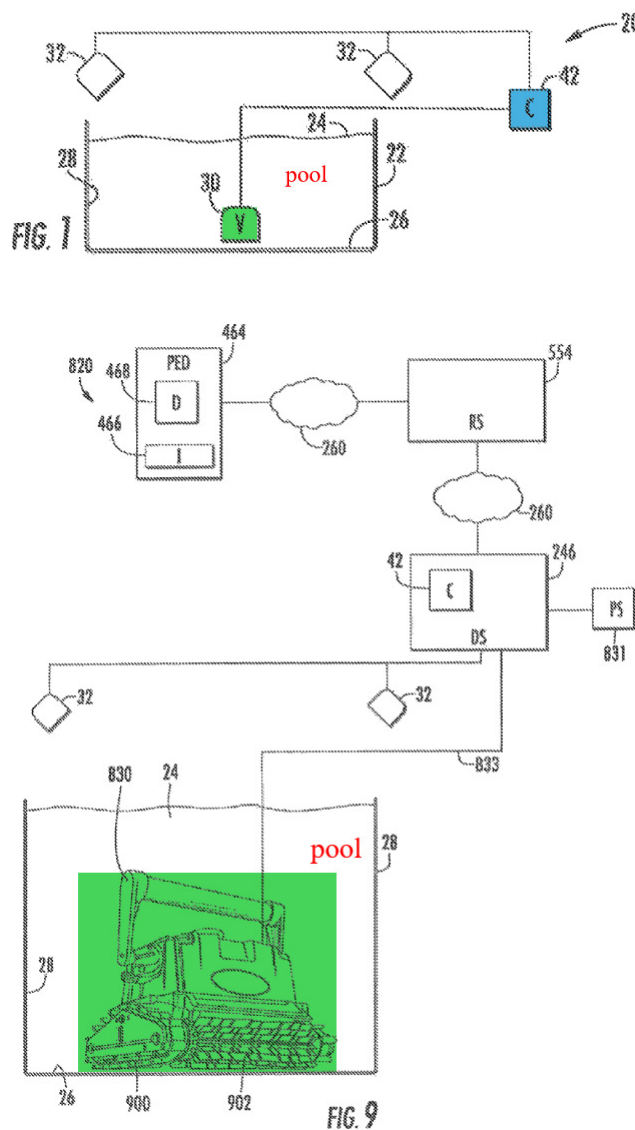
112. In my opinion, Durvasula and Fu-007 render independent claim 1 obvious.

a. **1[pre] “A self-propelled pool cleaner for cleaning debris from a submerged surface of a swimming pool, comprising”**

113. In my opinion, Durvasula discloses or suggests 1[pre].

114. Durvasula discloses a “pool cleaner” by disclosing a pool cleaning vehicle as part of a pool cleaning system. Durvasula, FIGS. 1-10 and [0002]–[0012]. Durvasula describes “[v]ehicle 30 comprises an automated powered device configured to **travel adjacent to submerged or water containing surfaces of pool 20...while cleaning such surfaces**” and “[v]ehicle 830 comprises a robotic or automated **pool cleaning device...to systematically clean surfaces of pool 22.**” Durvasula, [0014], [0046], FIGS. 1, 9 (annotated below). *See also* Durvasula, [0031] (“wherein controller 42 generates control signals for steering **the pool cleaning**

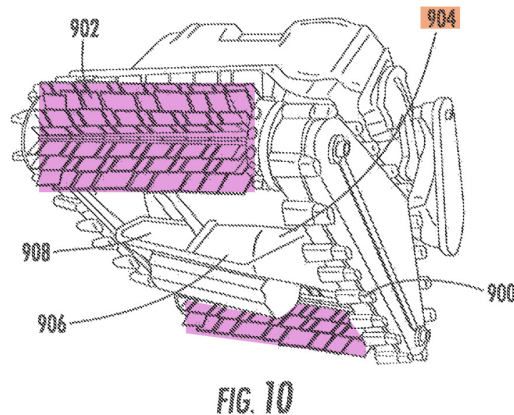
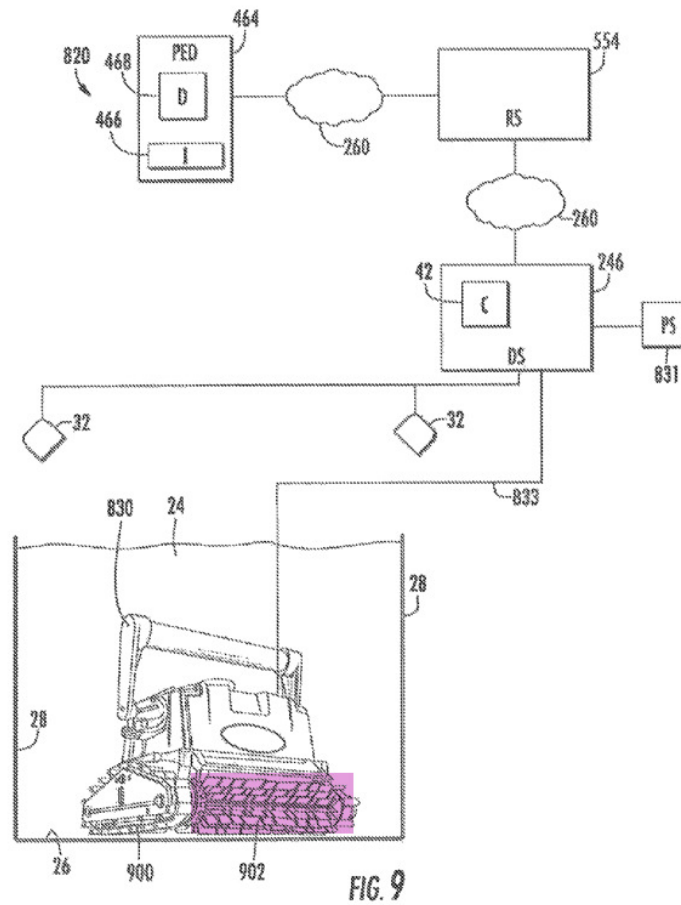
vehicle 30 of system 320”), [0045] (“Pool cleaning system 820 is similar to pool cleaning system 520 except the pool cleaning system 820 located controller 42 in dry station 246 and includes **pool cleaning vehicle 830, a specific example of vehicle 30**”), Abstract (“A pool cleaning system utilizes a powered **robotic surface cleaning vehicle**”), Claims 1, 17.



115. Durvasula discloses its pool cleaning vehicle as a “self-propelled” pool

cleaner: “[v]ehicle 30 comprises an **automated powered** device,” “includes one or more propulsion mechanisms” to “move along the submerged surfaces of pool 22,” and “[c]ontroller 42 is configured to generate control signals for steering **vehicle 30**.” Durvasula, [0014], [0016], [0022], FIG. 1 (annotated above); *see also id.*, [0023], [0026], [0030]-[0031], [0034], FIGS. 2-10.

116. Durvasula discloses its pool cleaning vehicle 30 as a pool cleaner “cleaning debris from a submerged surface of a swimming pool” throughout its description, including, e.g., “vehicle 30 may include vacuum or suction devices, a liquid circulation system and a filter **to draw debris**, such as bacterial growth or plant growth, from such pool surfaces, wherein the drawn liquid containing such residue or foreign matter is filtered **to collect the debris**.” (Durvasula, [0014]; *see also id.* [0015]-[0016]); “[v]ehicle 830 comprises a robotic or automated **pool cleaning device**...to systematically **clean surfaces of pool 22**” and “[v]ehicle 830 comprises **rotating brushes 902** to loosen waterline buildup and **breakdown large debris**” (Durvasula, [0046], FIGS. 9-10 (annotated below)).

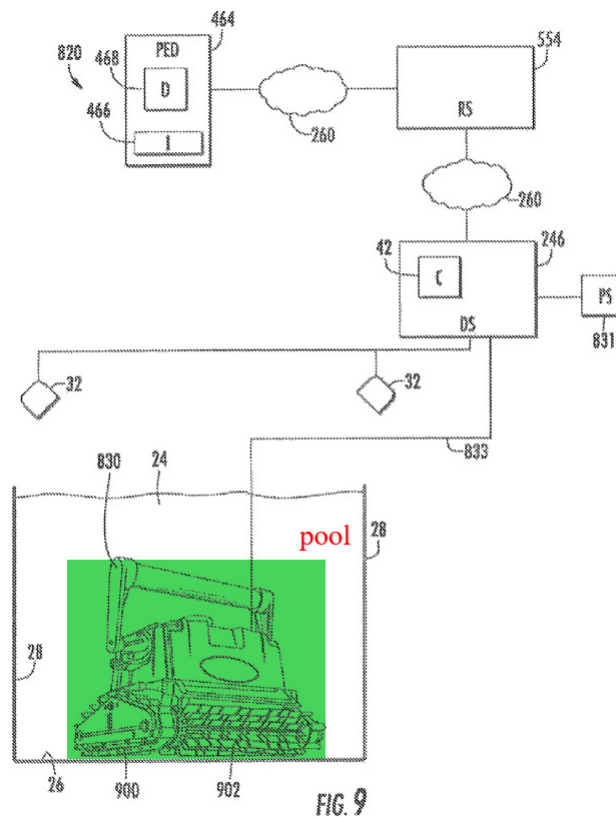
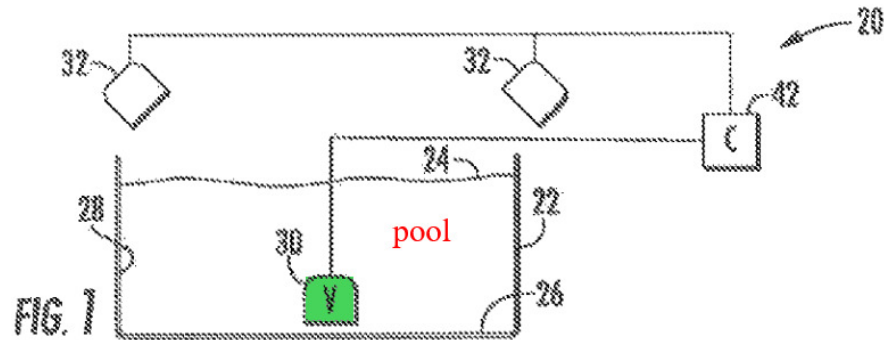


b. 1[a] “a. a vehicle body”

117. In my opinion, Durvasula discloses or suggests 1[a].

118. 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. A POSITA would have understood vehicle 30/830 that travels within the pool is the claimed “vehicle body.”

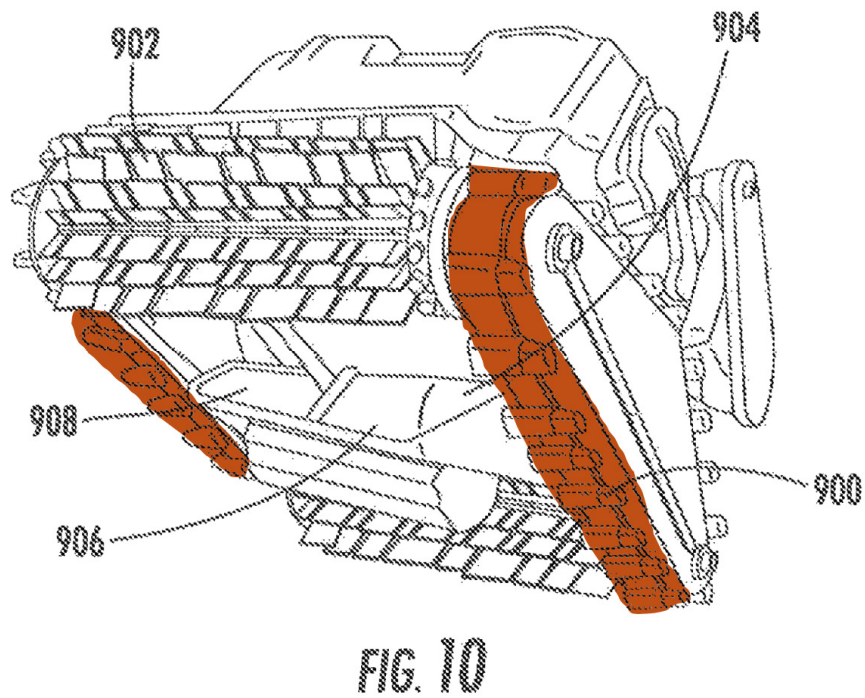
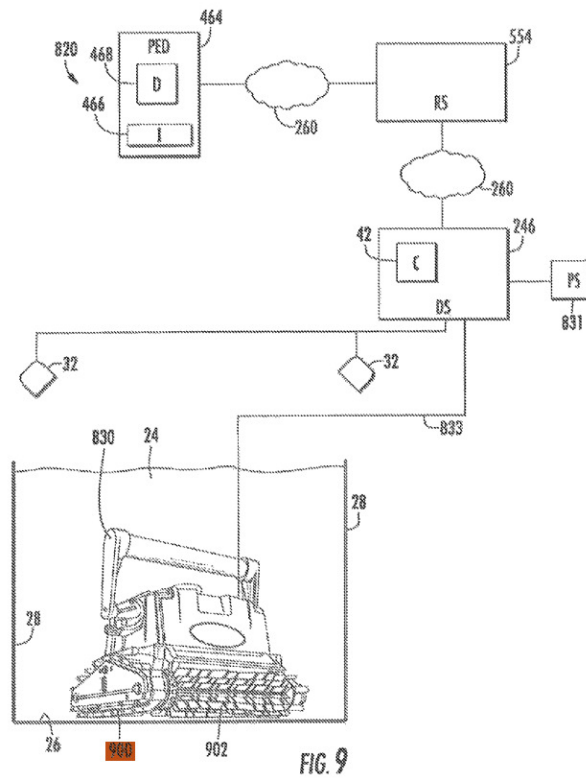


- c. 1[b] “b. means for moving the vehicle body within the swimming pool”

119. In my opinion, Durvasula discloses or suggests 1[b].

120. In my opinion, the format and content of 1[b] invoke claim interpretation under pre-AIA 35 U.S.C. §112 ¶6, or 35 U.S.C. §112(f). As explained in §VI.D, the recited function for the claimed “means for” is “moving the vehicle body within the swimming pool,” and the corresponding structure in the description of the ’766 Patent is “wheels, rollers, tracks, or other surface contacting members powered by a motor.” EX1001, 3:31-43, 10:12-14, FIGS. 9-10.

121. In my opinion, Durvasula discloses identical function and corresponding structure disclosed in the ’766 Patent. **Function:** *see, e.g.*, Durvasula, [0014] (“[v]ehicle 30 comprises an automated powered device configured to **travel** adjacent to submerged or water containing surfaces of **pool 20**”); *see also id.*, Abstract, [0016], [0023], Claims 1, 17, FIGS. 9-10. **Structure:** *see, e.g., id.*, [0016] (“vehicle 30 is propelled along the submerged pool surfaces using **wheels, rollers, tracks or other surface contacting members powered by a motor**”); *see also id.*, [0046], FIGS. 9-10 (annotated below).



- d. 1[c] “c. a filter configured to retain debris collected from the submerged surface;”

122. In my opinion, Durvasula discloses “a filter configured to retain debris” because Durvasula describes “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].

e. **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”**

123. In my opinion, 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].

f. **1[e][i] “e. a controller (i) positioned on or in the body”**

124. It is my opinion that the Durvasula-Fu-007 combination discloses or suggests 1[e][i].

125. Durvasula discloses a controller. Specifically, 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]. Durvasula further describes that 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].

126. As explained in §VI.C.1 regarding the relationship between the ’918

Application and the '766 Patent in connection with the claimed priority to the '918 Application, Durvasula, the patent publication of the '918 Application, fails to disclose that its controller is “positioned on or in the body.”

127. Like Durvasula, Fu-007 discloses an underwater cleaning robot for swimming pools using camera-based control. *See* §VII.A.2. Like Durvasula, Fu-007 uses a controller to generate, in response to the captured image, at least one control signal to cause movement of the pool cleaning body within the swimming pool. Specifically, 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 independently controllable cleaning drive wheels 3 and drainage devices. Fu-007, pp.12-14, Claims 1, 3, FIGS.1-2 (annotated below). Similar to the teaching in Durvasula for moving the pool cleaning vehicle, Fu-007 teaches the use of cleaning drive wheels, synchronous belt gears, and synchronous drive belts as part of a cleaning and moving platform to cause and control the movement of the platform during the pool cleaning operation. Fu-007, pp.8-9, 12-14, Claims 1, 3.

128. For the reasons explained in §VII.A.3, a POSITA would have been motivated to modify Durvasula by substituting Durvasula's external controller with Fu-007's onboard controller structure. The modified system incorporates Fu-007's

central processing unit (controller), which is housed in the “sealed drive control enclosure” inside Durvasula’s vehicle. In such modified system, Fu-007’s onboard controller within the cleaning and moving platform would be in electronic communication with Durvasula’s camera mounted to the vehicle body 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).

g. 1[e][ii] “(ii) in electronic communication with the at least one camera, and”

129. It is my opinion that Durvasula-Fu-007 combination discloses or suggests 1[e][ii].

130. 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].

131. As explained in §VII.A.3, §VII.A.4.f (1[e][i]), with a reasonable expectation of success, a POSITA would have been motivated to modify Durvasula’s system by substituting Durvasula’s external controller with an onboard controller structure taught by Fu-007, where the onboard controller is in electronic

communication with the camera (mounted to the vehicle body) via Fu-007's internal connection architecture (specifically, the camera connects to the central processing unit via an "image acquisition card"). Fu-007, pp.12-14, Claim 4, FIGS. 1, 4, 6.

- h. 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."**

132. In my opinion, the Durvasula-Fu-007 combination discloses or suggests 1[e][iii].

133. Specifically, 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]. Durvasula further 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 until such portions have been satisfactorily cleaned"—i.e., to the first portion identified from the captured image. Durvasula, [0023]; *see also id.*, [0026], [0044].

134. As explained in §VII.A.3, §VII.A.4.f (1[e][i]), with a reasonable expectation of success, a POSITA would have been motivated to modify Durvasula's

system to use Fu-007's onboard controller structure configured 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.

135. The claim limitation uses the disjunctive "or" between "to" and "away from," meaning the limitation is satisfied by teaching either alternative. 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 element.

136. Therefore, it is my opinion that Durvasula, in view of Fu-007, renders Claim 1 obvious.

5. Claim 2 Unpatentable over Durvasula and Fu-007

137. In my opinion, Durvasula and Fu-007 render independent Claim 2 obvious.

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

138. Limitations 2[pre], 2[a]-2[c], and 2[e][i]-2[e][iii] are exactly the same as limitations 1[pre], 1[a]-1[c], and 1[e][i]-1[e][iii], respectively. It is my opinion that, for at least the same reasons explained above in §§VII.A.4.a-VII.A.4.d (1[pre], 1[a]-1[c]), Durvasula discloses or suggests 2[pre] and 2[a]-2[c]. Additionally, it is

my opinion that, for at least the same reasons explained above in §§VII.A.4.f-h (1[e][i]-[iii]), the Durvasula-Fu-007 combination discloses or suggests limitations 2[e][i]-2[e][iii].

b. 2[d]

139. Limitation 2[d] is substantially the same as limitation 1[d], with the only difference being that Limitation 2[d] recites “at least one camera **carried by the body**,” whereas limitation 1[d] recites “at least one camera **mounted directly or indirectly to the body**.”

140. It is my opinion that, as explained above in §VII.A.4.e (1[d]), Durvasula discloses “at least one camera mounted directly...to the body.” Thus, Durvasula also discloses limitation 2[d], because a camera that is “mounted directly...to the body” is also “carried by the body.”

141. Therefore, it is my opinion that Durvasula, in view of Fu-007, renders Claim 2 obvious.

6. Claim 3 Unpatentable over Durvasula and Fu-007

142. In my opinion, Durvasula and Fu-007 render independent Claim 3 obvious.

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

143. Limitations 3[pre], 3[a]-3[c], and 3[e][i] are exactly the same as limitations 1[pre], 1[a]-1[c], and 1[e][i], respectively. For at least the same reasons

explained above in §§VII.A.4.a-d (1[pre], 1[a]-1[c]), Durvasula discloses or suggests 3[pre] and 3[a]-3[c]. Additionally, for at least the same reasons explained above in §VII.A.4.f (1[e][i]), the Durvasula-Fu-007 combination discloses or suggests limitation 3[e][i].

b. 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”

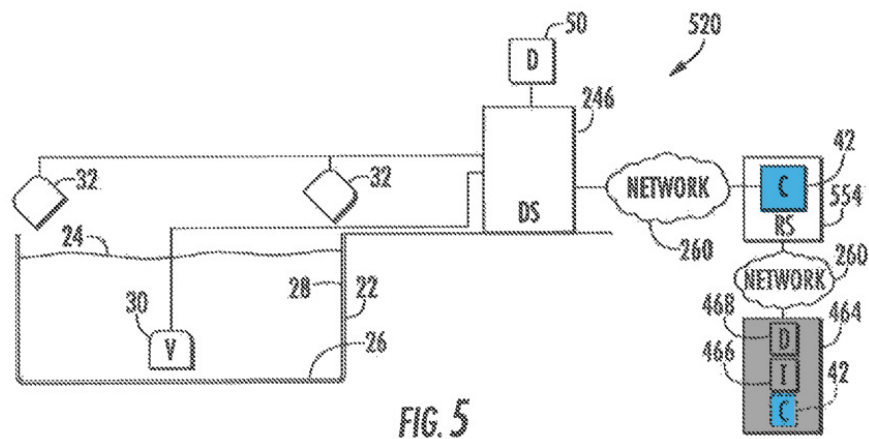
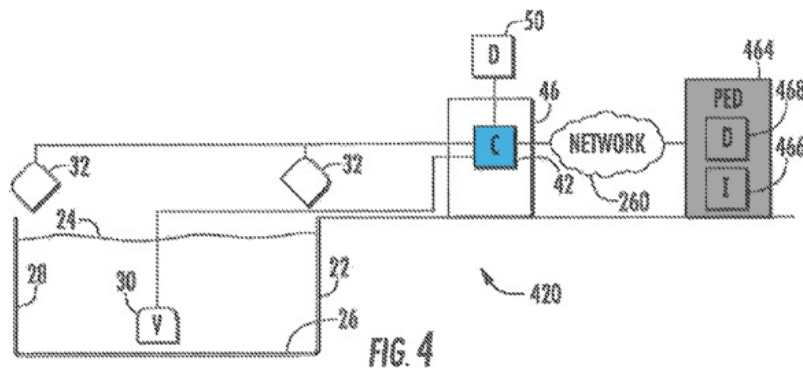
144. Limitation 3[d] recites substantially the same features as limitation 1[d], with the only difference being that limitation 3[d] recites “at least one camera **positioned on or in, or carried by, the body,**” whereas limitation 1[d] recites “at least one camera **mounted directly or indirectly to the body.**” As explained above in §VII.A.4.e (1[d]), Durvasula discloses “at least one camera mounted directly...to the body.” Thus, Durvasula also discloses limitation 3[d], because a camera that is “mounted directly...to the body” is also “positioned on or in, or carried by, the body.”

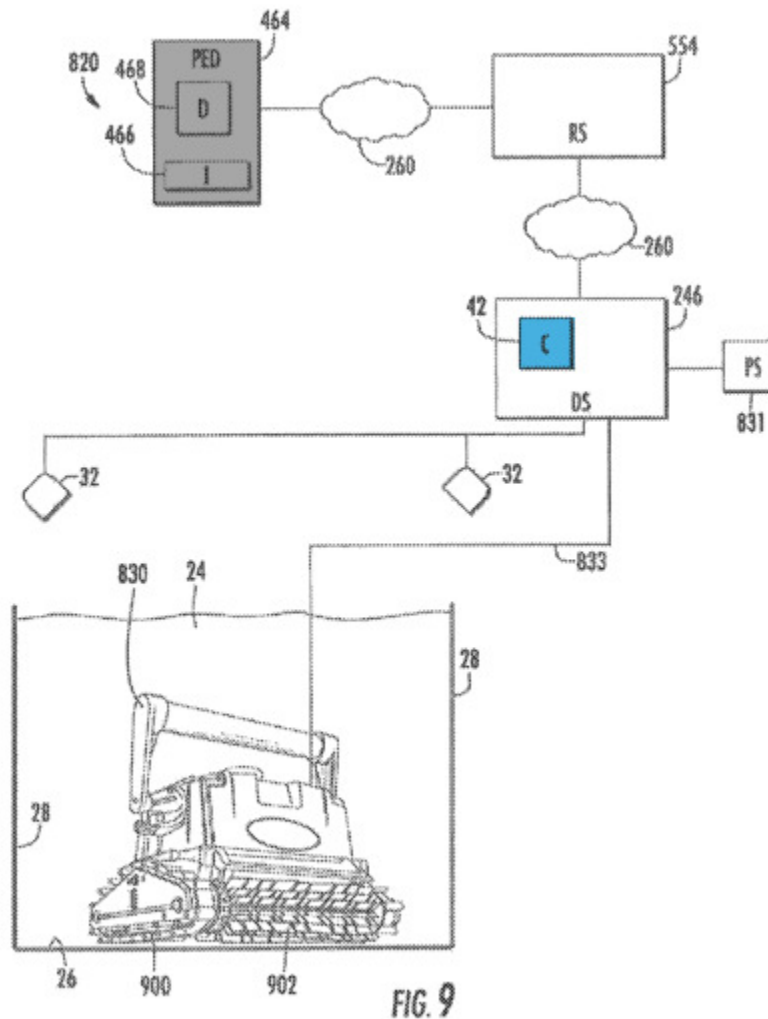
c. 3[e][ii] “(ii) in electronic communication with the at least one camera and a portable electronic device, and”

145. In my opinion, the Durvasula-Fu-007 combination discloses or suggests 3[e][ii].

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

147. Durvasula also discloses a **portable electronic device 464** that includes 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).





148. Fu-007 also discloses that its onboard controller communicates with control keyboard 31 as a portable electronic device that is outside its cleaning and moving platform and pool, and is operated by a user. *See* Fu-007, pp.13-14, FIGS.7-8. The control keyboard 31 is operated to have wirelessly communications with the underwater platform via control signal buoyant antenna 27 that is installed on and connected to an antenna interface of the signal relay and cable manager 28. *Id.*

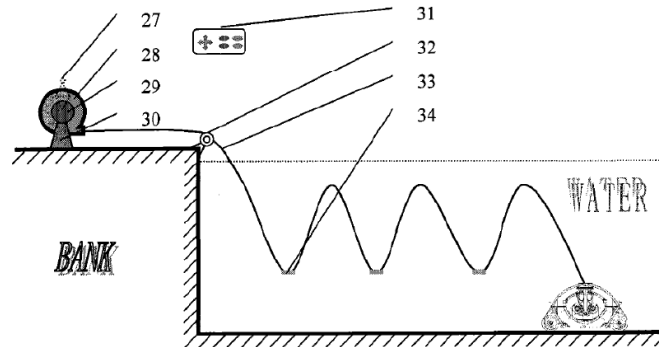


FIG. 7

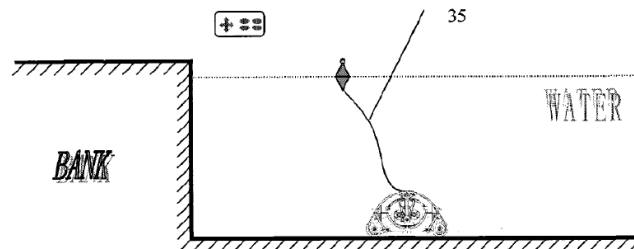


FIG. 8

149. Specifically, 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** (portable electronic device) 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.

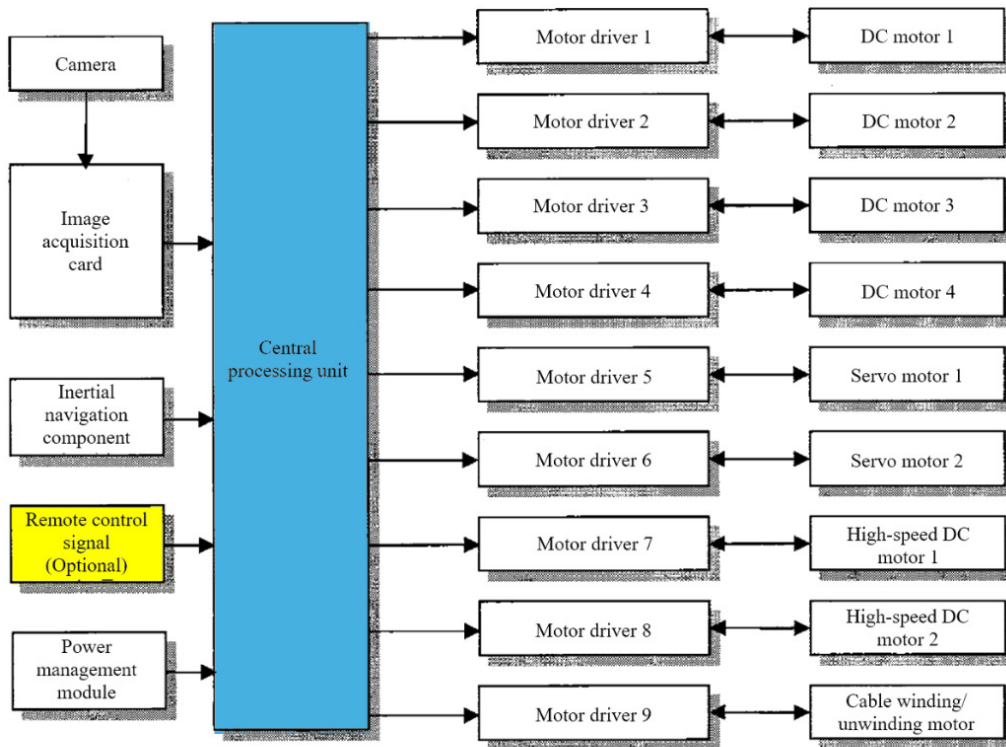


FIG. 6

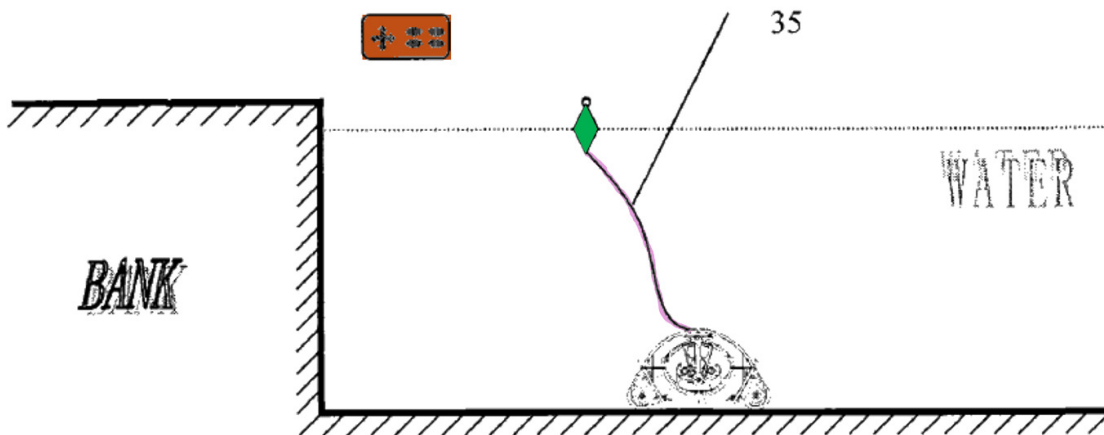


FIG. 8

150. Fu-007 describes a “control keyboard 31” used for “manual operation” to send control signals. Fu-007, pp.12-14. A POSITA would have understood that

Fu-007's "control keyboard 31" is a portable electronic device because it is distinct from the vehicle and designed to "wirelessly communicate" with the antenna floating on the water surface. *See* Fu-007, pp.12-14, FIG. 8.

151. As explained in §VII.A.4.f (1[e][i]), a POSITA would have been motivated to replace Durvasula's controller with Fu-007's onboard controller. A POSITA 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. 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. This configuration would replace Durvasula's original wired communication path with Fu-007's wireless communication link

152. A POSITA would have been motivated to make such a combination at least for the following reasons.

153. First, as discussed in §VII.A.4.f (1[e][i]), a POSITA 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]), a POSITA 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.

154. Second, a POSITA would have motivated to make such a combination, because using Fu-007's buoyant antenna (which stays on the surface for clear signal reception), the user could reliably drive the robot to the wall for removal using the PED, eliminating the need to physically pull a cord or wait for the robot to surface randomly. Durvasula, [0033], FIGS. 4-5, 9; Fu-007, pp.12-14, FIG. 8.

155. A POSITA would have had a reasonable expectation of success. Specifically, Fu-007 teaches a working implementation where its onboard controller is already configured with a "Remote control signal" interface and a "buoyant antenna" specifically designed to communicate with a remote control keyboard. *See* Fu-007, pp.12-14, FIG. 8. Configuring this existing, wireless interface to accept signals from Durvasula's PED would have been a routine integration of compatible electronic components yielding predictable results.

- d. **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."**

156. In my opinion, the Durvasula-Fu-007 combination discloses or

suggests 3[e][iii].

157. The limitation requires the controller to generate signals in response to **one of** the captured image **or** the PED. As explained in §§VII.A.4.f-VII.A.4.h (1[e][i]-[iii]), with a reasonable expectation of success, a POSITA would have been motivated to modify Durvasula’s system to use Fu-007’s onboard controller configured 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). *See, e.g.*, Durvasula, [0022]-[0023], [0026], [0044]; Fu-007, Abstract, pp.8-9, 14-16, Claims 1, 4. Thus, the Durvasula-Fu-007 combination satisfies this limitation through the “captured image” prong alone. *Id.*

158. Additionally, Durvasula describes a user may “enter commands or selections” through PED 464 to “adjust the steering of vehicle 30” or change “the path or route of vehicle 30.” Durvasula, [0036]. A POSITA would have understood that controller 42 generates control signals to steer vehicle 30 “to” identified portions in response to user commands entered through PED 464. Fu-007 similarly teaches that its controller receives remote signals to “control the movement of the robot.” Fu-007, Claim 7. At least for the same reasons explained in §§VII.A.4.f and VII.B.5.c (1[e][i], 3[e][ii]), a POSITA would have been motivated, with reasonable expectation of 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. *See* Fu-007, pp.8-9, 14-16; Durvasula, [0033], [0036].

159. Therefore, it is my opinion that Durvasula, in view of Fu-007, renders Claim 3 obvious.

7. Claim 4 Unpatentable over Durvasula and Fu-007

160. In my opinion, Durvasula and Fu-007 render independent Claim 4 obvious.

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

161. Limitations 4[pre], 4[a]-4[c], and 4[e] are exactly the same as limitations 1[pre], 1[a]-1[c], and 1[e], respectively. It is my opinion that, for at least the same reasons explained above in §§VII.A.4.a-VII.A.4.d (1[pre], 1[a]-1[c]) and §§VII.A.4.f-VII.A.4.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 limitations 4[e][i]-[iii].

b. 4[d] "at least one camera for capturing an image of at least a first portion of the submerged surface; and"

162. Limitation 4[d] recites substantially the same features as limitation 1[d], with the only difference being that 4[d] omits the feature that the camera be

“mounted directly or indirectly to the body.” Thus, it is my opinion that, for at least the reasons explained above in §VII.A.4.e (1[d]), Durvasula discloses limitation 4[d].

8. Claim 5 Unpatentable over Durvasula and Fu-007

163. In my opinion, Durvasula and Fu-007 render independent Claim 5 obvious.

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

164. Limitations 5[pre] and 5[a]-5[c] are exactly the same as limitations 1[pre] and 1[a]-1[c], respectively. It is my opinion that, for at least the same reasons explained above in §§VII.A.4.a-VII.A.4.d (1[pre], 1[a]-1[c]), Durvasula discloses or suggests 5[pre] and 5[a]-5[c].

b. 5[d] “d. a chemical dispenser on, in, or carried by the vehicle body;”

165. In my opinion, Durvasula discloses or suggests 5[d] because Durvasula describes “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].

c. 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”

166. Limitation 5[e] recites substantially the same features as limitation 1[d],

with the only difference being that limitation 5[e] recites “at least one camera on, in, or carried by the vehicle body,” whereas limitation 1[d] recites “at least one camera mounted directly or indirectly to the body.” As explained above in §VII.A.4.e (1[d]), Durvasula discloses “at least one camera mounted directly...to the body.” Thus, it is my opinion that Durvasula 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.”

d. 5[f][i] “f. a controller (i) on, in, or carried by the vehicle body”

167. Limitation 5[f][i] is substantially the same as limitation 1[e][i], with the only difference being that 5[f][i] recites a controller “on, in, or carried by the vehicle body,” whereas 1[e][i] recites a controller “positioned on or in the body.” As explained above in §VII.A.4.f (1[e][i]), the Durvasula-Fu-007 combination discloses or suggests a controller “positioned on...the body.” Thus, it is my opinion that Durvasula also discloses 5[f][i], because a controller that is “positioned on...the body” is also “on, in, or carried by the vehicle body.”

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

168. Limitations 5[f][ii] and 5[f][iii] are exactly the same as limitations 1[e][ii] and 1[e][iii], respectively. It is my opinion that, for at least the same reasons explained above in §§VII.A.4.f-VII.A.4.h (1[e][ii]-1[e][iii]), the Durvasula-Fu-007 combination discloses or suggests 5[f][ii] and 5[f][iii].

B. Ground 2A: Claims 1-4 Are Unpatentable under AIA 35 U.S.C. §103 and Pre-AIA AIA 35 U.S.C. §103 over Cui with Fu-007

1. Cui

169. Cui (EX1005) is Chinese Patent Application Publication No. CN1540119A published on October 27, 2004 and is prior art under AIA 35 U.S.C. §102(a)(1) and is not subject to exceptions under AIA 35 U.S.C. §102(b)(1) because it was published more than one year before its effective filing date which is no earlier than July 11, 2016. *See* §VI.C, *supra*. In addition, Cui is also prior art under pre-AIA 35 U.S.C. §102(b).

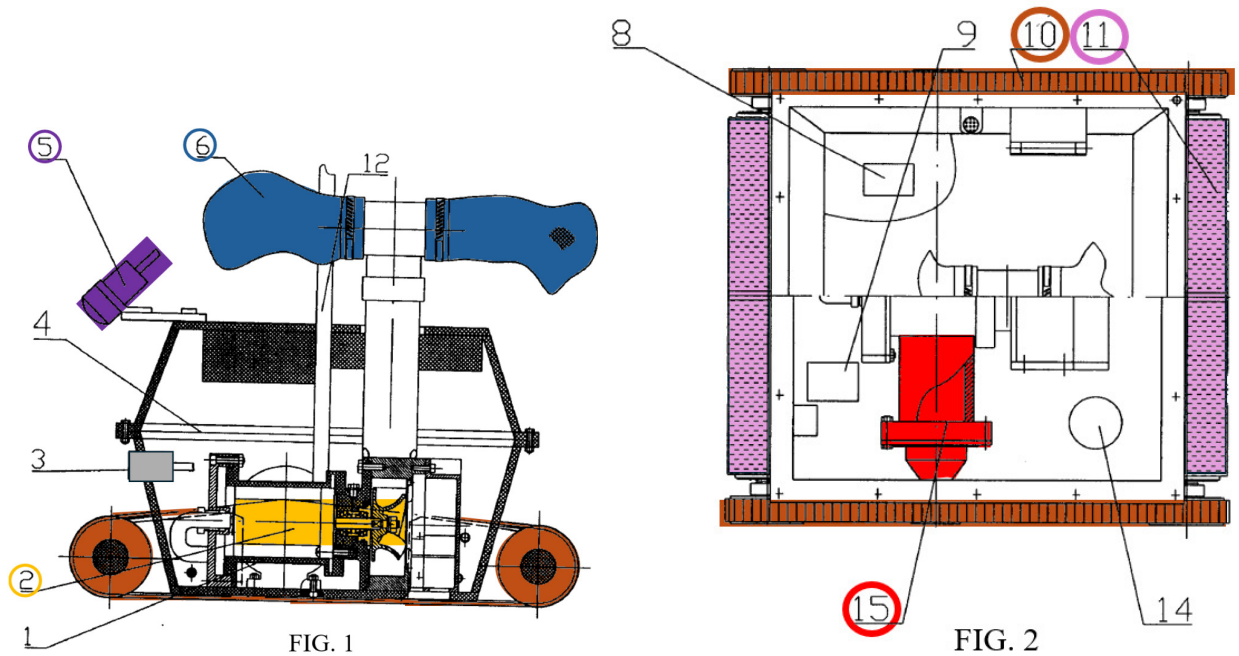
170. Cui discloses a pool cleaner with debris detection capability for use in swimming pools. *See* Cui, Title, Abstract. Cui's pool cleaner uses a CCD camera to continuously capture images of pool surfaces, compares them with pre-stored standard images of clean surfaces, and controls the cleaner's operation based on detected debris levels/distributions. *Id.*, Abstract, pp.5-7.⁴ Cui is analogous art with respect to Claims 1-5 of the '766 Patent.

171. As illustrated in FIGS. 1-2 (annotated below), Cui's pool cleaner comprises a housing 4 containing various components including a **brushless DC**

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

water pump motor 2, an infrared distance sensor 3, a CCD camera 5, a filter bag 6, an industrial control computer 7 with related software, sensors 8, 9, track-type crawling mechanisms 10, roller brushes 11, and hybrid stepper motors 15.

Cui, Claim 1, pp.5-6, FIGS. 1-3.



Cui, FIGS. 1-2 (annotated)

172. Cui's computer 7 is connected to camera 5 through image acquisition card 21 and processes the captured images to generate control signals that adjust the crawling speed based on detected debris levels/distributions. Cui, pp.4-7, FIGS. 5-6 (annotated below). Camera 5 captures images that undergo A/D conversion and comparison with stored standard images. *Id.* Greater sediment/debris produce larger grayscale differences, causing computer 7 to adjust speed of motors 15 via relay

board 20, controlling crawling speed and cleaning force. *Id.*

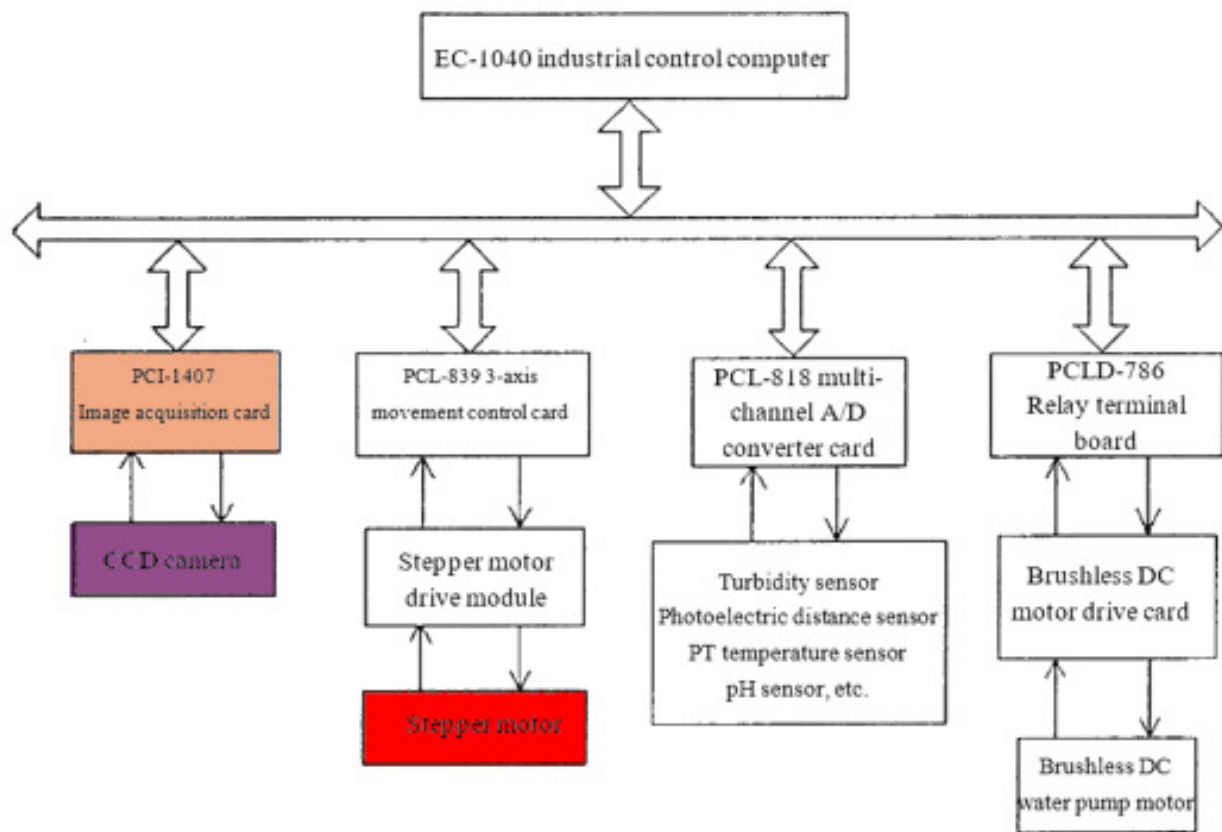
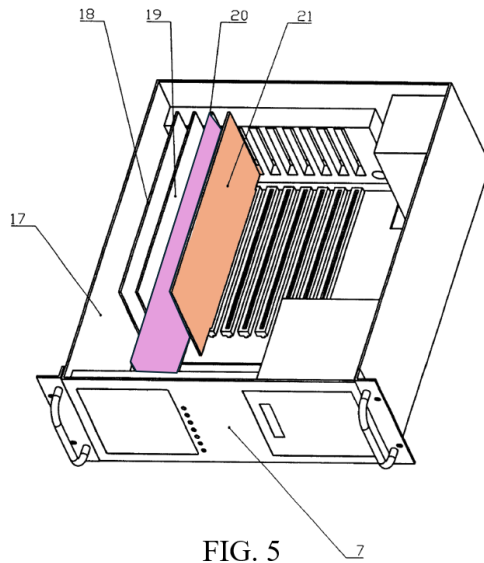


FIG. 6

173. Human-machine interface 16 of computer 7 displays pool area with different colors to indicate cleaned areas and areas to be cleaned, sensor values, and control switches. Cui, p.6, FIG. 4.

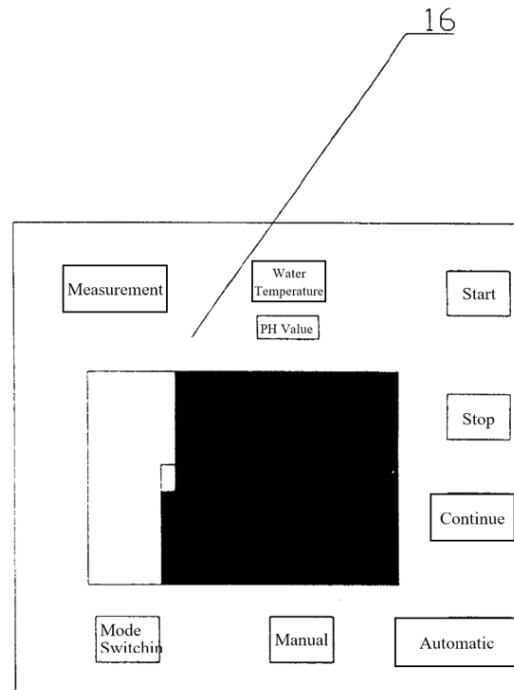


FIG. 4

Cui, FIG. 4

2. Reasons to Combine Cui and Fu-007

174. 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. A POSITA would have been motivated to combine the complementary teachings of Cui and Fu-007 to achieve improved autonomous pool cleaning operations.

175. A POSITA would have recognized that the teachings in Cui and Fu-007 are directed to the same pool cleaning technical field, are based on recognition of the same or similar technical issues in pool cleaning, and provide similar technical solutions to address those issues. Specifically, both references 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 references 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, a POSITA would have investigated the technical teachings in both Cui and Fu-007 to seek guidance when designing a pool cleaning system for specific pool cleaning considerations and applications.

176. Cui and Fu-007, however, differ in their technical implementations of certain common features. Different from Cui's placement of the controller (industrial control computer 7) outside the pool and separate from the pool cleaning vehicle in

a tethered configuration via cable assembly 12, Fu-007 places its controller within the cleaning and moving platform as part of a sealed drive control enclosure suitable for underwater operation. 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. A POSITA 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.

177. First, a POSITA would have been guided by Cui and Fu-007 to make such a combination to advance Cui’s goal of autonomous pool cleaning by eliminating physical dependencies on external infrastructure. Cui’s reliance on an external computer and cable assembly constrains autonomy by limiting range and requiring human intervention to manage cable entanglements. Fu-007 explicitly 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. A POSITA would have recognized that by integrating Fu-007’s onboard controller architecture into Cui, the modified system would have enhanced Cui’s autonomous operation by liberating the robot from shore-side constraints—generating control signals onboard to plan paths and complete cleaning tasks without requiring human supervision or corresponding

transmission of data (e.g., images, control signals) between the underwater cleaner and an external controller located outside the water (in a dry station, a remote server, or a portable electronic device (Durvasula, [0013]-[0039], [0045]-[0046], FIGS. 1-5, 9, Claims 2-4, 10)). Additionally, removing the external tether would allow the vehicle to navigate freely without cable management constraints. Cui's cable assembly 12 can become tangled with pool features such as ladders, drains, and return fittings during cleaning operations, potentially interrupting the cleaning cycle and requiring user intervention. Fu-007's tetherless design avoids these complications, allowing the robot to navigate complex pool geometries without obstruction. Fu-007, pp.9-10, 14. Even if a power tether were retained, relocating the controller onboard would eliminate or reduce the need for signal transmission through the tether, reducing its diameter and mass and resulting in less hydrodynamic drag and impedance to movement.

178. Second, a POSITA would have been motivated to adopt this modification to further improve the safety of Cui's system. Cui discloses a tethered configuration where industrial control computer 7 is connected to the cleaner via an external "cable assembly 12." Cui, pp.5-6, Claim 1, FIGS. 1-2. A POSITA would have recognized that tethered systems introduce safety risks by requiring a physical electrical connection between shore-side electronics and the submerged cleaner,

creating potential pathways for electrical leakage into the swimming pool environment if cable insulation wears down or connections become compromised. A POSITA would have further recognized that this risk is exacerbated in swimming pool environments, where dissolved chemicals (e.g., chlorine, calcium, pH balancers, algaecides) increase water conductivity and thus the potential for electrical current to reach pool users.

179. As explained in §VII.A.3, Fu-007 teaches a safer architecture that eliminates the external tether, including the power cable. A POSITA would have been motivated to replace Cui's tethered computer arrangement with Fu-007's onboard, sealed, battery-powered architecture, because this modification would have eliminated the need for any external cables entering the water—including power cables—thereby removing the primary pathway for electrical leakage and enhancing the overall safety profile of the device for pool users.

180. A POSITA would have had a reasonable expectation of success in making this combination because positioning the controller on the vehicle body was a well-known design choice in autonomous pool cleaning robots, as shown by the teachings in Fu-007. *See, e.g.*, Fu-007, pp.8–10, 12–14. *See also* Knoll, [0007], [0027]–[0028], FIG.1 (showing control unit 11 inside the vehicle that receives images from camera 6, processes the images, and controls the drive means 12

accordingly, as explained in §§VII.D.1-VII.D.2); Renaud (EX1017), [0008], [0009], [0029]-[0030] (disclosing a processing device/microprocessor inside the cleaner that receives images from a vision system, processes the images to identify debris, and actuates the motor to direct the cleaner to the debris, as explained in §§VII.G.1-VII.G.2). 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 to control the vehicle's movement (e.g., adjusting drive wheels based on debris thresholds). Fu-007, pp.8–10, 14–16. Because Fu-007's controller is already configured to execute image-based cleaning tasks, a POSITA would have reasonably expected that Fu-007's controller could implement Cui's specific control logic (e.g., processing images to control crawling speed based on debris levels; Cui, pp.5–7), thereby yielding predictable results.

3. Claim 1 Unpatentable over Cui and Fu-007

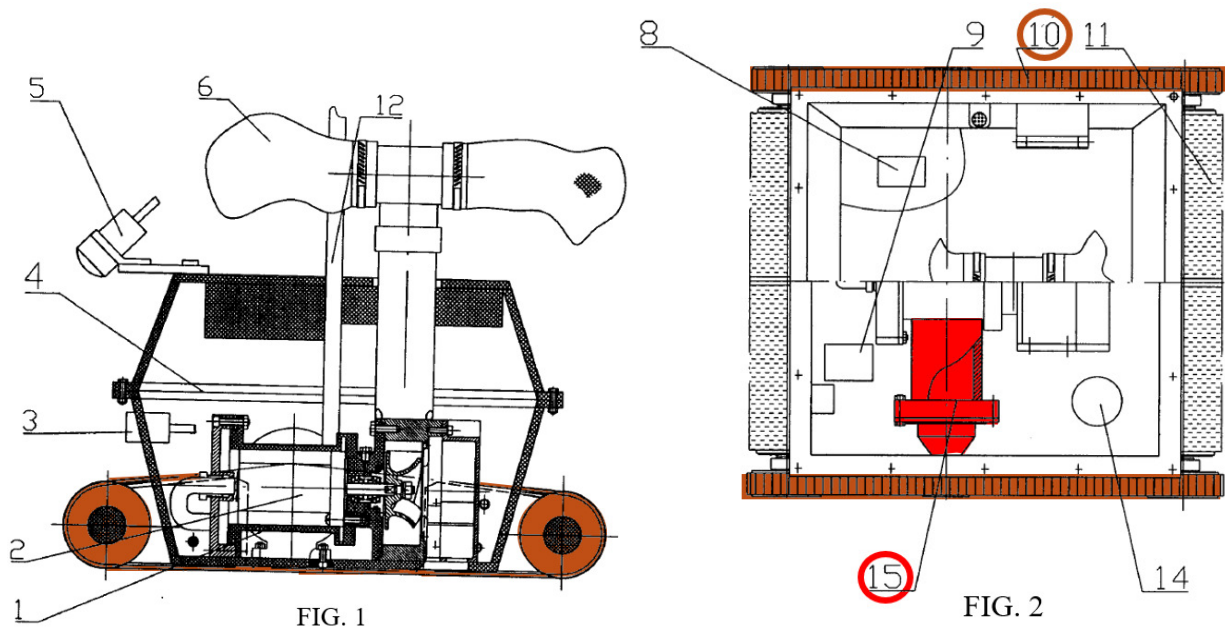
181. In my opinion, the Cui-Fu-007 combination renders independent claim 1 obvious.

a. 1[pre] “A self-propelled pool cleaner for cleaning debris from a submerged surface of a swimming pool, comprising”

182. In my opinion, Cui discloses or suggests 1[pre].

183. Cui discloses a system designed for “professional or commercial

swimming pools,” including an underwater cleaning vehicle with **track-type crawling mechanisms 10** powered by **hybrid stepper 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).



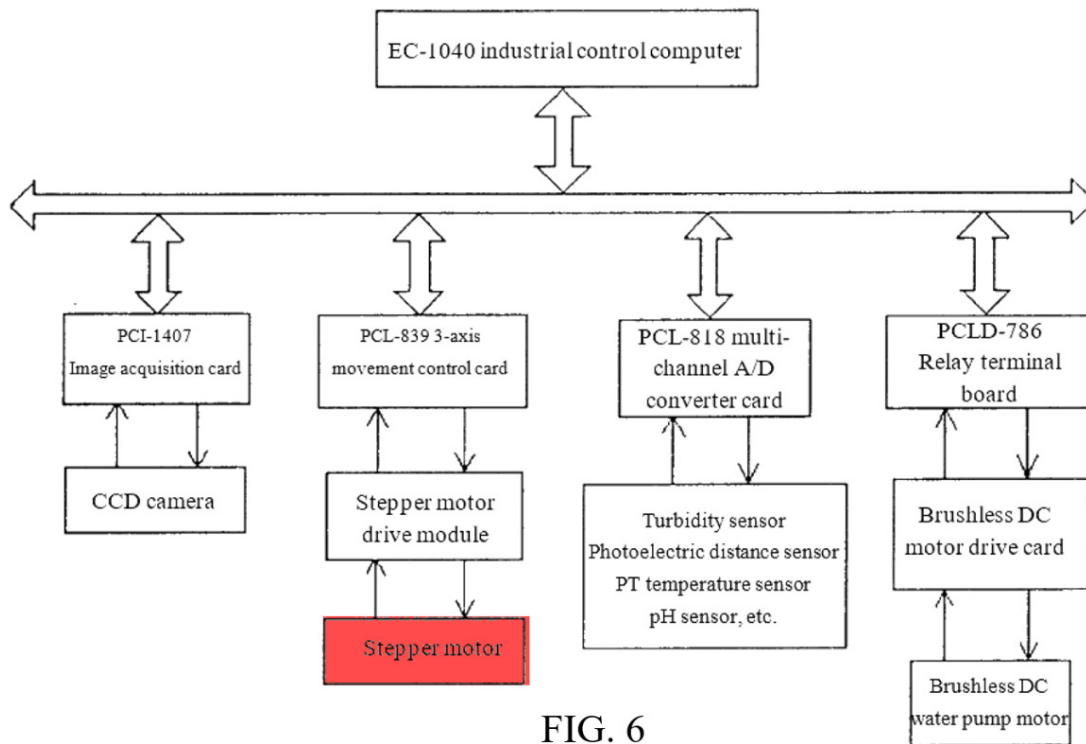


FIG. 6

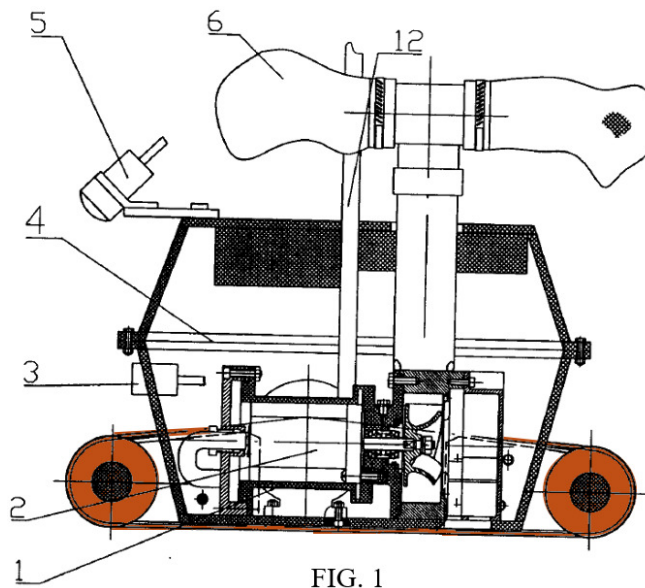
184. Cui's cleaning vehicle is self-propelled because under the control of computer 7, motors 15 drive track-type crawling mechanisms 10 to move it autonomously across pool surfaces. Cui, Claim 1, pp.5-6.

185. Cui's system detects debris by capturing images with camera 5 and comparing them (via computer 7) 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.

b. 1[a] “a. a vehicle body”

186. In my opinion, Cui discloses or suggests 1[a].

187. Cui’s pool cleaner includes a vehicle body, at least in the form of 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). A POSITA would have understood this assembled structure is the claimed “vehicle body” that travels within the pool.



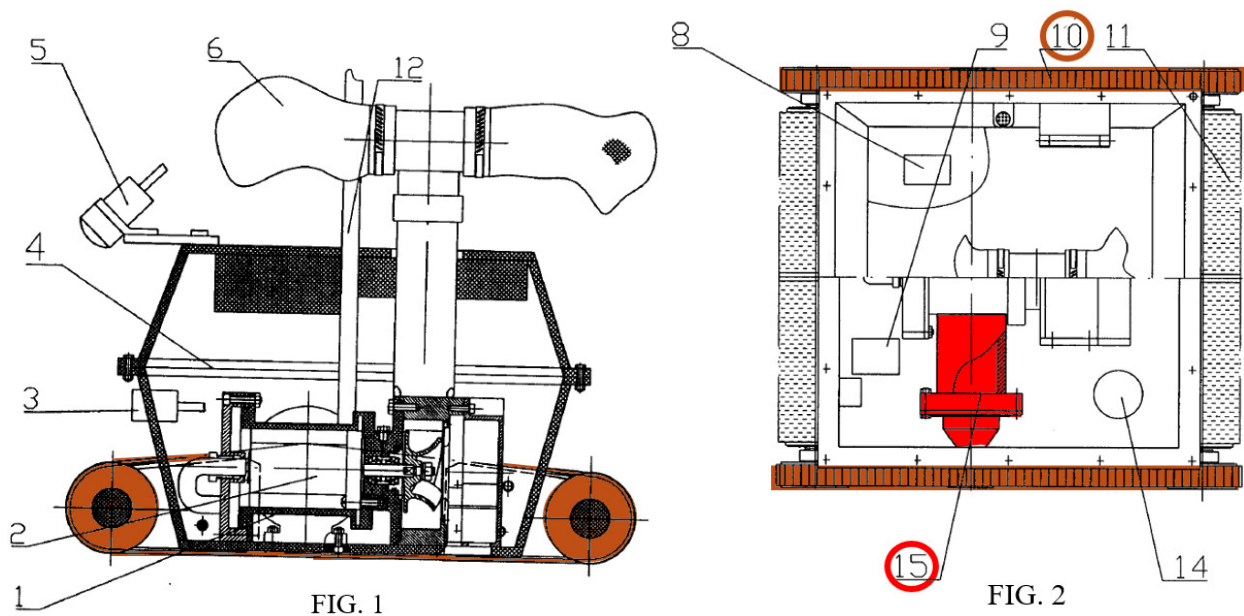
c. 1[b] “b. means for moving the vehicle body within the swimming pool”

188. In my opinion, Cui discloses or suggests 1[b].

189. the format and content of 1[b] invoke claim interpretation under pre-AIA 35 U.S.C. §112 ¶6, or 35 U.S.C. §112(f). As explained in §VI.D, the recited

function is “moving the vehicle body within the swimming pool,” and the corresponding structures are “wheels, rollers, **tracks**, other surface contacting members powered by a motor, a vacuum, or a liquid jet.” EX1001, 3:33-45, 10:15-17, FIGS.9-10.

190. Cui discloses moving the vehicle body within the swimming pool. Specifically, Cui discloses **track-type crawling mechanisms 10** powered by **motors 15**. Cui, Claim 1, pp.5-6, FIGS. 1-2 (annotated below). Motors 15 are mounted on both sides of sealed motor cover 1, and track-type crawling mechanisms 10 are mounted at front and rear ends of housing 4. Cui, pp.5-6.



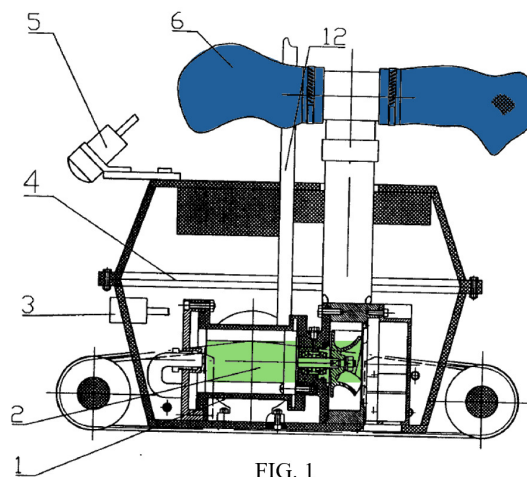
191. A POSITA would have understood that Cui’s **track-type** crawling mechanisms 10 powered by hybrid stepper motors 15 is substantially the same as the ’766 Patent’s disclosed “**tracks**...powered by a motor”—both are motor-powered

track systems that contact pool surfaces to propel the vehicle body. This structure of Cui performs the claimed function because motors 15 drive track-type crawling mechanisms 10, which contact pool surfaces and propel the vehicle body within the swimming pool. Cui, pp.5-7, FIGS. 1-3.

d. 1[c] “c. a filter configured to retain debris collected from the submerged surface”

192. In my opinion, Cui discloses or suggests 1[c].

193. Cui’s system includes a filter configured to retain debris collected from the submerged surface, at least in the form of **filter bag 6**, which is in the water circulation system including **brushless DC water pump motor 2**. Cui, Claim 1, pp.5-6, FIG.1 (annotated below). A POSITA would have understood that Cui’s pump motor 2 draws water containing debris from pool surfaces by suction and filter bag 6 retains this collected debris, while allowing clean water to pass through.



- e. 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”

194. In my opinion, Cui discloses or suggests 1[d].

195. Cui’s pool cleaner includes **camera 5** “**mounted at** the upper front end of the **housing 4**,” which is part of the vehicle body, to observe pool surfaces ahead of the cleaner. Cui, Claim 2, FIG. 1 (annotated below), pp.5-6.

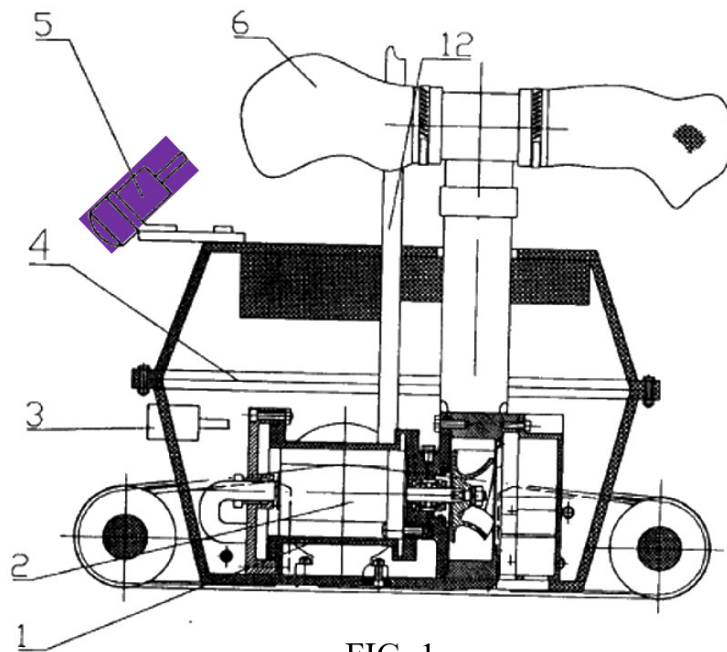


FIG. 1

196. Cui describes that its camera “continuously captures images of areas to be cleaned located directly in front and below a crawling direction of the cleaner,” including images showing “sediment at the pool bottom.” Cui, pp.5-7. Cui describes that the captured images are “compared with the original standard image(s) of the pool bottom” to identify areas with debris requiring cleaning. Cui, pp.6-7. A POSITA 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 surface and debris/sediment on that surface, and the pool bottom is a submerged surface when the pool is filled with water during cleaning operations, where an area with debris requiring cleaning constitutes the claimed “first portion of the submerged surface.” Cui, pp.5-7.

f. 1[e][i] “e. a controller (i) positioned on or in the body,”

197. In my opinion, 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 a POSITA would have been motivated to modify Cui’s system to incorporate Fu-007’s teaching of the onboard controller.

198. Cui’s pool cleaner includes **industrial control computer 7** that is separated from pool cleaner and is connected to the pool cleaner via cable 12. Cui, FIGS. 1-3. The industrial control computer 7 is “connected to the pool cleaner through the **cable assembly 12** and the **plug assembly 14**.” Cui, pp.5-6, FIGS. 1-2 (annotated below). The industrial control computer 7 is connected 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. 5-6 (annotated below). Cui further 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; *see also* §VII.B.3.e (1[d]). A POSITA would have understood that Cui’s
industrial control computer 7 is a “controller.”

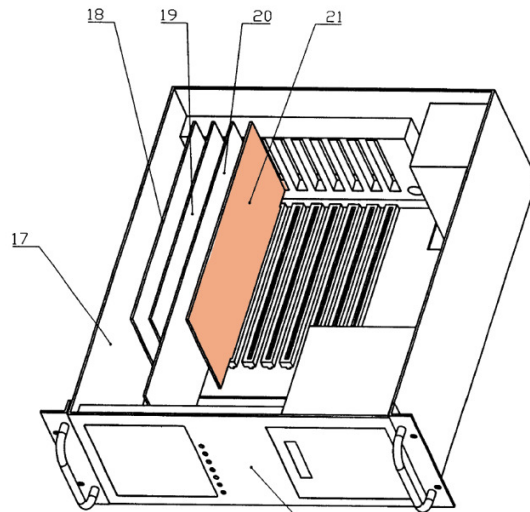


FIG. 5

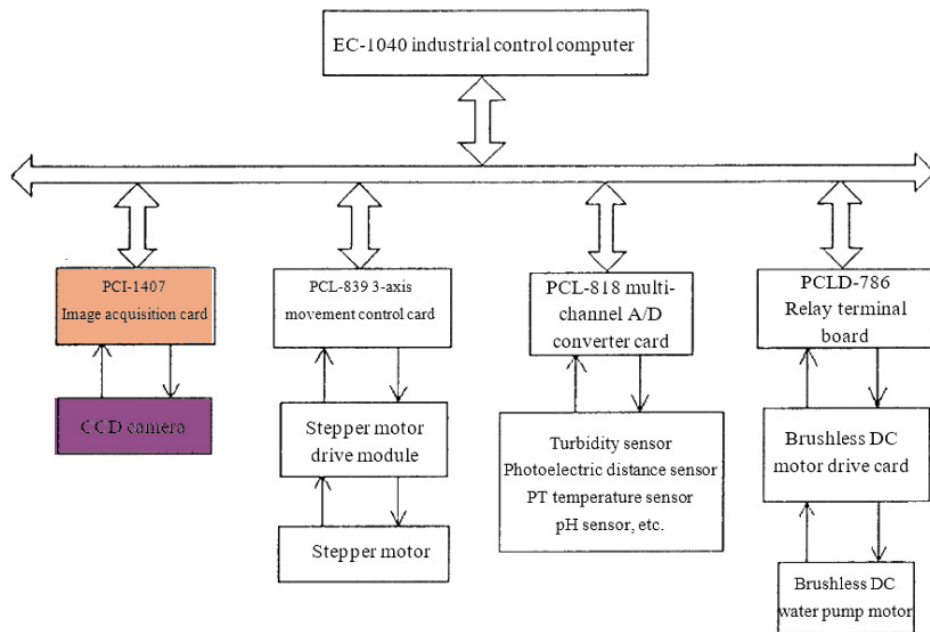
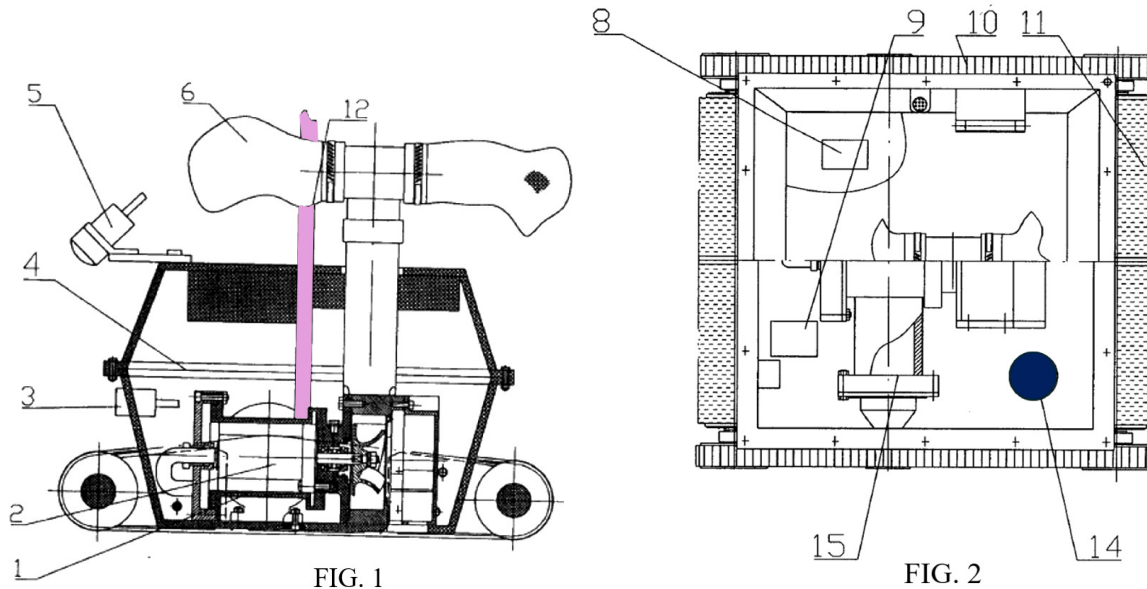
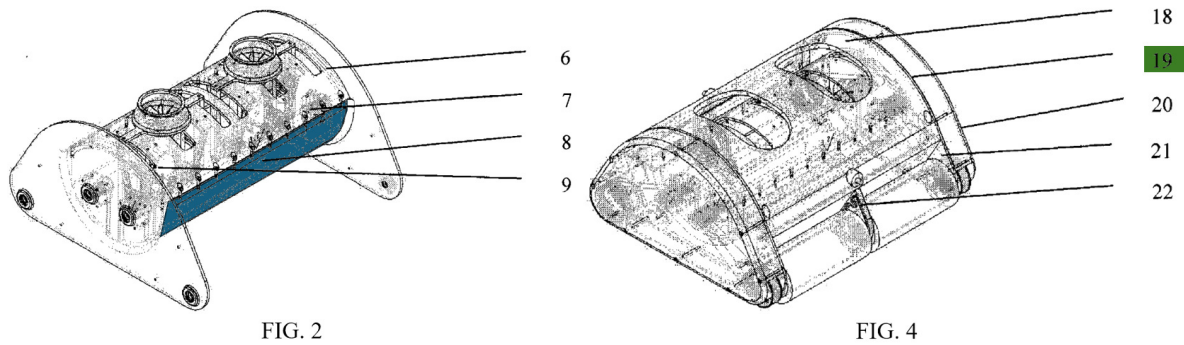


FIG. 6

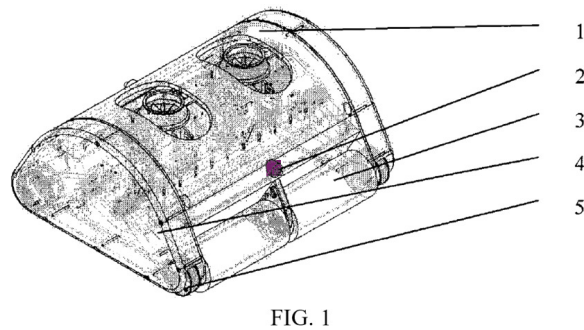


199. Like Cui, Fu-007 discloses an underwater cleaning robot for swimming pools using camera-based control. *See* §VII.A.2. Like Cui, Fu-007 uses a controller to generate, in response to captured images, at least one control signal to cause movement of the pool cleaning body within the swimming pool.

200. Fu-007 discloses a controller positioned in the body of its cleaning and moving platform. Specifically, as explained in §§VII.A.2, VII.A.4.f, Fu-007 discloses a “central processing unit” (controller) housed in **control system enclosure 8** that is sealingly enclosed in **robot main shell 19**. Fu-007, pp.8-9, 12-14, Claim 4, FIGS.2, 4 (annotated below).



201. This onboard controller connects to the **monitoring camera 2** via an internal “image acquisition card” and can be powered by an onboard “rechargeable battery box.” Fu-007, pp.12-14, Claim 4, FIGS.1, 6 (annotated below); *see also* §VII.A.4.f.



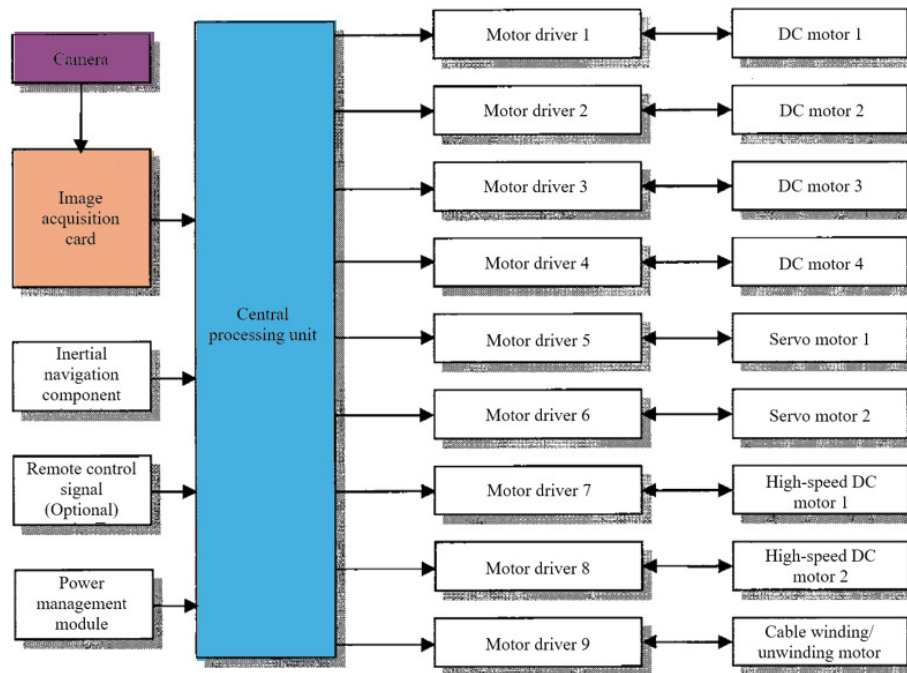


FIG. 6

202. For the reasons explained in §VII.B.2, a POSITA would have been motivated to modify Cui's system by substituting Cui's external computer 7 with Fu-007's onboard controller structure. In such modified system, Fu-007'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 a compatible power source (e.g., 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 taught by Cui and/or Fu-007. Cui, pp.5–7; Fu-007, pp.14–16.

g. 1[e][ii] “(ii) in electronic communication with the at least one camera, and”

203. In my opinion, the Cui-Fu-007 combination discloses or suggests 1[e][ii].

204. Cui describes that **computer 7** is connected to camera 5 through **image acquisition card 21**, and “the **image acquisition card 21** is connected to the **charge-coupled device (CCD) camera 5.**” 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.

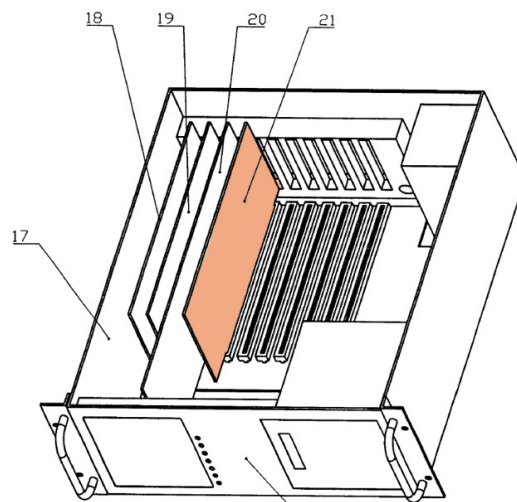


FIG. 5

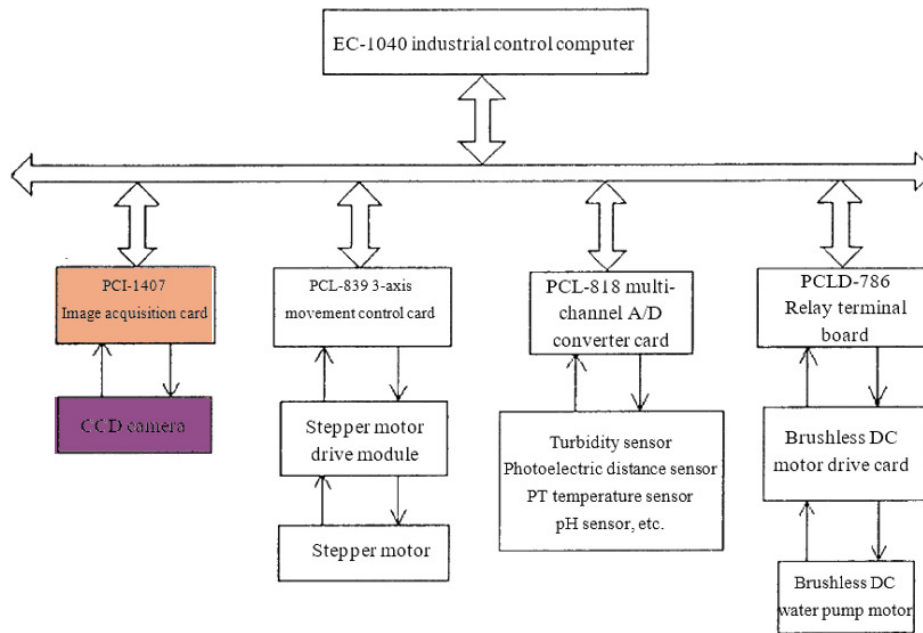


FIG. 6

205. As explained in §VII.B.2, §VII.B.3.f (1[e][i]), with a reasonable expectation of success, a POSITA would have been motivated to modify Cui’s system by substituting Cui’s external computer with Fu-007’s onboard controller structure taught by Fu-007 to, e.g., eliminate external tether dependencies. *See* Fu-007, pp.8-10, 12-14, Claim 4. 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 (specifically, the camera connects to the central processing unit via an “image acquisition card”). Fu-007, pp.12-14, Claim 4, FIGS. 1, 4, 6. Thus, the Cui-Fu-007 combination discloses or suggests this limitation.

- h. 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.”**

206. In my opinion, the Cui-Fu-007 combination discloses or suggests 1[e][iii].

207. Cui discloses or suggests that its computer 7 (controller) “generate[s], in response to the captured image, at least one control signal to cause movement of the body within the swimming pool to...the first portion of the submerged surface.” Specifically, Cui describes that its 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.” As explained in §VII.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 forward **toward** the debris-laden area identified in the

image—i.e., the control signals cause movement “to” the first portion of the submerged surface.

208. Additionally, Fu-007 discloses that its controller generates control signals in response to captured images to cause movement to a targeted portion of the surface. Specifically, Fu-007 describes that during autonomous cleaning, the central processing unit sets “a swimming pool cleanliness image threshold” and uses the monitoring 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.” *Id.* To execute this planned movement, the controller “adjusts operating conditions of the four cleaning drive wheels 3...to complete the cleaning task.” *Id.* Fu-007 further explains that 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.* A POSITA 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.*

209. As explained in §VII.B.2, §VII.B.3.f (1[e][i]), a POSITA 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 taught by Cui and/or Fu-007, including configuring the onboard controller to implement Fu-007’s image-based navigation logic—specifically, planning movements based on image thresholds. Indeed, a POSITA would have recognized that integrating Fu-007’s ability to “plan[] a cleaning movement” and execute specific directional movements via “different wheel speed combinations” would result in more effective debris removal and improved “operating efficiency” compared to passive speed adjustment. Fu-007, pp.14-16.

210. The claim limitation uses the disjunctive “or” between “to” and “away from,” meaning the limitation is satisfied by teaching either alternative. Because the Cui-Fu-007 combination teaches control signals that cause movement “to” the first object, the Cui-Fu-007 combination discloses or suggests this element.

211. Therefore, in my opinion, Cui, in view of Fu-007, renders Claim 1 obvious.

4. Claim 2 Unpatentable over Cui and Fu-007

212. In my opinion, the Cui-Fu-007 combination renders Claim 2 obvious.

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

213. Limitations 2[pre], 2[a]-2[c], and 2[e] are exactly the same as limitations 1[pre], 1[a]-1[c], and 1[e], respectively. For at least the same reasons explained above in §§VII.B.3.a-d (1[pre], 1[a]-1[c]), Cui discloses or suggests 2[pre] and 2[a]-2[c]. Additionally, for at least the same reasons explained above in §§VII.B.3.f-h (1[e][i]-[iii]), the Cui-Fu-007 combination discloses or suggests limitation 2[e].

b. 2[d]

214. Limitation 2[d] recites substantially the same features as limitation 1[d], with the only difference being that limitation 2[d] recites “at least one camera carried by the body,” whereas limitation 1[d] recites “at least one camera mounted directly or indirectly to the body.” As explained above in §VII.B.3.e (1[d]), Cui discloses “at least one camera mounted directly...to the body.” Thus, Cui also discloses limitation 2[d], because a camera that is “mounted directly...to the body” is also “carried by the body.”

215. Therefore, it is my opinion that Cui, in view of Fu-007, renders Claim 2 obvious.

5. Claim 3 Unpatentable over Cui and Fu-007

216. In my opinion, the Cui-Fu-007 combination renders Claim 3 obvious.

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

217. Limitations 3[pre], 3[a]-3[c], and 3[e][i] are exactly the same as limitations 1[pre], 1[a]-1[c], and 1[e][i], respectively. For at least the same reasons explained above in §§VII.B.3.a-VII.B.3.d (1[pre], 1[a]-1[c]), Cui discloses or suggests 3[pre] and 3[a]-3[c]. Additionally, for at least the same reasons explained above in §VII.B.3.f (1[e][i]), the Cui-Fu-007 combination discloses or suggests limitation 3[e][i].

b. 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”

218. Limitation 3[d] is substantially the same as limitation 1[d], with the only difference being that 3[d] recites “at least one camera **positioned on or in, or carried by**, the body,” whereas 1[d] recites “at least one camera **mounted directly or indirectly to the body**.” As explained above in §VII.B.3.e (1[d]), Cui discloses “at least one camera mounted directly...to the body.” Thus, Cui also discloses 3[d], because a camera that is “mounted directly...to the body” is also “positioned on or in, or carried by, the body.”

c. 3[e][ii] “(ii) in electronic communication with the at least one camera and a portable electronic device, and”

219. In my opinion, the Cui-Fu-007 combination discloses or suggests 3[e][ii].

220. In my opinion, as explained in §VII.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**.”

221. In my opinion, the Cui-Fu-007 combination also discloses or suggests the controller “in electronic communication with...a **portable electronic device**.”

222. Cui’s computer 7 includes “a human-machine interface 16” that displays “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.

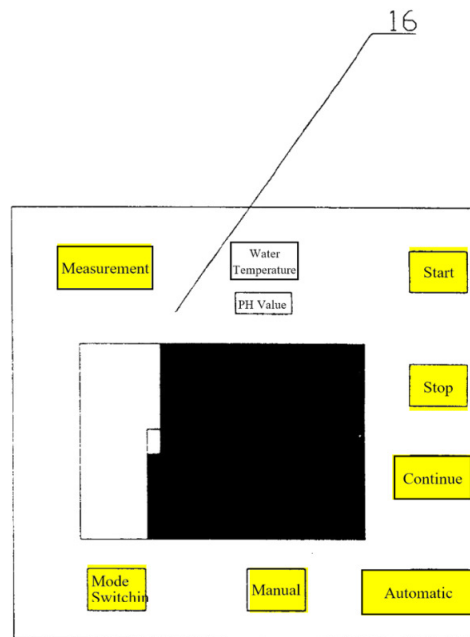


FIG. 4

223. Fu-007 also discloses that its underwater cleaning robot operates in two modes: “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).

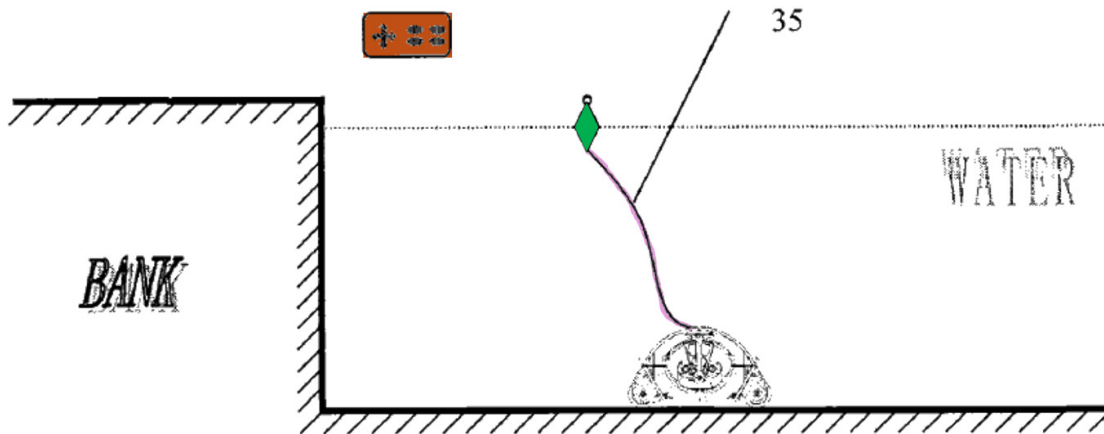


FIG. 8

224. As explained in §VII.B.3.f (1[e][i]), a POSITA would have been motivated by the disclosure of wireless communication link between the portable control keyboard 31 and the cleaning and moving platform in Fu-007 to modify Cui's system to eliminate the external cable and move the controller onboard to improve autonomy and safety. In this modified, untethered system, a POSITA would have been further motivated to incorporate Fu-007's "manual mode" functionality (including the control keyboard and buoyant antenna and cable) to replace the functionality of Cui's shore-side human-machine interface. Fu-007, pp.12-14, FIG. 8; Cui, pp.6-7, Claim 3, FIG. 4.

225. A POSITA would have made such a modification for at least the following reasons. First, to preserve Cui's existing manual control capabilities. *See* Cui, pp.6-7, Claim 3, FIG. 4. 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 a POSITA would have recognized that utilizing Fu-007's wireless "control keyboard" and "manual mode" architecture provides a functional substitute, restoring the user's ability to manually "start," "stop," or steer the robot (e.g., via the "manual switches" logic) without requiring the hazardous physical tether. Fu-007, pp.12-14; Cui, pp.6-7.

226. Second, to enable "short-term local cleaning" and retrieval. Fu-007 teaches that the wireless antenna mode is specifically advantageous for "short-term local cleaning" where the robot operates "without using... the signal and power cable." Fu-007, p.14. A POSITA would have been motivated to add this capability to Cui's robot to allow for quick cleaning tasks or to manually drive the robot to the poolside for retrieval, leveraging Fu-007's teaching that the robot can be "directly...control[led]...via the control signal buoyant antenna" in this mode. *Id.*

227. A POSITA would have had a reasonable expectation of success. 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. Integrating 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.

- d. **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.”**

228. In my opinion, the Cui-Fu-007 combination discloses or suggests 3[e][iii].

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

230. In my opinion, the combined system satisfies this limitation through the “captured image” prong alone, because as explained in §§VII.B.3.f-VII.B.3.h (1[e][i]-[iii]), a POSITA would have been motivated to, with reasonable expectation of success, 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...the first portion of the submerged surface” (e.g., to debris-laden areas). Cui, pp.6-7; Fu-007, pp.14-16.

231. Additionally, as explained in §VII.B.5.c (3[e][ii]), a POSITA would have been motivated, with a reasonable expectation of 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 portable electronic device and generate control signals to steer the vehicle “to” a specific portion of the submerged surface selected by the user (e.g., moving to a spot for “short-term local cleaning” or driving to the poolside for retrieval). Fu-007, pp.12-14, FIG. 8; Cui, pp.6-7, Claim 3, FIG. 4.

232. Therefore, it is my opinion that Cui, in view of Fu-007, renders Claim 3 obvious.

6. Claim 4 Unpatentable over Cui and Fu-007

233. In my opinion, the Cui-Fu-007 combination renders Claim 4 obvious.

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

234. Limitations 4[pre], 4[a]-4[c], and 4[e] are exactly the same as limitations 1[pre], 1[a]-1[c], and 1[e], respectively. For at least the same reasons explained above in §§VII.B.3.a-VII.B.3.d (1[pre], 1[a]-1[c]), Cui discloses or suggests 4[pre] and 4[a]-4[c]. Additionally, for at least the same reasons explained above in §§VII.B.3.f-VII.B.3.h (1[e][i]-[iii]), the Cui-Fu-007 combination discloses or suggests limitation 4[e].

b. 4[d]

235. Limitation 4[d] recites substantially the same features as limitation 1[d], with the only difference being that limitation 4[d] omits the requirement that the camera be “mounted directly or indirectly to the body.” As explained above in

§VII.B.3.e (1[d]), Cui discloses “at least one camera mounted directly...to the body” for capturing an image. Thus, Cui also discloses limitation 4[d], because the prior art’s disclosure of a mounted camera satisfies the broader requirement of a camera generally.

236. Therefore, it is my opinion that Cui, in view of Fu-007, renders Claim 4 obvious.

C. Ground 2B: Claim 5 is Unpatentable under AIA 35 U.S.C. §103 and Pre-AIA AIA 35 U.S.C. §103 over Cui, Fu-007, and Porat

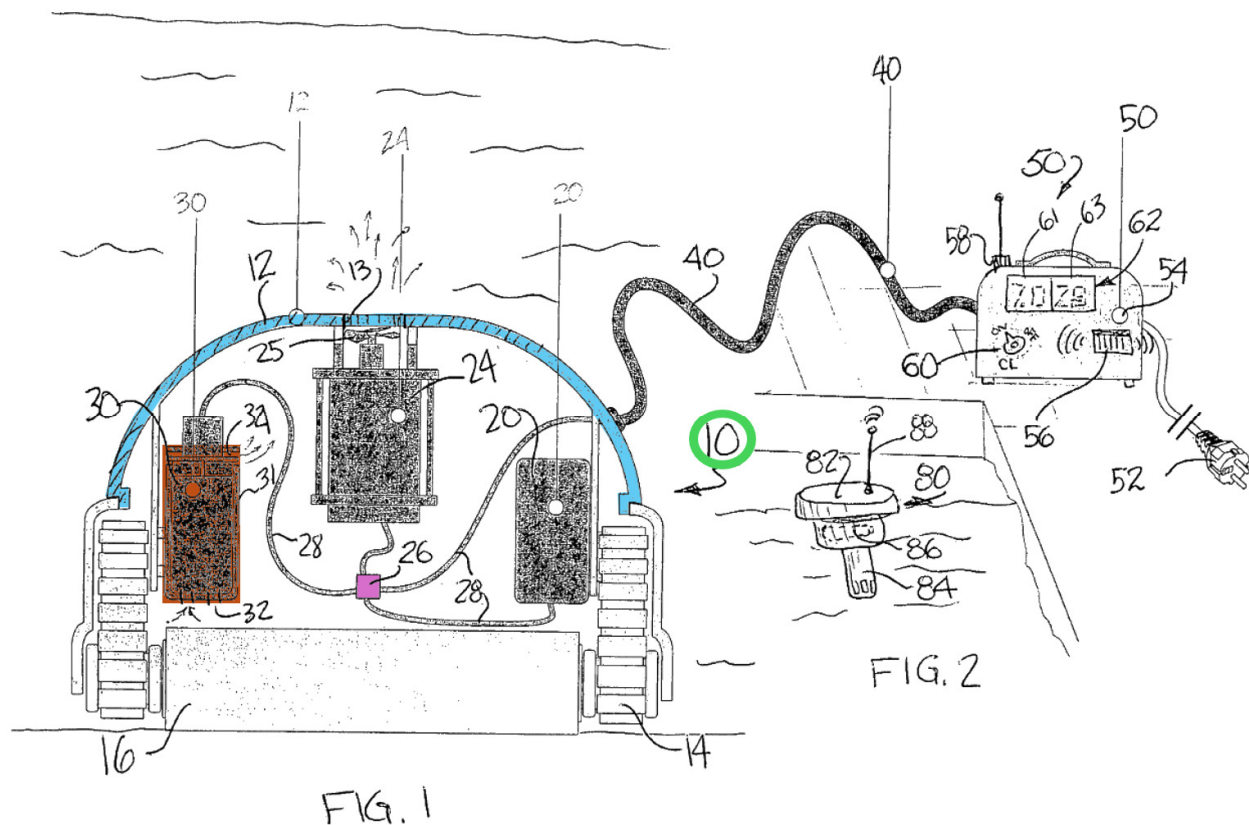
1. Porat

237. Porat (EX1016) is U.S. Publication No. 20060053572A1 published on March 16, 2006. Porat is prior art under AIA 35 U.S.C. §102(a)(1) and is not subject to exceptions under AIA 35 U.S.C. §102(b)(1) because it was published more than one year before the effective filing date of the ’766 Patent which is no earlier than July 11, 2016. *See* §VI.C, *supra*. In addition, Porat is also prior art under pre-AIA 35 U.S.C. §102(b).

238. Porat discloses an automated self-propelled robotic pool cleaner “having a housing and drive means for moving the pool cleaner over at least the bottom wall of a pool” and “an electronic processor/controller in the form of an[sic] integrated circuit device 26” that “is connected...to the floating power cable 40 and also to the drive motor 20, pump motor 24 and electrochemical generator 30.” Porat,

Abstract, [0029], FIGS. 1-2 (annotated below). Porat is analogous art to Claims 1-5 of the '766 Patent.

239. As illustrated in FIGS. 1-2 (annotated below), Porat's **pool cleaner 10** includes **housing 12**, drive means 14 powered by drive motor 20, cleaning brush 16, pump motor 24 with impeller 25 that draws water through a filter element, and **electrochemical chlorine generator 30** "mounted on the interior of the housing." Porat, [0028].



240. Porat's electrochemical chlorine generator 30 is controlled by an **electronic processor/controller 26**. *Id.*, [0029], FIG. 1 (annotated above). The

processor/controller 26 includes control means for initiating and terminating the operation of the chlorine generator 30. *Id.*, [0008], [0010], Claims 1, 8–9. The electrochemical chlorine generator 30 has “an outlet for discharging water containing chlorine ions produced by the electrochemical generator to thereby distribute the chlorine into the water proximate the exterior of the pool cleaner housing.” *Id.*, Abstract, Claim 1.

241. Porat teaches that integrating a chemical dispenser onto a self-propelled pool cleaner provides advantages over conventional systems, including: (1) “efficiently and effectively distribut[ing] the chlorine throughout the volume of water in the pool so as to provide a uniform concentration of the desired chlorine ions” (*id.*, [0007]); and (2) providing “a method and apparatus for generating and adding chlorine to pools that is essentially self-contained and the use of which requires no installation services by a plumber and requires no separate or specialized electrical power connections for its operation” (*id.*, [0005]).

2. Reasons for Combining Cui and Fu-007 with Porat

242. 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 §VII.B.2, the Cui-Fu-007 combination provides a pool cleaner using camera-based control to autonomously adjust cleaning operations

based on detected debris. As explained in §VII.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]. A POSITA would have been motivated to combine the complementary teachings of Cui, Fu-007, and Porat to achieve improved autonomous pool maintenance operations.

243. A POSITA would have recognized that the teachings in the Cui-Fu-007 combination and Porat are directed to the same pool cleaning technical field, are based on recognition of the same or similar technical issues in pool maintenance, and provide similar technical solutions to address those issues. Specifically, these references disclose self-propelled pool cleaners having a housing, drive means for moving the pool cleaner over pool surfaces, a pump, and a filter for removing debris. *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; *see also* §VII.C.1 (summarizing Porat). Accordingly, a POSITA 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.

244. As explained in §VII.B.2, the Cui-Fu-007 combination discloses physical debris removal using camera-guided adaptive cleaning. As explained in

§VII.C.1, Porat discloses an onboard chemical dispenser—specifically, “an integral on-board electrochemical chlorine generator” that is “mounted on the interior of the housing” and distributes chlorine “as the cleaner moves across the pool surfaces being cleaned.” Porat, [0009], [0028], FIGS. 1–2. The use of a pool cleaner for debris removal alone (Cui-Fu-007) and the use of a pool cleaner with an integrated chemical dispenser (Porat) had been two known design options. A POSITA would have been motivated to modify the Cui-Fu-007 combination by incorporating Porat's onboard chemical dispenser for at least two reasons.

245. First, a POSITA would have been guided by Cui, Fu-007, and Porat to make such a combination to enhance the cleaning effectiveness of the Cui-Fu-007 pool cleaner by combining mechanical debris removal with chemical application. The Cui-Fu-007 combination provides adaptive debris removal mechanically. As explained in §VII.C.1, Porat explicitly teaches that integrating a chemical dispenser onto a moving pool cleaner allows distribution of chlorine “as the cleaner moves across the pool surfaces being cleaned.” Porat, [0009]. A POSITA would have recognized that by incorporating Porat's onboard chemical dispenser into the Cui-Fu-007 combination, the modified system would have enhanced overall pool maintenance capability—enabling both camera-guided debris removal and chemical application in a single automated device.

246. Second, a POSITA would have been motivated to adopt this modification to improve the convenience and reduce the cost of pool maintenance. As explained in §VII.C.1, Porat explains that conventional electrochemical chlorine generators “are installed in-line with the main pumping and filter system outside of the pool” and “are relatively expensive to purchase and require the services of an experienced plumber and an electrician for their proper installation.” Porat, [0002]. Porat further teaches that integrating a chemical dispenser onto a self-propelled pool cleaner provides “a method and apparatus for generating and adding chlorine to pools that is essentially self-contained and the use of which requires no installation services by a plumber and requires no separate or specialized electrical power connections for its operation.” Porat, [0005]. A POSITA would have recognized that incorporating Porat's onboard chemical dispenser into the Cui-Fu-007 combination would have provided pool owners with a single, self-contained device capable of performing multiple pool maintenance functions—debris detection, adaptive cleaning, and chemical application—without requiring additional equipment, professional installation, or separate power connections.

247. A POSITA would have had a reasonable expectation of success in making this combination because integrating a chemical dispenser onto a self-propelled pool cleaner was a well-known design choice, as explained in §VII.C.1,

Porat's electrochemical chlorine generator is already configured for mounting "on the interior of the housing" of a robotic pool cleaner having drive means, a pump, and a filter—structural components that are also present in the Cui-Fu-007 combination. Porat, [0028]. A POSITA would have reasonably expected that Porat's chemical dispenser could be incorporated into the Cui-Fu-007 pool cleaner without significant modification, thereby yielding predictable results.

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

248. In my opinion, the Cui-Fu-007-Porat combination renders Claim 5 obvious.

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

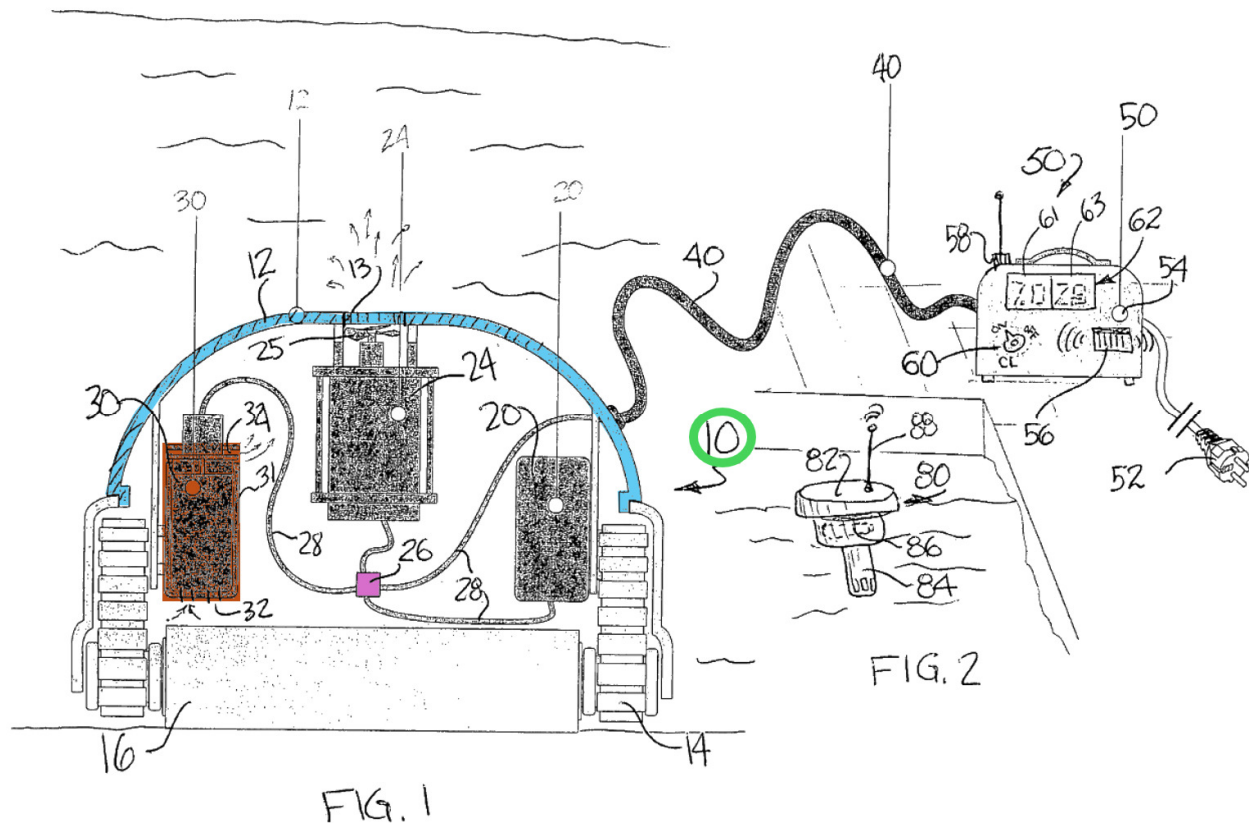
249. Limitations 5[pre] and 5[a]-5[c] are exactly the same as limitations 1[pre] and 1[a]-1[c], respectively. For at least the same reasons explained above in §§VII.B.3.a-VII.B.3.d (1[pre], 1[a]-1[c]), Cui discloses or suggests 5[pre] and 5[a]-5[c].

b. 5[d]

250. In my opinion, the Cui-Fu-007-Porat combination discloses or suggests 5[d].

251. As explained in §VII.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 **electrochemical chlorine generator 30** is “mounted on the interior of the **housing**” of **pool cleaner 10** and controlled by an **integrated circuit device 26**. Porat, [0028], FIGS. 1-2 (annotated below).



252. As explained in §VII.C.2, a POSITA would have been motivated to modify the Cui-Fu-007 combination by incorporating Porat’s onboard chemical dispenser.

253. As explained in §VII.C.1, Porat’s “integral on-board electrochemical chlorine generator” is “mounted on the interior of the housing” of a self-propelled pool cleaner and configured to “distribute the chlorine into the water proximate the

exterior of the pool cleaner housing” as the cleaner “moves across the pool surfaces being cleaned.” Porat, Abstract, [0009], [0028], Claim 1. A POSITA would have understood that Porat’s electrochemical chlorine generator is a “chemical dispenser” that is “on, in, or carried by the vehicle body.”

254. In the Cui-Fu-007-Porat combination, Porat’s electrochemical chlorine generator would be mounted on or in the Cui-Fu-007 pool cleaner housing. *See* §VII.C.2. As the Cui-Fu-007 pool cleaner moves across pool surfaces during camera-guided cleaning operations, the onboard chemical dispenser would distribute chlorine into the pool water, thereby providing both adaptive debris removal and chemical application.

c. 5[e]

255. Limitation 5[e] recites substantially the same features as limitation 1[d], with the only difference being that limitation 5[e] recites “at least one **camera on, in, or carried by** the vehicle body,” whereas limitation 1[d] recites “at least one **camera mounted directly or indirectly to** the body.” As explained above in §VII.B.3.e (1[d]), Cui discloses “at least one camera mounted directly...to the body.” Thus, Cui 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.”

d. 5[f][i]

256. Limitation 5[f][i] is substantially the same as limitation 1[e][i], with the only difference being that 5[f][i] recites a controller “on, in, or carried by the vehicle body,” whereas 1[e][i] recites a controller “positioned on or in the body.” As explained above in §VII.B.3.f (1[e][i]), the Cui-Fu-007 combination discloses a controller “positioned on...the body.” Thus, it is my opinion that the combination also discloses limitation 5[f][i], because a controller that is “positioned on...the body” is also “on, in, or carried by the vehicle body.”

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

257. Limitations 5[f][ii] and 5[f][iii] are exactly the same as limitations 1[e][ii] and 1[e][iii], respectively. It is my opinion that for at least the same reasons explained above in §§VII.B.3.g-VII.B.3.h (1[e][ii]-1[e][iii]), Cui and Fu-007 disclose or suggest 5[f][ii] and 5[f][iii].

258. Therefore, in my opinion, Cui, in view of Fu-007 and Porat, renders Claim 5 obvious.

D. Ground 3A: Claims 1-2 and 4 Are Unpatentable under AIA 35 U.S.C. §103 and Pre-AIA AIA 35 U.S.C. §103 over Knoll

1. Knoll

259. Knoll (EX1006) is German Patent Application Publication No. DE102007053310A1 published on June 10, 2009. Knoll is prior art under AIA 35 U.S.C. §102(a)(1) and is not subject to exceptions under AIA 35 U.S.C. §102(b)(1)

because it was published more than one year before the effective filing date of the '766 Patent which is no earlier than July 11, 2016. *See* §VI.C, *supra*. In addition, Knoll is also prior art under pre-AIA 35 U.S.C. §102(b).

260. Knoll discloses “a pool robotic vehicle, in particular a pool cleaning robot, whose working element is, for example, a filter device and/or suction device and/or cleaning device” and disclose features of an autonomous pool cleaner with camera-based navigation capacities. Knoll, Title, Abstract, [0001]-[0002], [0007], [0021], Claims 1-14, Fig. 1 (reproduced below, described in [0027]). Knoll is analogous art with respect to Claims 1-5 of the '766 Patent.

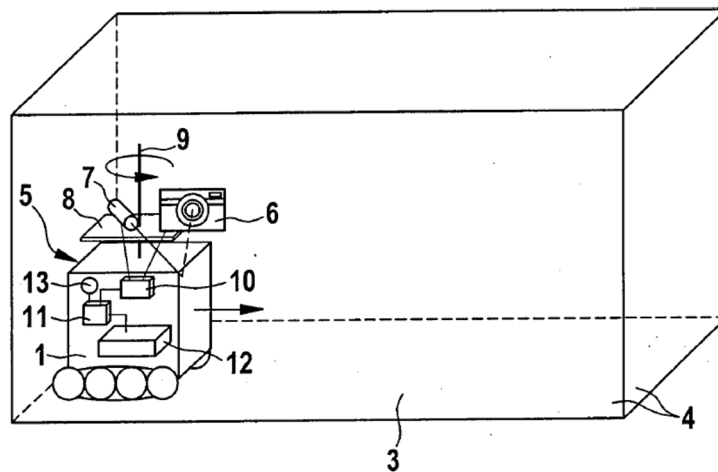


Fig. 1

261. Knoll's system includes robotic vehicle 1 with drive means 12, distance-determining device 5 comprising digital camera 6 and light beam source 7 rotatably mounted on mounting plate 8, and control unit 11 for controlling the drive

means. *See* Knoll, [0007], [0027]-[0028], FIGS. 1-2. The robotic vehicle is “a pool robot with a suction and/or filter and/or cleaning device” that operates on working area 3 formed by the pool bottom and delimited by boundary surface 4 (pool walls). *Id.*

262. Knoll’s camera 6 captures images of the boundary surface, which evaluation unit 10 processes to derive “quasi-continuously determined 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 “away from or toward” the boundary to maintain a “defined distance.” Knoll, [0028], Claim 2, FIG. 2 (reproduced below).

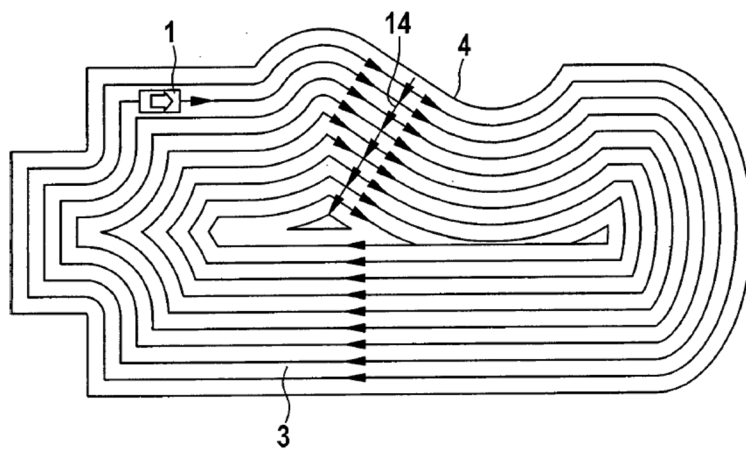


Fig. 2

2. Claim 1 Unpatentable over Knoll

263. In my opinion, Knoll renders Claim 1 obvious.

a. **1[pre] “A self-propelled pool cleaner for cleaning debris from a submerged surface of a swimming pool, comprising:”**

264. In my opinion, Knoll discloses or suggests 1[pre].

265. 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).

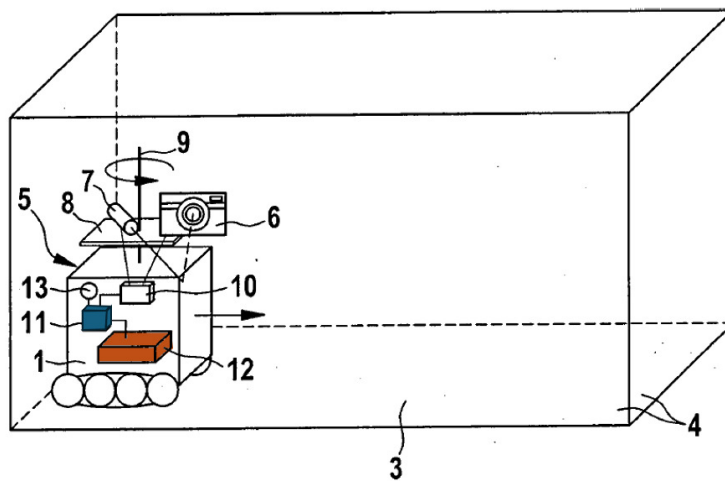


Fig. 1

Knoll, Fig. 1 (annotated)

266. Knoll’s robotic vehicle is a self-propelled pool cleaner because it is a “pool robot with a suction and/or filter and/or cleaning device” and its drive means autonomously propels the vehicle under the control of control unit 11. Knoll, [0007], [0028].

267. Knoll’s robotic vehicle equipped with a suction/filter/cleaning device,

cleans debris from a submerged surface of a swimming pool because it operates on “working area 3...formed by the bottom of the pool” and achieves “a complete and efficient cleaning of a pool floor and/or the pool walls.” Knoll, [0007], [0027]-[0028], FIG. 1 (below).

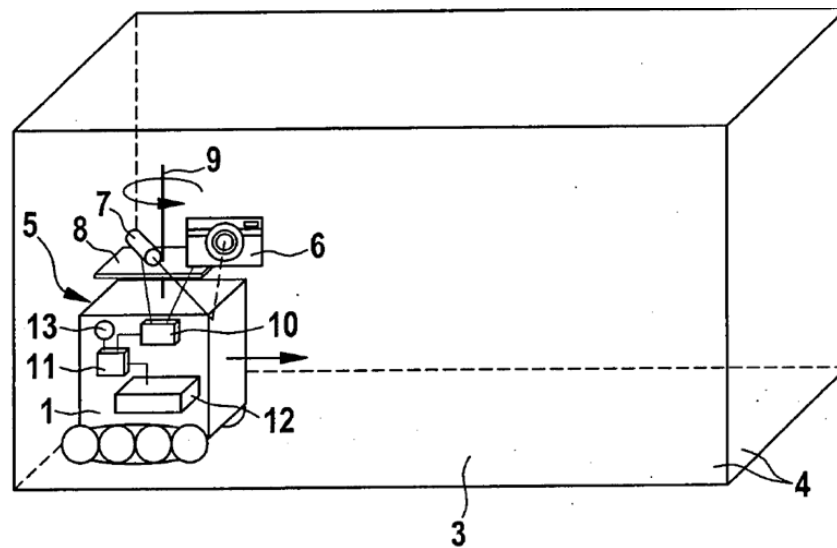


Fig. 1

268. A POSITA would have understood that Knoll’s robotic vehicle (pool cleaner) cleans debris from submerged pool surfaces—including working area 3 (pool bottom) and pool walls—because the pool bottom and walls are submerged when the pool is in normal service, and pool-cleaning robots are intended to operate in filled pools to clean debris from these submerged surfaces.

b. 1[a] “a. a vehicle body;”

269. In my opinion, Knoll discloses or suggests 1[a].

270. Knoll’s robotic vehicle 1 (pool cleaning system) includes various

components: **drive means 12** “for generating propulsion and for steering,” **control unit 11** that “controls the drive means” and is “designed to automatically calculate a trajectory of the robotic vehicle,” and “suction and/or filter and/or cleaning device.” Knoll, Abstract, [0007], [0021], [0027]-[0028], Claims 1-2, 14, FIG.1 (annotated below).

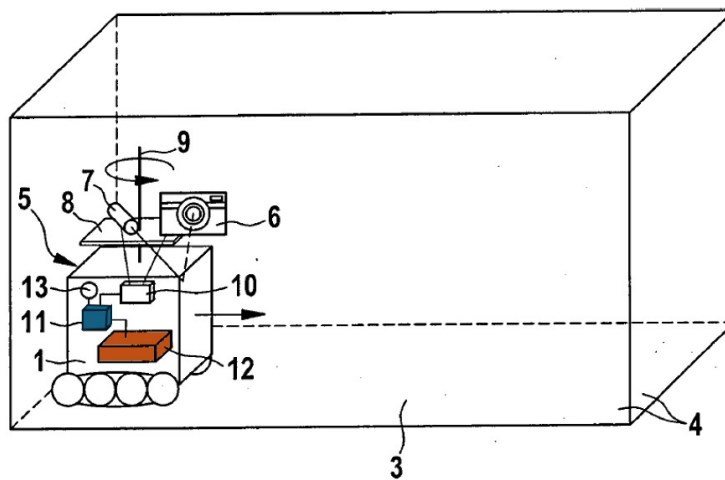


Fig. 1

271. A POSITA would have understood that Knoll’s robotic vehicle—comprising the integrated physical structure housing these components—constitutes the claimed “vehicle body.”

c. 1[b] “b. means for moving the vehicle body within the swimming pool;”

272. In my opinion, Knoll discloses or suggests 1[b].

273. The format and content of 1[b] invoke claim interpretation under pre-AIA 35 U.S.C. §112 ¶6, or 35 U.S.C. §112(f). As explained in §VI.D, the recited

function is “moving the vehicle body within the swimming pool,” and the corresponding structure is wheels, rollers, tracks, or other surface contacting members powered by a motor, or vacuum or liquid jet. ’766 Patent, 3:31-43, 10:12-14, FIGS. 9-10.

274. Knoll’s Fig 1 (annotated below) shows robotic vehicle 1 with **drive means 12** and **wheels** contacting the pool bottom surface within working area 3. Knoll, Fig. 1.

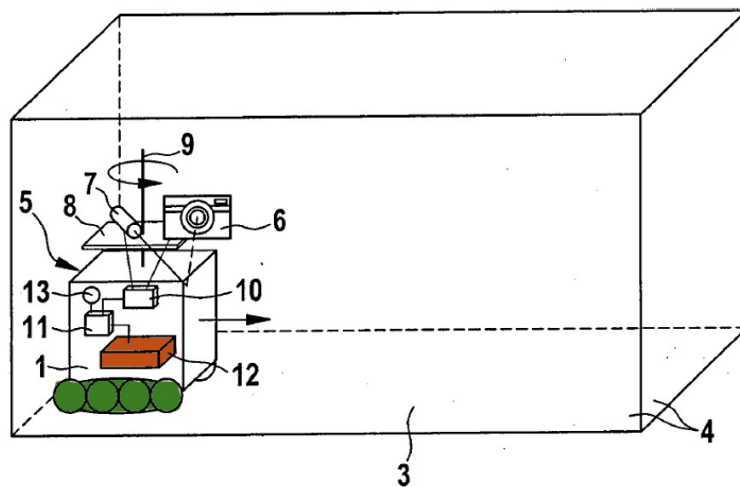


Fig. 1

Knoll, Fig. 1 (annotated)

275. Knoll describes that “drive means (12) for driving and steering the robotic vehicle (1)” are configured “for generating propulsion and for steering the robotic vehicle 1.” Knoll, Abstract, [0028], Claims 1, 14. A POSITA would have understood that Knoll’s drive means 12 comprises motor(s) powering the wheels, because generating propulsion and steering for a wheeled robotic vehicle needs

motor-driven wheel rotation.

276. A POSITA would have understood that Knoll thus discloses the claimed **function** and corresponding **structure: wheels** contact the submerged pool surfaces and are **powered by a motor to propel the vehicle body** within the swimming pool. Specifically, the '766 Patent discloses wheels that propel the vehicle “along the submerged pool surfaces” and are “powered by a motor” (EX1001, 3:33-39), and Knoll similarly discloses wheels (Figure 1) that contact the pool bottom surface and are powered by motor(s) (as part of drive means 12) to move robotic vehicle 1 within the pool.

d. 1[c] “c. a filter configured to retain debris collected from the submerged surface;”

277. In my opinion, Knoll discloses or suggests 1[c].

278. It is my opinion that Knoll discloses this limitation 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].

279. A POSITA 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, because Knoll’s robot operates on the bottom of

the pool and has “waterproof housing” for its control unit (Knoll, [0008]), and the filters in pool cleaning systems, like Knoll’s, capture and retain debris while allowing clean water to pass through, preventing debris from recirculating back into the pool.

- e. **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”**

280. In my opinion, Knoll discloses or suggests 1[d].

281. Knoll discloses “at least one camera mounted directly or indirectly to the body” or carried by the body, because Knoll describes “robotic vehicle 1 is equipped with a distance-determining device 5 (sensor device), which...comprises a...digital camera 6.” Knoll, [0028], FIG. 1 (annotated below).

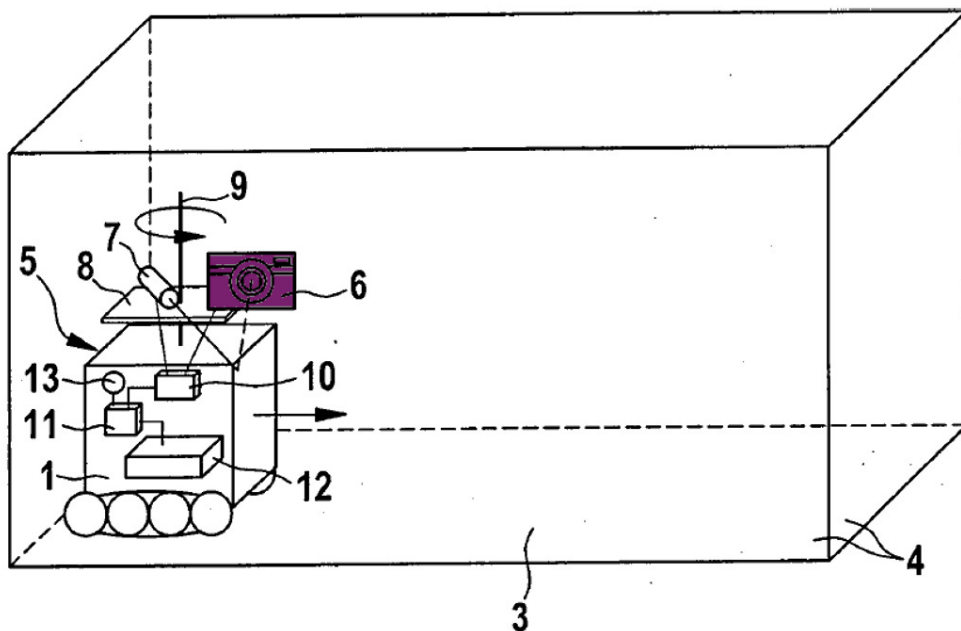


Fig. 1

282. As explained in §VII.D.2.b (1[a]), Knoll’s robotic vehicle is the claimed “vehicle body,” and a POSITA would have understood that camera 6, which is part of distance-determining device 5 arranged on robotic vehicle 1, is “mounted directly or indirectly to the body,” or carried by the body.

283. In my opinion, Knoll also discloses “the at least one camera...for capturing an image of at least a first portion of the submerged surface.” As explained in §VII.D.2.a (1[pre]), Knoll’s pool cleaning robot achieves “a complete and efficient cleaning of a pool floor and/or the pool walls,” where the pool bottom (working area 3) and pool walls (boundary surface 4) are submerged surfaces. Knoll, [0007], [0027]-[0028].

284. Knoll describes that camera 6 is positioned to observe boundary surface 4 formed by pool walls. Knoll, [0028], FIG. 1. Knoll explains that “a light beam is focused on the boundary line or boundary surface and **observed with a camera**,” and that “the angle at which the light beam is **observed** changes and thus the position of **its image** on the **camera**’s photo sensor changes” as the “distance of the boundary line or the boundary surface (measurement object) from the sensor (e.g., a **camera**) changes.” Knoll, [0018].

285. A POSITA would have understood that camera 6 captures images of “at least a first portion of the submerged surface” because: (1) the pool walls (boundary

surface 4) observed by camera 6 are themselves submerged surfaces that Knoll's robot cleans; and (2) for triangulation to determine distance, the camera captures an image of a scene—not merely a point or line—and the camera's field of view encompasses portions of the submerged pool surfaces (first portion), e.g., pool bottom and/or walls, within the scene where the light beam is reflected. Knoll, [0018], [0027]-[0028].

f. 1[e][i] “e. a controller (i) positioned on or in the body,”

286. It is my opinion that Knoll discloses or suggests 1[e][i].

287. Knoll's robotic vehicle 1 includes a **control unit 11** inside the vehicle body that controls **drive means 12** and is “designed to automatically calculate a trajectory of the robotic vehicle,” and “suction and/or filter and/or cleaning device.” Knoll, Abstract, [0007], [0021], [0027]-[0028], Claims 1-2, 14, FIG.1 (annotated below).

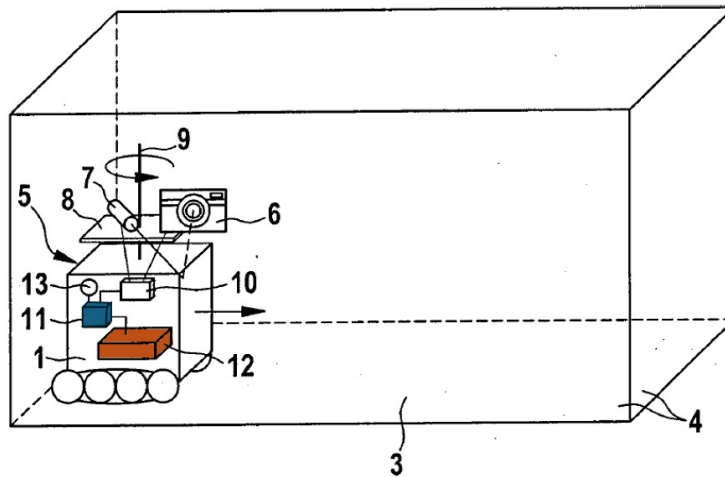


Fig. 1

288. Knoll's robotic vehicle 1 includes various components: **drive means 12** "for generating propulsion and for steering," **control unit 11** that "controls the drive means" and is "designed to automatically calculate a trajectory of the robotic vehicle," and "suction and/or filter and/or cleaning device." Knoll, Abstract, [0007], [0021], [0027]-[0028], Claims 1-2, 14, FIG.1 (annotated below).

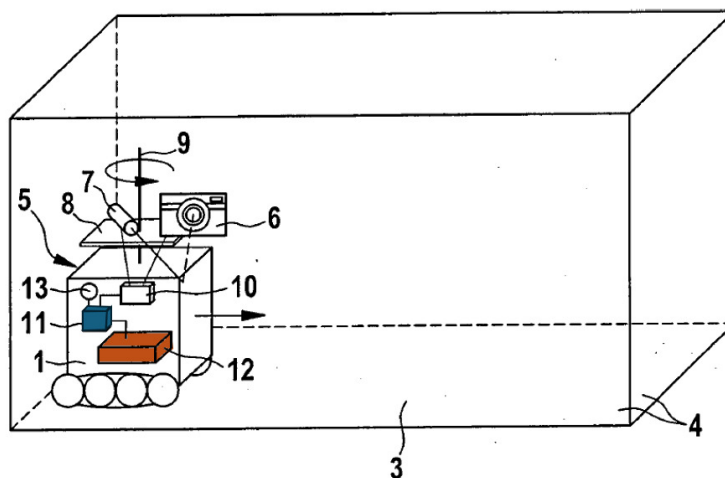


Fig. 1

289. Knoll discloses the controller "positioned...in the body" because Knoll

describes “the **control unit** is preferably **located inside the robotic vehicle** in a waterproof housing or in the camera.” Knoll, [0008], FIG. 1 (annotated above). As explained in §VII.D.2.b (1[a]), robotic vehicle 1 is the claimed “vehicle body.” A POSITA would have understood that control unit 11 located “inside the robotic vehicle” is “positioned on or in the body,” or carried by the body.

g. 1[e][ii] “(ii) in electronic communication with the at least one camera, and”

290. In my opinion, Knoll discloses or suggests 1[e][ii].

291. Knoll discloses its control unit (controller) is in electronic communication with camera 6, because it receives and processes image data from camera 6. *See, e.g.*, Knoll, [0018], [0028]. Specifically, Knoll explains that “the distance-determining device uses the rotating light beam source and the rotating camera to determine the distance to the boundary line or boundary surface by triangulation” and that the device includes “an **evaluation unit 10** for evaluating or determining the measured distance values,” with “the evaluation unit 10 [being] part of a **control unit 11**.” Knoll, [0018], [0028], FIG. 1 (annotated below; showing **evaluation unit 10** (part of **control unit 11**) is connected to **camera 6** via a **wire/cable**).

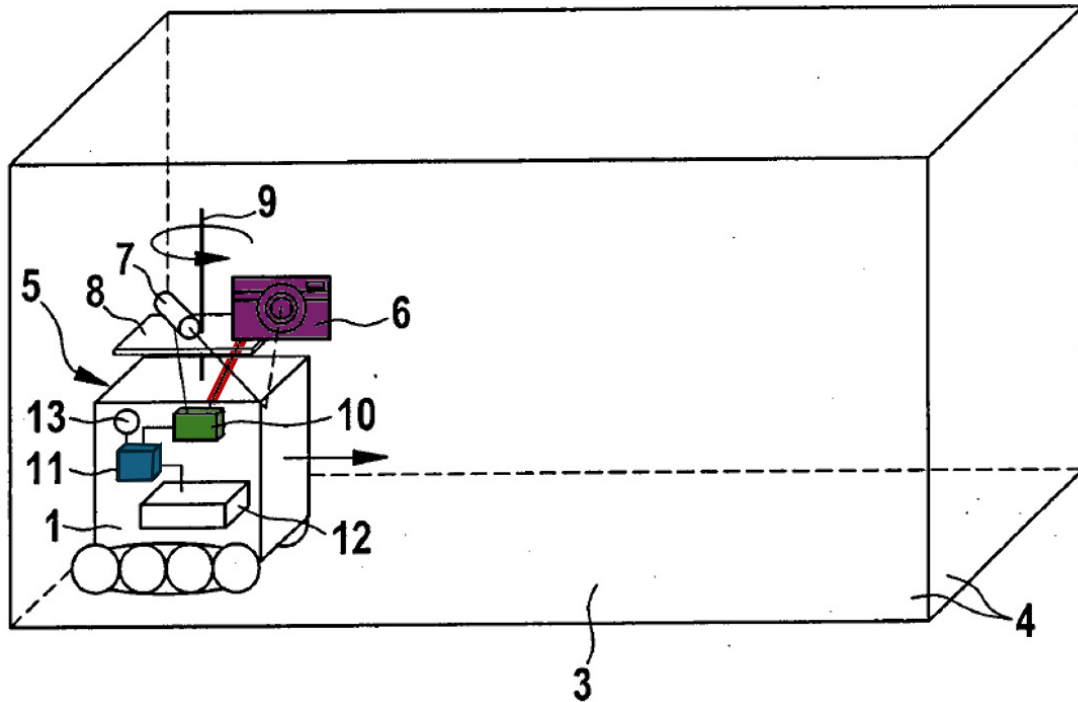


Fig. 1

292. Knoll further explains that “a light beam is focused on the boundary line or boundary surface and observed with a camera,” and that as “the angle at which the light beam is observed changes...the **position of its image on the camera’s photo sensor changes,**” with “[t]he distance...then **calculated from the change in position.**” Knoll, [0018]. A POSITA would have understood that control unit 11 is in electronic communication with camera 6 because, to calculate distance values from images captured on the camera, evaluation unit 10, part of control unit 11, would receive data from camera 6 for processing. Knoll, [0018], [0028].

- h. 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.”

293. In my opinion, Knoll discloses or suggests 1[e][iii].

294. Knoll discloses generating control signals “in response to the captured image.” Specifically, Knoll’s control unit 11 receives sensor information from a 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]. Knoll also explains that the distance measurement values are derived from images captured by camera 6, where “the position of its image on the camera’s photo sensor changes” based on the distance to boundary surface 4, and “[t]he distance...is then calculated from the change in position.” Knoll, [0018]. A POSITA 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.

295. Knoll also discloses generating control signals to cause movement “to, or away from, the first portion of the submerged surface.” As explained in §VII.D.2.e (1[d]), a portion of boundary surface 4 captured by camera 6 constitutes the “first portion of the submerged surface.” Knoll further explains that control unit 11 controls drive means 12 “in such a way that the robotic vehicle maintains a defined

distance from the boundary line and/or boundary surface” as the vehicle travels working area 3 in a plurality of laps. Knoll, [0011], Claim 4, FIG. 2 (below).

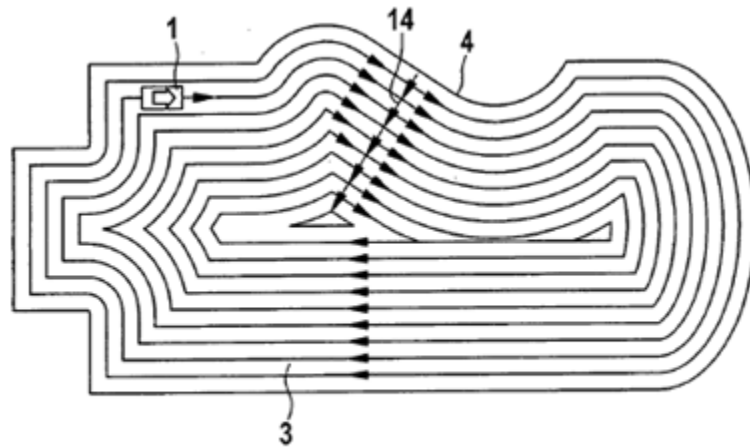


Fig. 2

296. A POSITA would have understood that, to maintain a defined distance from boundary surface 4 (first portion of the submerged surface), Knoll’s control unit generates control signals that cause the vehicle body to **move away** from boundary surface 4 when the measured distance becomes too small and **toward** boundary surface 4 when the measured distance becomes too large.

297. Therefore, it is my opinion that Knoll renders Claim 1 obvious.

3. Claim 2 Unpatentable over Knoll

298. In my opinion, Knoll renders Claim 2 obvious.

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

299. Limitations 2[pre], 2[a]-2[c], and 2[e] are exactly the same as limitations 1[pre], 1[a]-1[c], and 1[e], respectively. It is my opinion that, for at least

the same reasons explained above in §§VII.D.2.a-VII.D.2.d (1[pre], 1[a]-1[c]), Knoll discloses or suggests 2[pre] and 2[a]-2[c]. Additionally, for at least the same reasons explained above in §§VII.D.2.f-VII.D.2.h (1[e][i]-[iii]), Knoll discloses or suggests limitations 2[e][i]-[iii].

b. 2[d]

300. Limitation 2[d] is substantially as limitation 1[d], with the only difference being that 2[d] recites “at least one camera carried by the body,” whereas 1[d] recites “at least one camera mounted directly or indirectly to the body.” As explained above in §VII.D.2.e (1[d]), Knoll discloses “at least one camera mounted directly...to the body.” Thus, it is my opinion that Knoll also discloses limitation 2[d], because a camera that is “mounted directly...to the body” is also “carried by the body.”

301. Therefore, it is my opinion that Knoll renders Claim 2 obvious.

4. Claim 4 Unpatentable over Knoll

302. In my opinion, Knoll renders Claim 4 obvious.

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

303. Limitations 4[pre], 4[a]-4[c], and 4[e] are exactly the same as limitations 1[pre], 1[a]-1[c], and 1[e], respectively. For at least the same reasons explained above in §§VII.D.2.a-VII.D.2.d (1[pre], 1[a]-1[c]), Knoll discloses or suggests 4[pre] and 4[a]-4[c]. Additionally, for at least the same reasons explained

above in §§VII.D.2.f-VII.D.2.h (1[e][i]-[iii]), Knoll discloses or suggests limitation 4[e].

b. 4[d]

304. Limitation 4[d] recites substantially the same features as limitation 1[d], with the only difference being that Limitation 4[d] omits the requirement that the camera be “mounted directly or indirectly to the body.” As explained above in §VII.D.2.e (1[d]), Knoll discloses “at least one camera mounted directly...to the body” for capturing an image. Thus, in my opinion, Knoll also discloses limitation 4[d], because the prior art’s disclosure of a mounted camera satisfies the broader requirement of a camera generally.

305. Therefore, it is my opinion that Knoll renders Claim 4 obvious.

E. Ground 3B: Claim 3 Is Unpatentable under AIA 35 U.S.C. §103 and Pre-AIA AIA 35 U.S.C. §103 over Knoll and Fu-957

1. Fu-957

306. Fu-957 (EX1015) is Chinese Patent Application Publication No. CN101481957A published on July 15, 2009 and is prior art under AIA 35 U.S.C. §102(a)(1) and is not subject to exceptions under AIA 35 U.S.C. §102(b)(1) because it was published more than one year before the effective filing date of the ’766 Patent which is no earlier than July 11, 2016. *See* §VI.C, *supra*. In addition, Fu-957 is also prior art under pre-AIA 35 U.S.C. §102(b).

307. Fu-957 discloses a swimming pool cleaning robot comprising a cleaning robot main unit with a filter, housing body, transmission systems, cleaning rollers, and “the control circuit board of an underwater controller...mounted inside the sealed enclosure cover.” Fu-957, Abstract, Claim 1, pp.6–7⁵, FIGS. 1–2. Fu-957 is analogous art to Claims 1–5 of the ’766 Patent.

308. Fu-957’s swimming pool cleaning robot includes a cleaning robot main unit 1, a power control box 2, and a remote controller 3. *Id.*, Abstract, Claim 1, FIG. 1.

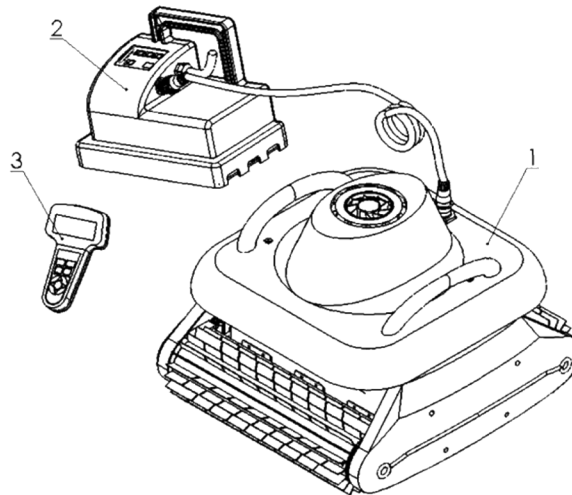


Figure 1

309. The cleaning robot main unit 1 comprises a filter 11, a housing body

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

component 12, an axial-flow pump and sealed enclosure 13, a housing cover component 14, transmission systems 15, cleaning rollers 16, and a self-buoyant cable 17. *Id.*, pp.6–7, Claims 1-2, FIG. 2.

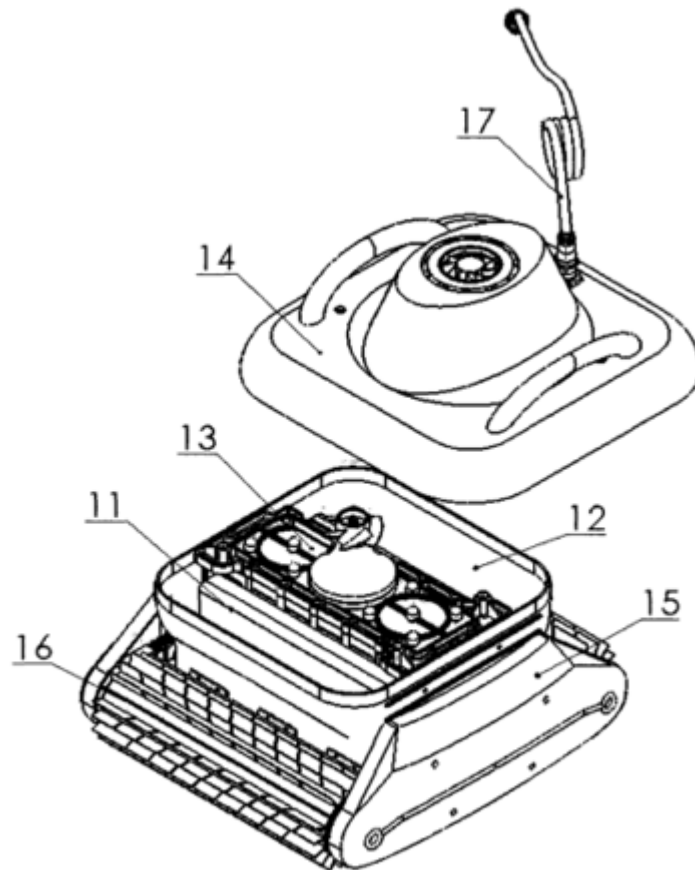


Figure 2

310. Fu-957 describes a sealed housing for the underwater controller. Fu-957, Claim 1, FIG.13 (annotated below). Specifically, Fu-957 describes that “[t]he sealed enclosure cover 135 and the sealed enclosure body 139 are connected through a cylindrical-surface sealing connection with a sealing ring and are locked with

screws.” *Id.*, pp.12-13, FIG.7 (annotated below). “Inside the sealed enclosure, a heat-conducting plate 136 is installed, on which the pump control circuit board [137] and the underwater controller circuit board [138] are fixedly mounted.” *Id.* Drive motors 139A are mounted at both side ends of the sealed enclosure body 139, with “connection end plates...sealingly fitted to holes of the sealed enclosure body by sealing rings.” *Id.*

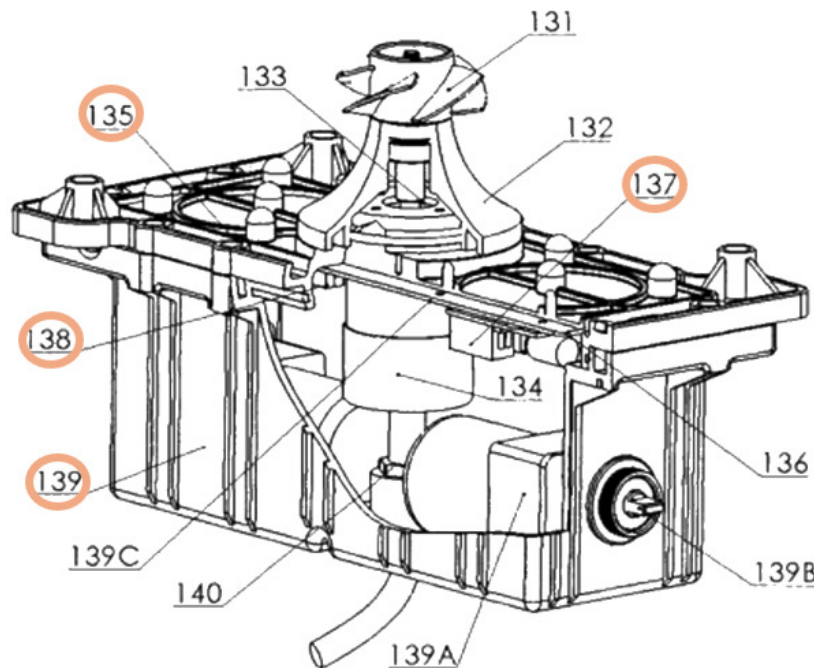


Figure 7

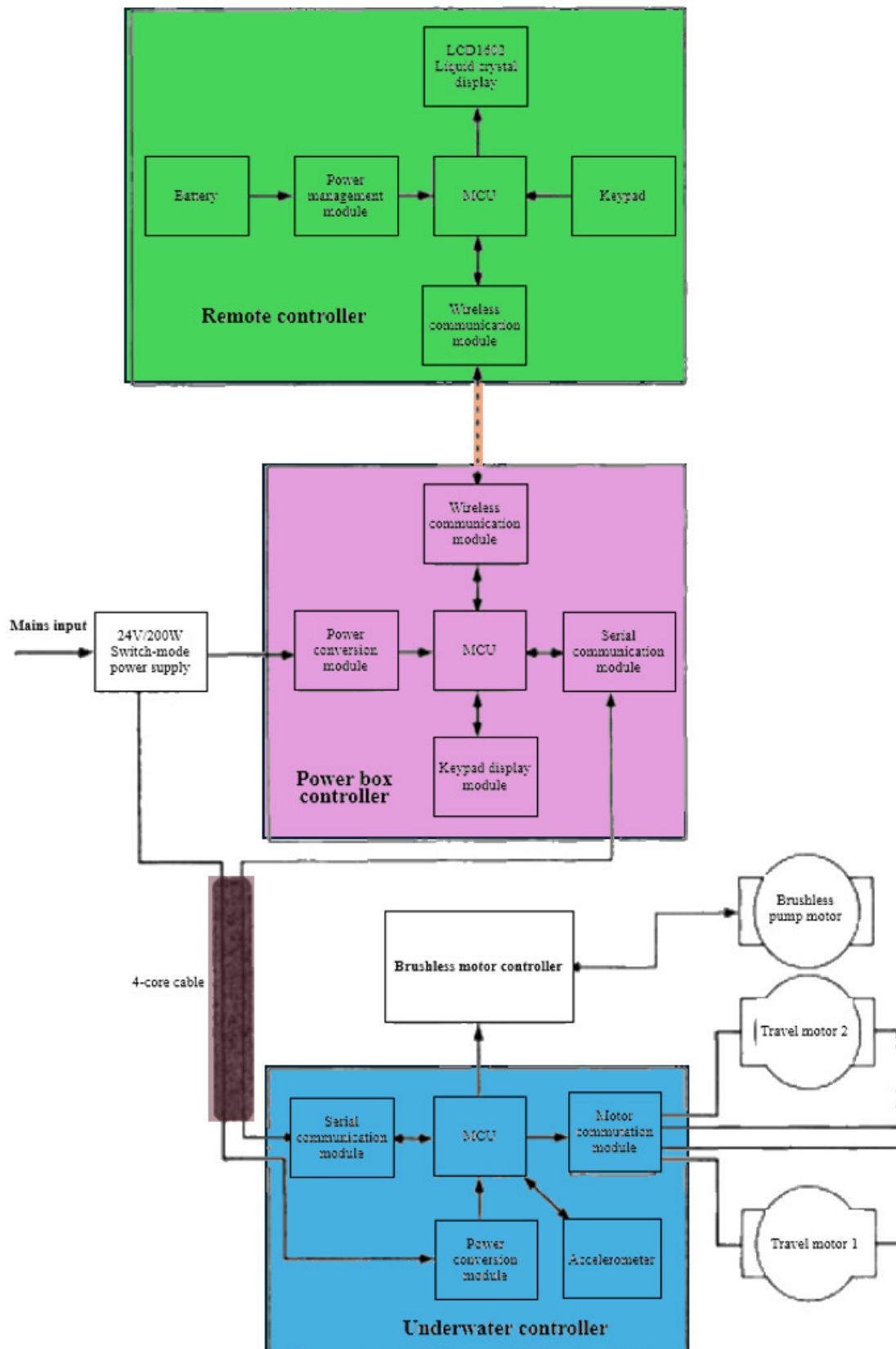


Figure 13

311. 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 discloses that “the microcontroller issues a command to control the rotational speeds of the two drive motors,” and that “the two drive motors of the cleaning robot respectively drive the left and right transmission systems.” *Id.*, pp.16-18. Fu-957 discloses that “an overload sensor is provided in the control system of the cleaning robot to detect and determine touching conditions during crawling and cleaning and to issue a corresponding signal to cause the cleaning robot to enter the next step of program operation.” *Id.*, Abstract. Fu-957 also discloses that “[a]n accelerometer is provided on the circuit board of the underwater controller.” *Id.*, Claims 5, 8. During cleaning operations, “when the sensor detects and the microcontroller (MCU) determines that the cleaning robot main unit has touched a pool wall,” the MCU “issues a command” to control subsequent movement. *Id.*, pp.17–18.

312. Fu-957's **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. 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 receive[] alarm signals,” and the membrane keys to “set an automatic work mode and manual operations.” *Id.*, Abstract, Claim 6, pp.10, 14, FIGS.12-13 (annotated above).

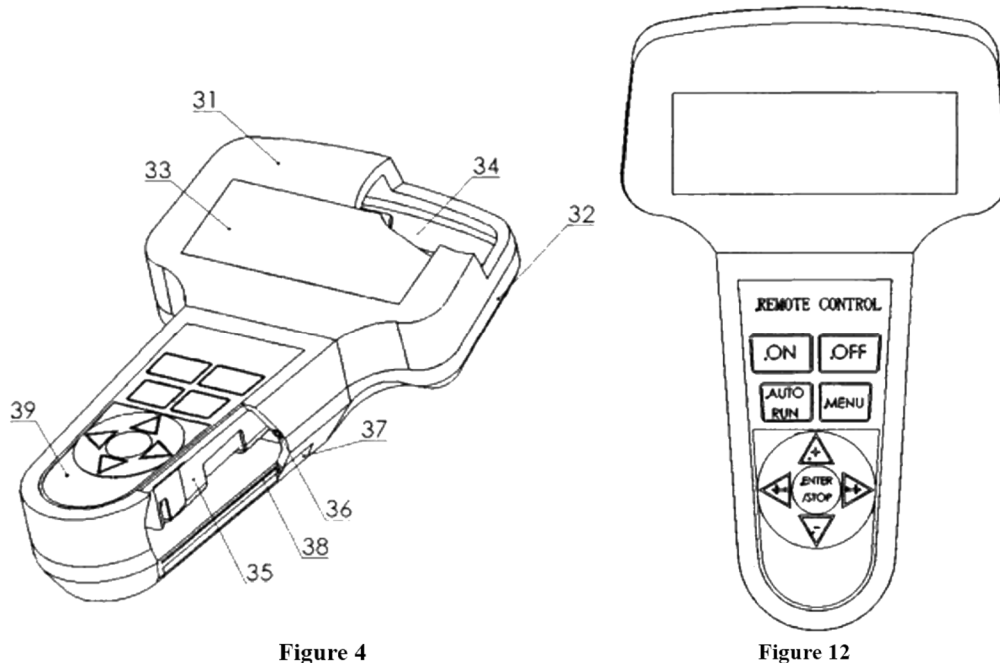


Figure 4

Figure 12

313. Fu-957 teaches that when “the manual keys for moving forward, backward, and for turning left or right are pressed manually, the cleaning robot main unit may crawl and clean along the path controlled by the operator’s intention.” *Id.*, p.18. Fu-957 also teaches alarm functions including “automatic shutdown protection and alarm when the main unit emerges from water, jam alarm and protection when the main unit is stuck during cleaning, and a filter-pocket pore clogging alarm.” *Id.*, p.10.

314. Fu-957 further discloses sequential cleaning methods for swimming pools of different shapes, including a “full-span back-and-forth path method” for rectangular pools and a “half-span back-and-forth path method” for non-rectangular pools. *Id.*, Abstract, Claims 8–9.

2. Reasons for Combining Knoll and Fu-957

315. Both Knoll and Fu-957 disclose autonomous pool cleaning robots, and both sought to improve pool cleaning operations. Knoll describes a robotic vehicle that can achieve “path-optimized and completely covered” cleaning of a pool “without the need to program a correspondingly optimized path.” Knoll, [0005], [0007]. As explained in §§VII.A.2-VII.A.3, Fu-957 similarly describes a pool cleaning robot capable of “sequential full-coverage cleaning” of swimming pools. Fu-957, Abstract. A POSITA would have been motivated to combine the complementary teachings of Knoll and Fu-957 to achieve improved pool cleaning operations with enhanced user control.

316. A POSITA would have recognized that the teachings in Knoll and Fu-957 are directed to the same pool cleaning technical field, are based on recognition of the same or similar technical issues in pool cleaning, and provide similar technical solutions to address those issues. Specifically, both references disclose self-propelled pool cleaners having a housing, drive means for moving the pool cleaner

over pool surfaces, an onboard controller housed in a waterproof enclosure that processes sensor data and generates control signals for navigation, and sensors for detecting conditions during cleaning operations. *Compare* Knoll, [0007]–[0008], [0027]–[0028], FIG. 1 (control unit 11 inside waterproof housing processing distance information from sensor device 5 to control drive means 12), *with* Fu-957, Abstract, Claim 1, pp.6–10, 16-18, Claim 9 (microprocessor inside sealed enclosure processing sensor data from overload sensor and accelerometer to control transmission systems 15); *see also* §VII.E.1. Accordingly, a POSITA would have investigated the technical teachings in both Knoll and Fu-957 to seek guidance when designing a pool cleaning system for specific pool cleaning considerations and applications.

317. Knoll’s robotic vehicle 1 operates autonomously under the control of control unit 11, which “is designed to automatically calculate a trajectory” based on sensor information from distance-determining device 5. 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* §VII.E.1; Fu-957, Abstract, Claim 6, pp.10, 14, 18, FIGS. 4, 12-13. The use of a fully autonomous pool cleaner (Knoll) and the use of a pool cleaner with remote user control capability (Fu-957) had been two known design options. A POSITA would

have been motivated to modify Knoll by incorporating Fu-957's portable remote controller and communication architecture for at least two reasons.

318. First, a POSITA would have been guided by Knoll and Fu-957 to make such a combination to add user control functionalities to Knoll's autonomous pool cleaner. Knoll's robotic vehicle 1 operates autonomously without continuous user intervention. Knoll, Abstract, [0027]–[0028]. As explained in §VII.E.1, Fu-957 teaches that a portable remote controller enables the robot to operate “according to operator's intention” and allows manual control for “moving forward, backward, and for turning left or right.” Fu-957, p.18, Claim 6. A POSITA would have recognized that incorporating Fu-957's portable remote controller would enable users to manually direct Knoll's cleaner to specific areas or override automatic operation when desired, complementing Knoll's autonomous cleaning capabilities.

319. Second, a POSITA would have been motivated to adopt this modification to add the remote monitoring of Knoll's cleaning operations. As explained in §VII.E.1, Fu-957 teaches that its remote controller “displays an operating status of the cleaning robot main unit and receives alarm signals.” Fu-957, p.10, Claim 6. Fu-957 further teaches alarm functions including “automatic shutdown protection and alarm when the main unit emerges from water, jam alarm and protection when the main unit is stuck during cleaning, and a filter-pocket pore

clogging alarm.” Fu-957, p.10, Claim 6. A POSITA would have recognized that incorporating Fu-957’s portable remote controller would have provided users with real-time visibility into Knoll’s cleaning operations and alert users to potential problems, thereby improving user experience and facilitating timely maintenance.

320. A POSITA would have had a reasonable expectation of success in making this combination 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. *See* §VII.E.1; Fu-957, pp.10, 18, Claim 6, FIG. 13. Both Knoll and Fu-957 are pool cleaners with onboard controllers inside waterproof housings that process sensor data and generate control signals for navigation. Knoll, [0008]; Fu-957, Abstract, pp.7-9, 17-18, Claim 1. 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, a POSITA would have reasonably expected that Fu-957’s communication architecture could be integrated with Knoll’s control unit 11, thereby yielding predictable results.

3. Claim 3 Unpatentable over Knoll and Fu-957

321. In my opinion, the Knoll-Fu-957 combination renders Claim 3 obvious.

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

322. Limitations 3[pre], 3[a]-3[c], and 3[e][i] are exactly the same as limitations 1[pre], 1[a]-1[c], and 1[e][i], respectively. It is my opinion, for at least the same reasons explained above in §§VII.D.2.a-VII.D.2.d (1[pre], 1[a]-1[c]), Knoll discloses or suggests 3[pre] and 3[a]-3[c]. Additionally, it is my opinion that, for at least the same reasons explained above in §VII.D.2.f (1[e][i]), Knoll discloses or suggests limitation 3[e][i].

b. 3[d]

323. Limitation 3[d] is substantially the same as limitation 1[d], with the only difference being that 3[d] recites “at least one camera positioned on or in, or carried by, the body,” whereas 1[d] recites “at least one camera mounted directly or indirectly to the body.” As explained above in §VII.D.2.e (1[d]), Knoll discloses “at least one camera mounted directly...to the body,” and thus, also discloses limitation 3[d], because a camera that is “mounted directly...to the body” is also “positioned on or in, or carried by, the body.”

c. 3[e][ii] “(ii) in electronic communication with the at least one camera and a portable electronic device, and”

324. In my opinion, the Knoll-Fu-957 combination discloses or suggests 3[e][ii].

325. As explained in §VII.D.2.g (1[e][ii]), Knoll discloses the controller “in

electronic communication with the at least one **camera.**”

326. In my opinion, the Knoll-Fu-957 combination discloses the controller “in electronic communication with...a **portable electronic device.**”

327. As explained in §VII.E.1, Fu-957 discloses a portable remote controller 3 for user control of pool cleaning operations. Fu-957, Title, Abstract, Claims 1, 6, FIGS. 1, 4, 12. A POSITA would have understood that Fu-957’s remote controller 3 constitutes a “portable electronic device,” because it is a handheld device comprising display screen 33, membrane keys 39, communication circuit board 34, and battery box 35. Fu-957, p.14, Claim 6, FIGS.4, 12.

328. As further explained in §VII.E.1, Fu-957 discloses electronic communication between the remote controller 3 (portable electronic device) 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, and power control box 2 communicates with the underwater controller via self-buoyant cable 17. Fu-957, Claim 6, p.14, FIG. 13.

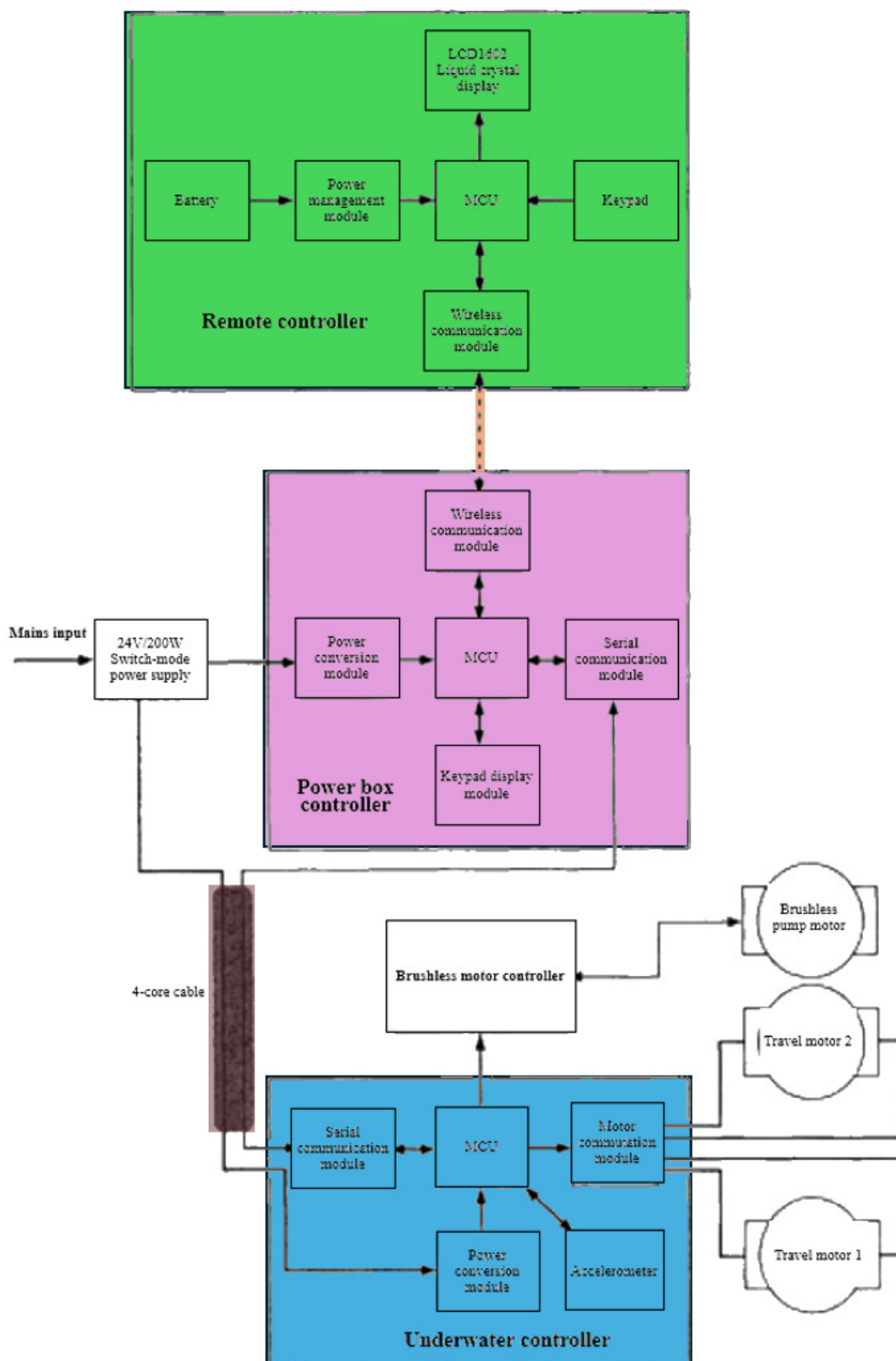


Figure 13

329. As explained in §VII.E.2, a POSITA would have been motivated to combine Knoll with Fu-957's remote controller (portable electronic device) and communication/control mechanism between an onboard controller and the remote controller.

330. In the Knoll-Fu-957 combination, Knoll's control unit 11 (controller) would be: (1) in electronic communication with camera 6 (as explained in §VII.D.2.g) and a portable electronic device (per Fu-957's remote controller 3 communicating with the onboard controller via power control box 2 and self-buoyant cable 17); (2) configured to receive control commands from, and transmit status information to, the portable electronic device 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 manual keys for moving forward, backward, and for turning left or right...[being] pressed manually." *See* §VII.E.2; Knoll, [0008], [0028]; Fu-957, Claim 6, pp.10, 14, 18, FIG. 13. As explained in §VII.E.2, a POSITA would have a reasonable expectation of success in implementing this combination.

- d. **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."**

331. In my opinion, Knoll or the Knoll-Fu-957 combination discloses or suggests 3[e][iii].

332. The limitation requires the controller to generate signals in response to **one of** the captured image **or** the PED. As explained in §VII.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,” and thus, Knoll teaches or suggests this limitation. *See also* Knoll, [0011], [0018], [0028].

333. Therefore, it is my opinion that the Knoll-Fu-957 combination renders Claim 3 obvious.

F. Ground 3C: Claim 5 Is Unpatentable under AIA 35 U.S.C. §103 and Pre-AIA AIA 35 U.S.C. §103 over Knoll and Porat

1. Reasons for Combining Knoll and Porat

334. Both Knoll and Porat disclose autonomous pool cleaning robots. See §VII.D.1, §VII.C.1. Knoll describes a robotic vehicle that can achieve “path-optimized and completely covered” cleaning of a pool. Knoll, [0005], [0007]. Porat discloses a robotic pool cleaner with an integrated chemical dispenser that “produces and distributes chlorine ions...as the cleaner moves.” Porat, Title, Abstract, [0009]. A POSITA would have been motivated to combine the teachings of Knoll and Porat to achieve improved pool cleaning and chemical application.

335. A POSITA would have recognized that the teachings in Knoll and Porat are directed to the same pool cleaning technical field, are based on recognition of the same or similar technical issues in pool maintenance, and provide complementary technical solutions to address those issues. Specifically, both references disclose self-propelled pool cleaners having a housing, drive means for moving the pool cleaner over pool surfaces, and an onboard controller for navigation. *Compare* Knoll, [0007]–[0008], [0027]–[0028], FIG. 1, *with* Porat, Abstract, [0029], FIGS. 1–2. Accordingly, a POSITA would have investigated the technical teachings in both Knoll and Porat to seek guidance when designing a pool cleaning system for specific pool cleaning considerations and applications.

336. Knoll and Porat, however, differ in their approach to pool maintenance. Knoll's robotic vehicle 1 focuses on mechanical cleaning—traversing pool surfaces along calculated trajectories to remove debris. Knoll, [0005], [0007], [0012]. Porat discloses integrating a chemical dispenser, specifically “an electrochemical generator 30 for producing chlorine,” into a robotic pool cleaner. Porat, Abstract, [0009], [0028], Claim 1. A POSITA would have been motivated to modify Knoll by incorporating Porat's chemical dispenser for at least two reasons.

337. First, a POSITA would have been motivated to enable Knoll's cleaner to simultaneously sanitize water and remove debris. A POSITA would have

recognized that integrating Porat's chlorine generator, which “produces and distributes chlorine ions...as the cleaner moves,” into Knoll’s robotic vehicle 1 would create a single autonomous device capable of performing both mechanical cleaning and chemical sanitization in one pass. Porat, [0009].

338. Second, a POSITA would have recognized that because Knoll’s vehicle traverses the pool surfaces along calculated trajectories (e.g., ring-shaped paths), equipping it with Porat’s dispenser would “efficiently and effectively distribute[] the chlorine” into the water “proximate the exterior of the pool cleaner housing” as the cleaner “moves across the pool surfaces being cleaned.” Knoll, [0005], [0010]–[0012]; Porat, Abstract, [0009], [0028], Claim 1.

339. Similar to the explanation in §VII.C.2 regarding the combination of Cui-Fu-007 and Porat, a POSITA would have had a reasonable expectation of success in making this combination because incorporating a chemical dispenser into a robotic pool cleaner like Knoll’s had been well-known, and incorporating Porat’s chemical dispenser into Knoll’s vehicle would have yielded predictable results. *See, e.g.*, Porat, [0028]; Durvasula, [0015]; Knoll, [0007], [0027]–[0028].

2. Claim 5 Unpatentable over Knoll and Porat

340. It is my opinion that the Knoll-Porat combination renders Claim 5 obvious.

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

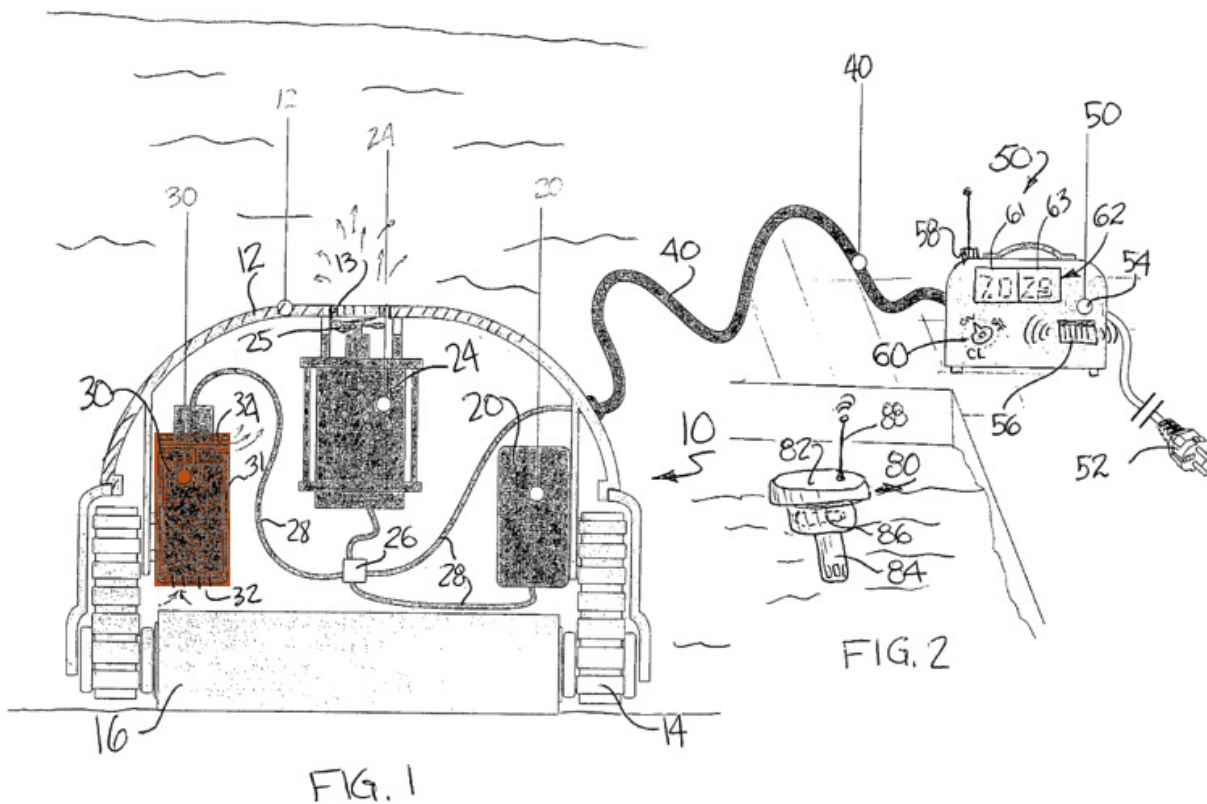
341. Limitations 5[pre], 5[a]-5[c], 5[f][ii], and 5[f][iii] are exactly the same as limitations 1[pre], 1[a]-1[c], 1[e][ii], and 1[e][iii], respectively. In my opinion, for at least the same reasons explained above in §§VII.D.2.a-VII.D.2.d and VII.D.2.g-VII.D.2.h (1[pre], 1[a]-1[c], 1[e][ii]-[iii]), Knoll discloses or suggests 5[pre], 5[a]-5[c], and 5[f][ii]-5[f][iii].

b. 5[d] “d. a chemical dispenser on, in, or carried by the vehicle body;”

342. In my opinion, the Knoll-Porat combination discloses or suggests 5[d].

343. As explained in §VII.D.2.b (1[a]), Knoll discloses robotic vehicle 1 comprising a vehicle body including housing 2. Knoll, [0027], FIG. 1.

344. As explained in §VII.C.1, Porat discloses a robotic pool cleaner with an **onboard chemical dispenser**. Porat, Title, Abstract, Claims 1, 11, 16, FIGS. 1-2 (annotated below). Specifically, Porat discloses “an electrochemical generator 30” that is carried by the cleaner’s housing. Porat, [0028]–[0029], FIGS. 1–2 (annotated below). A POSITA would have understood that Porat’s onboard electrochemical generator 30 constitutes a “chemical dispenser” because it “produc[es] chlorine” and “distributes chlorine ions...as the cleaner moves.” Porat, Abstract, [0009], [0028].



345. As explained in §VII.F.1, a POSITA would have been motivated to incorporate Porat's chemical dispenser into Knoll's housing 2 (vehicle body) to enable simultaneous chemical application and debris removal, and to efficiently distribute chlorine via Knoll's calculated traversal paths. Also as explained in §VII.F.1, a POSITA would have had a reasonable expectation of success to implement this combination.

346. In my opinion, in the Knoll-Porat combination, Knoll's robotic vehicle 1 would include Porat's electrochemical generator 30 (chemical dispenser) carried by Knoll's housing 2 (body), thereby disclosing "a chemical dispenser on, in, or

carried by the body.” *See* §VII.F.1; Knoll, [0027], FIG. 1; Porat, [0028]–[0029], FIGS. 1–2

c. 5[e]

347. Limitation 5[e] is substantially the same as limitation 1[d], with the only difference being that 5[e] recites “at least one camera on, in, or carried by the vehicle body,” whereas 1[d] recites “at least one camera mounted directly or indirectly to the body.” As explained above in §VII.D.2.e (1[d]), Knoll discloses “at least one camera mounted directly...to the body.” Thus, in my opinion, 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.”

d. 5[f][i]

348. Limitation 5[f][i] is substantially the same as limitation 1[e][i], with the only difference being that limitation 5[f][i] recites a controller “on, in, or carried by the vehicle body,” whereas limitation 1[e][i] recites a controller “positioned on or in the body.” As explained above in §VII.D.2.f (1[e][i]), Knoll discloses a controller “positioned on or in the body.” Thus, it is my opinion that Knoll also discloses limitation 5[f][i], because a controller that is “positioned on or in the body” is also “on, in, or carried by the vehicle body.”

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

349. Limitations 5[f][ii] and 5[f][iii] are exactly the same as limitations

1[e][ii] and 1[e][iii], respectively. For at least the same reasons explained above in §§VII.D.2.g-VII.D.2.h (1[e][ii] and 1[e][iii]), Knoll discloses or suggests 5[f][ii] and 5[f][iii].

350. Therefore, it is my opinion that the Knoll-Porat combination renders Claim 5 obvious.

G. Ground 4A: Claims 1-4 Are Unpatentable under 35 U.S.C. §103 over Renaud

1. Renaud

351. Renaud (EX1017) is U.S. Publication No. 20140263087A1 published on September 18, 2014. Renaud is prior art under AIA 35 U.S.C. §102(a)(1) and is not subject to exceptions under AIA 35 U.S.C. §102(b)(1) because it was published more than one year before the effective filing date of the '766 Patent which is no earlier than July 11, 2016. *See* §VI.C, *supra*.

352. As explained below, Renaud discloses a self-propelled pool cleaning robot using controls based on camera images. Renaud is analogous art with respect to Claims 1-5 of the '766 Patent.

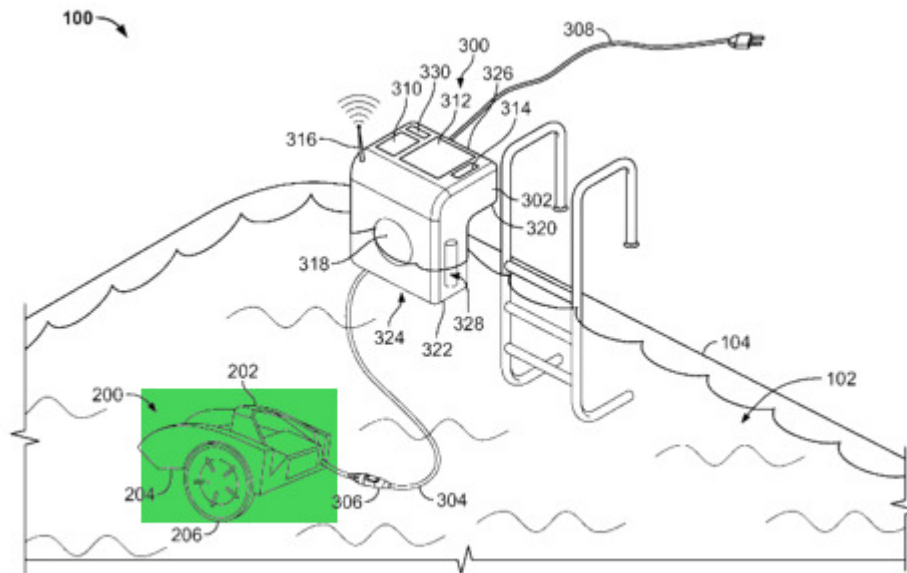
2. Claim 1 Unpatentable over Renaud

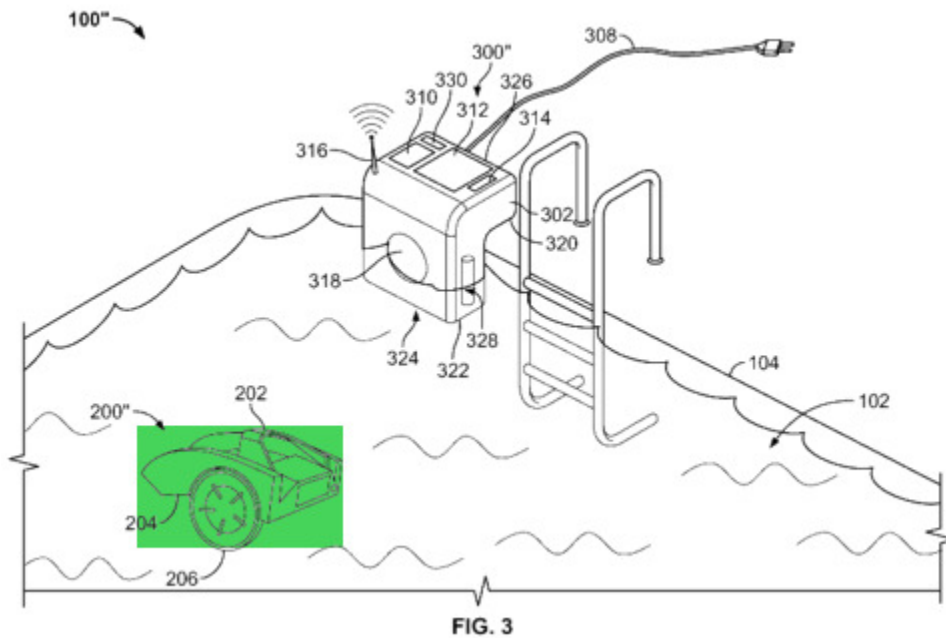
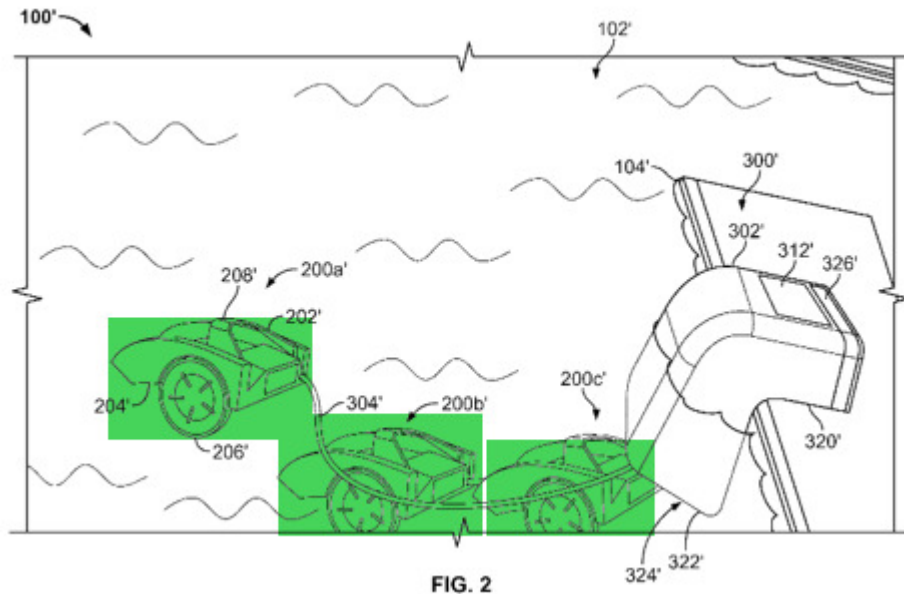
353. In my opinion, Renaud renders Claim 1 obvious.

- a. 1[pre] “A self-propelled pool cleaner for cleaning debris from a submerged surface of a swimming pool, comprising:”**

354. In my opinion, Renaud discloses or suggests 1[pre].

355. Renaud discloses a “swimming pool cleaner.” Renaud, Title, Abstract, [0002], [0022]-[0023], [0037], [0039], FIGS. 1-3 (**cleaners 200/200a’** (“positioned at the water line”)/**200b’** (“positioned at the bottom of the swimming pool”)/**200c’** (“positioned in a docking orientation relative to the docking station”)/**200”**). Renaud further describes that “[r]obotic swimming pool cleaners are generally designed to move along the swimming pool floor and/or walls to clean the necessary surfaces from, e.g., debris, sediment, and the like.” Renaud, [0003].





356. Renaud discloses the pool cleaner is “self-propelled” because Renaud describes cleaner 200 includes “a motor, e.g., an electronically commutated motor” and “wheels 206, e.g., rollers, tracks, and the like, for moving the cleaner 200 in the swimming pool 102.” Renaud, [0023], [0025]. Renaud further describes that “the

vision system can communicate with the cleaner 200 to drive and/or steer the wheels 206 of the cleaner 200 in the direction of the area of debris.” Renaud, [0030]. A POSITA would have understood that a robotic cleaner with an onboard motor that drives and steers wheels for movement under the control of the onboard vision system is “self-propelled.”

357. Renaud discloses the pool cleaner “cleaning debris from a submerged surface of a swimming pool” because Renaud describes cleaner 200 “traverses, and cleans near, the walls (e.g., vertical or horizontal walls) of the pool” in “bottom mode” and “rises to the water surface and cleans the water surface” in “top mode.” Renaud, [0022]. Renaud further describes cleaner 200 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, [0023], [0030]. A POSITA would have understood that cleaner 200 cleans a submerged surface below the water surface at least when operating in “bottom mode.”

b. 1[a] “a. a vehicle body;”

358. In my opinion, Renaud discloses or suggests 1[a].

359. As explained in §VII.G.2.a (1[pre]), Renaud discloses **cleaner 200/200a’** (“positioned at the water line”)/**200b’** (“positioned at the bottom of the

swimming pool 102’’)/**200c**’ (“positioned in a docking orientation relative to the docking station 300’’)/**200**’’. Renaud, [0022]-[0023], [0037], [0039], FIGS. 1-3 (annotated above). Renaud describes “cleaner 200 includes a housing 202 which includes a plurality of components therein,” including “a motor, e.g., an electronically commutated motor, a storage device, and a processing device,” as well as “a debris container,” and “wheels 206, e.g., rollers, tracks, and the like.” Renaud, [0023], [0025], FIGS. 1-3. A POSITA would have understood that the assembled structure of cleaner 200—comprising housing 202 and the components within or carried by it—that travels within the pool constitutes the claimed “vehicle body.”

c. 1[b] “b. means for moving the vehicle body within the swimming pool;”

360. It is my opinion that Renaud discloses or suggests 1[b].

361. The format and content of 1[b] invoke claim interpretation under 35 U.S.C. §112(f). As explained in §VI.D, the recited function is “moving the vehicle body within the swimming pool,” and the corresponding structure is “wheels, rollers, tracks, or other surface contacting members powered by a motor, or vacuum or liquid jet.” ’766 Patent, 3:31-43, 10:12-14, FIGS. 9-10.

362. Renaud discloses identical function because it describes cleaner 200 “includes wheels 206...for **moving the cleaner 200** in the swimming pool 102.” Renaud, [0025]. Renaud further describes the “vision system can communicate with

the cleaner 200 to drive and/or steer the wheels 206 of the cleaner 200 in the direction of the area of debris.” Renaud, [0030]. *See also* Renaud, [0003] (“Robotic swimming pool cleaners are generally designed to move along the swimming pool floor and/or walls”).

363. Renaud discloses identical corresponding structure. Renaud describes cleaner 200 includes “**wheels 206**, e.g., rollers, tracks, and the like” powered by “a **motor**, e.g., an electronically commutated **motor**.” Renaud, [0009], [0023], [0025], FIGS. 1-3 (annotated below).

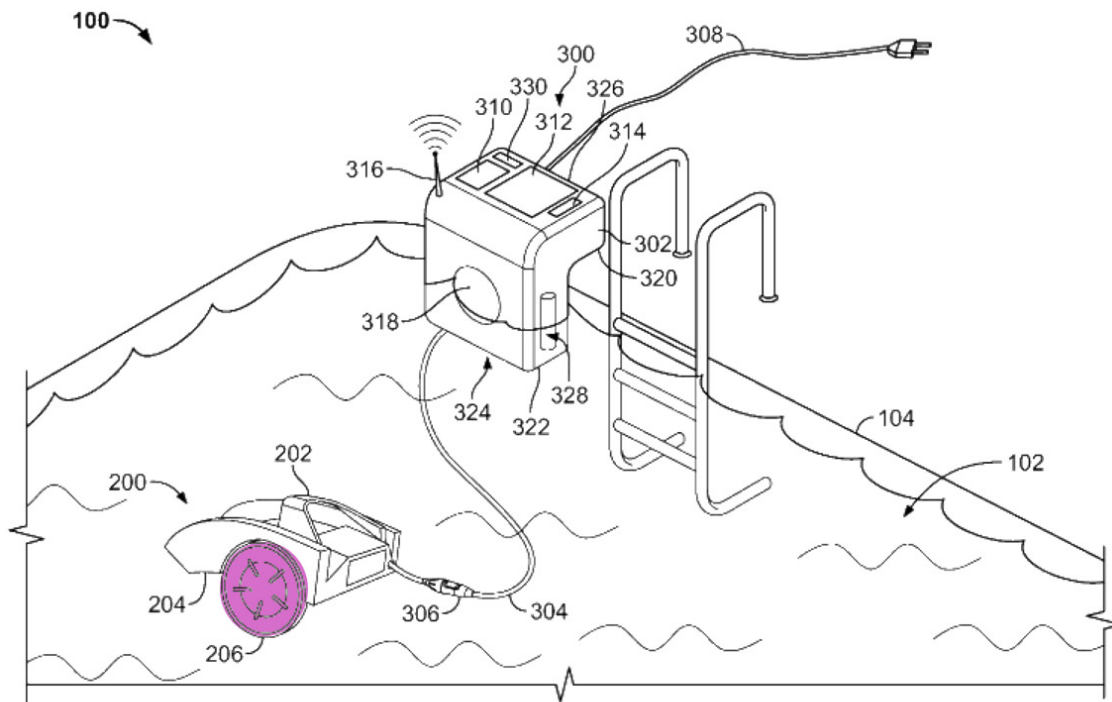


FIG. 1

[0030].

366. Renaud discloses “a filter configured to retain debris” because Renaud describes cleaner 200 includes “debris container” or “debris bag” for “collecting the debris collected from the swimming pool 102.” Renaud, Abstract, [0006], [0015], [0023], [0030], Claim 20. Renaud also describes cleaner 200 uses “a suction pump impeller to collect the debris in the swimming pool into the debris container located in the housing 202 of the cleaner 200.” Renaud, [0030].

367. Renaud further describes “[t]he self-cleaning of the debris container, e.g., a debris bag” where “the debris container of the cleaner 200 can be cleaned/emptied into the debris container of the docking station 300.” Renaud, [0033], [0036]. A POSITA would have understood that Renaud’s debris container/debris bag of cleaner 200 retains debris—otherwise, there would be no need to clean or empty the debris container/bag of cleaner 200 as Renaud describes.

e. **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”**

368. In my opinion, Renaud discloses or suggests 1[d].

369. 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. Renaud, [0008], Claim 1. As explained in

§VII.G.2.b (1[a]), cleaner 200 includes the claimed “vehicle body.” Renaud discloses the camera “for capturing an image of at least a first portion of the submerged surface” because Renaud describes “the sensors of the vision system can interact with the controller and/or processing device to identify **areas on the pool floor, walls** and/or water line **where debris or dirt exists** in the swimming pool 102, such as at the **bottom (on the horizontal or vertical walls).**” Renaud, [0029]. Renaud further describes the vision system “identifies **areas of debris** by sensing areas of **optical contrast**, for example, **generated by a foreign object, debris and/or dirt.**” Renaud, [0031]. A POSITA would have understood that a camera of the vision system captures images to facilitate identification of specific “areas of debris” or “areas of optical contrast” (first portion) on pool floor and walls (submerged surfaces), which constitute the claimed “at least a first portion of the submerged surface.”

370. Renaud discloses or suggests the camera is mounted on the body because Renaud explicitly identifies the camera as a component of the “vision system” (Renaud, [0008]) and physically locates the vision system “inside the cleaner 200” (e.g., “the vision system can include a PCB...disposed inside the cleaner 200”) (Renaud, [0029]).

f. **1[e][i] “e. a controller (i) positioned on or in the body,”**

371. In my opinion, Renaud discloses or suggests 1[e][i] because it describes a “processing device..., such as a microprocessor, **inside...cleaner 200**” and a “PCB (not shown) disposed **inside the cleaner 200,**” which interacts with the sensors to control the cleaner. Renaud, [0008]-[0009], [0029]-[0030].

372. 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]. Renaud further describes “the vision system can include “[a] **processing device** (not shown), such as a **microprocessor, inside of the cleaner 200...**can access the programmed data related to the vision system for **actuating the motor.**” Renaud, [0029]. Renaud describes “the **sensors** of the vision system can **interact with** the controller and/or **processing device** to identify areas on the pool floor, walls and/or water line where debris or dirt exists.” *Id.* Renaud also describes that “[u]pon identifying debris located in the swimming pool, the vision system can **actuate the motor** to direct the swimming pool cleaner to the debris.” Renaud, [0009]. *See also* Renaud, [0030] (“the vision system can communicate with one or more motors of the cleaner 200, to **actuate, or control the speed of, the motor.**”).

373. A POSITA would have understood that Renaud’s processing device/microprocessor (controller) receiving data from the camera, processing that

data, and generating signals to actuate/control the motor—constitutes the claimed “controller.”

374. In my opinion, as explained in §VII.G.2.b (1[a]), cleaner 200 is the claimed “vehicle body.” A POSITA would have understood that the processing device “disposed inside the cleaner 200” is positioned “on or in the body” or carried by the body.

g. 1[e][ii] “(ii) in electronic communication with the at least one camera, and”

375. It is my opinion that Renaud discloses or suggests that its processing device (controller) is in electronic communication with the at least one 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].

h. 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.”

376. It is my opinion, Renaud discloses or suggests 1[e][iii].

377. Renaud discloses or suggests that its processing device (controller) generates control signals “in response to the captured image.”

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

379. A POSITA 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. This is because Renaud explicitly tasks the processing device with the high-level logic: it receives the sensor data ([0029]) and “actuates” the controller/motor to move the cleaner ([0025], [0029]). Thus, a POSITA would understand that the “processing device” generates the necessary signals to “direct” or “steer” the cleaner specifically to the debris identified by the camera. Renaud, [0009], [0030].

380. 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]. A POSITA 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).

381. Therefore, in my opinion, Renaud renders Claim 1 obvious.

3. Claim 2 Unpatentable over Renaud

382. In my opinion, Renaud renders Claim 2 obvious.

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

383. Limitations 2[pre], 2[a]-2[c], and 2[e][i]-[iii] are exactly the same as limitations 1[pre], 1[a]-1[c], and 1[e], respectively. It is my opinion that, for at least the same reasons explained above in §§VII.G.2.a-VII.G.2.d, VII.G.2.f-VII.G.2.h (1[pre], 1[a]-1[c], 1[e][i]-1[e][iii]), Renaud discloses or suggests 2[pre] and 2[a]-2[c].

b. 2[d]

384. Limitation 2[d] is substantially the same as limitation 1[d], with the only difference being that 2[d] recites “at least one camera carried by the body,” whereas 1[d] recites “at least one camera mounted directly or indirectly to the body.”

As explained above in §VII.G.2.e (1[d]), Renaud discloses “at least one camera mounted directly or indirectly to the body.” Thus, Renaud also discloses 2[d], because a camera that is “mounted directly or indirectly to the body” is also “carried by the body.”

385. Therefore, in my opinion, Renaud renders Claim 2 obvious.

4. Claim 3 Unpatentable over Renaud

386. In my opinion, Renaud renders Claim 3 obvious.

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

387. Limitations 3[pre], 3[a]-3[c], and 3[e][i] are exactly the same as limitations 1[pre], 1[a]-1[c], and 1[e][i], respectively. It is my opinion that, for at least the same reasons explained above in §§VII.G.2.a-VII.G.2.d, VII.G.2.f (1[pre], 1[a]-1[c], 1[e][i]), Renaud discloses or suggests 3[pre], 3[a]-3[c], and 3[e][i].

b. 3[d]

388. Limitation 3[d] is substantially the same as limitation 1[d], with the only difference being that 3[d] recites “at least one camera positioned on or in, or carried by, the body,” whereas 1[d] recites “at least one camera mounted directly or indirectly to the body.” As explained above in §VII.G.2.e (1[d]), Renaud discloses “at least one camera mounted directly or indirectly to the body.” Thus, in my opinion, Renaud also discloses limitation 3[d], because a camera that is “mounted directly or indirectly to the body” is also “positioned on or in, or carried by, the body.”

c. 3[e][ii] “(ii) in electronic communication with the at least one camera and a portable electronic device, and”

389. In my opinion, Renaud discloses or suggests 3[e][ii].

390. As explained in §VII.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.”

391. 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).

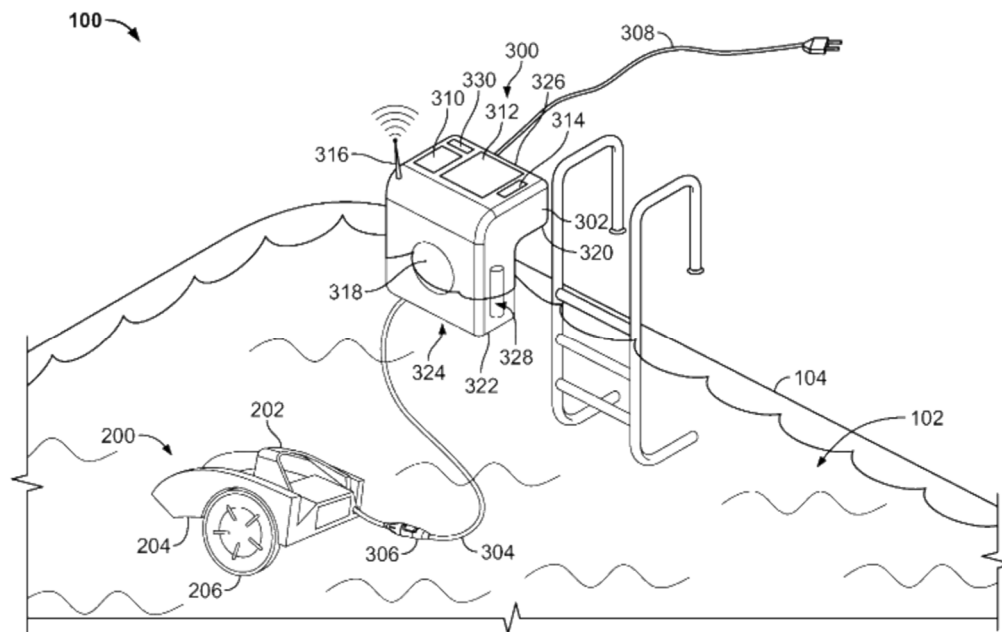


FIG. 1

392. 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].

393. A POSITA 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.

394. Additionally, Renaud also discloses “a remote control... and/or joystick...allow[ing] a user to manually control the position” of cleaner 200. Renaud, [0032]. A POSITA 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. 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.

- d. **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.”**

395. In my opinion, the Renaud-Durvasula combination discloses or suggests 3[e][iii].

396. The limitation requires the controller to generate signals in response to **one of** the captured image **or** the PED. As explained in §VII.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.”

397. Therefore, it is my opinion that Renaud renders Claim 3 obvious.

5. Claim 4 Unpatentable over Renaud

398. In my opinion, Renaud renders Claim 4 obvious.

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

399. Limitations 4[pre], 4[a]-4[c], and 4[e][i]-[iii] are exactly the same as limitations 1[pre], 1[a]-1[c], and 1[e][i]-[iii], respectively. It is my opinion that, for at least the same reasons explained above in §§VII.G.2.a-VII.G.2.d and VII.G.2.f-VII.G.2.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].

b. 4[d]

400. Limitation 4[d] is substantially the same as limitation 1[d], with the

only difference being that 4[d] omits the requirement that the camera be “mounted directly or indirectly to the body.” As explained above in §VII.G.2.e (1[d]), Renaud discloses “at least one camera mounted directly or indirectly to the body” for capturing an image. Thus, in my opinion, Renaud also discloses limitation 4[d], because Renaud’s disclosure of a mounted camera satisfies the broader requirement of a camera generally.

401. Therefore, in my opinion, Renaud renders Claim 4 obvious.

H. Ground 4B: Claim 5 Is Unpatentable under AIA 35 U.S.C. §103 and Pre-AIA AIA 35 U.S.C. §103 over Renaud and Durvasula

1. Reasons for Combining Renaud with Durvasula

402. Both Renaud and Durvasula disclose autonomous robotic pool cleaners. Renaud describes a swimming pool cleaner system that “permits cleaners to perform cleaning operations in a swimming pool while minimizing the interaction and/or supervision of users.” Renaud, [0042]. Durvasula similarly describes a pool cleaning system utilizing “a powered robotic surface cleaning vehicle to travel adjacent water containing surfaces of a pool while submerged within the pool.” Durvasula, Abstract. A POSITA would have been motivated to combine the teachings of Renaud and Durvasula to achieve improved pool cleaning and sanitization.

403. A POSITA would have recognized that the teachings in Renaud and

Durvasula are directed to the same pool cleaning technical field, are based on recognition of the same or similar technical issues in pool maintenance, and provide complementary technical solutions to address those issues. Specifically, both references disclose self-propelled pool cleaners having a housing, drive means (e.g., wheels, rollers, tracks) 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, a POSITA 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.

404. Both Renaud and Durvasula contemplate sanitization in addition to mechanical debris removal, but differ in their approach. 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]. A POSITA would have been motivated to modify Renaud by incorporating Durvasula’s chemical dispenser for at least two reasons.

405. First, a POSITA would have been motivated to enhance the sanitization

functionalities already taught by Renaud. 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]. A POSITA 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 methods. Durvasula, [0015]; Renaud, [0040].

406. Second, a POSITA 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 volume as the cleaner moves. Renaud, [0029]–[0031]; Durvasula, [0015].

407. A POSITA would have had a reasonable expectation of success in making this combination 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. *See, e.g.*, Porat, [0028]; Durvasula, [0015]; Renaud, [0010], [0023], [0040].

2. Claim 5 Unpatentable over Renaud and Durvasula

408. In my opinion, the Renaud-Durvasula combination renders Claim 5

obvious.

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

409. Limitations 5[pre], 5[a]-5[c], 5[f][ii], and 5[f][iii] are exactly the same as limitations 1[pre], 1[a]-1[c], 1[e][ii], and 1[e][iii], respectively. It is my opinion that, for at least the same reasons explained above in §§VII.G.2.a-VII.G.2.d and VII.G.2.g-VII.G.2.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].

b. 5[d] “d. a chemical dispenser on, in, or carried by the vehicle body;”

410. In my opinion, the Renaud-Durvasula combination discloses or suggests 5[d].

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

412. As explained in §VII.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]. A POSITA 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.*

413. As explained in §VII.H.1, a POSITA 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. 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]. A POSITA 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]. Also as explained in §VII.H.1, a POSITA would have had a reasonable expectation of success to implement this combination.

414. In my opinion, 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." *See* §VII.H.1; Renaud, [0022]–[0023], FIGS. 1–3; Durvasula, [0015].

c. 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"

415. Limitation 5[e] is substantially the same as limitation 1[d], with the only difference being that 5[e] recites "at least one camera **on, in, or carried by** the vehicle body," whereas 1[d] recites "at least one camera **mounted directly or indirectly to** the body." As explained above in §VII.G.2.e (1[d]), Renaud discloses

“at least one camera mounted directly or indirectly to the body.” Thus, it is my opinion that Renaud also discloses 5[e], because a camera that is “mounted directly or indirectly to the body” is also “on, in, or carried by the vehicle body.”

d. 5[f][i] “f. a controller (i) on, in, or carried by the vehicle body,”

416. Limitation 5[f][i] is substantially the same as limitation 1[e][i], with the only difference being that 5[f][i] recites a controller “**on, in, or carried by** the vehicle body,” whereas 1[e][i] recites a controller “positioned **on or in** the body.” As explained above in §VII.G.2.f (1[e][i]), Renaud discloses a controller “positioned on or in the body.” Thus, in my opinion, Renaud also discloses 5[f][i], because a controller that is “positioned on or in the body” is also “on, in, or carried by the vehicle body.”

417. Therefore, it is my opinion that the Renaud-Durvasula combination renders Claim 5 obvious.

VIII. CONCLUSION

418. Based on the foregoing analysis, it is my opinion that the challenged Claims of the ’766 Patent are invalid.

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true;

Dr. Jason A. Janet Declaration
Inter Partes Review of U.S. Patent 11,262,766 B2
PTAB Case No. IPR2026-00200

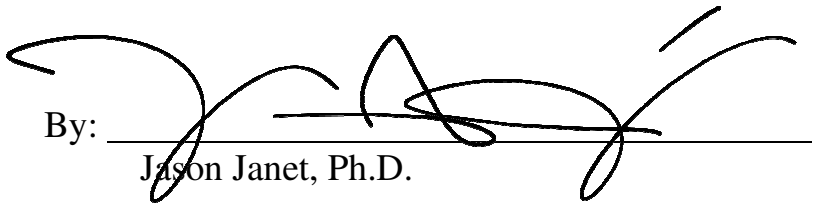
that these statements were made with knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under 18 U.S.C. §1001; and further that such willful false statements may jeopardize the validity of the application or any patent issued thereon. I declare under penalty of perjury under the laws of the United States of America that the foregoing is true and correct.

This declaration and my opinions herein are made to the best of my knowledge and understanding, and based on the material available to me, at the time of signing this declaration. I declare that all statements made herein on my own knowledge are true and that all statements made on information and belief are believed to be true, and further, that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 or Title 18 of the United States Code.

Dated: January 26, 2026

By: _____

Jason Janet, Ph.D.

A handwritten signature in black ink, consisting of a series of loops and strokes, positioned over a horizontal line.