

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. IPR2026-00201

U.S. Patent No. 11,880,207 B2

**PETITION FOR *INTER PARTES* REVIEW
OF U.S. Patent No. 11,880,207 B2**

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Exhibit List

No.	Exhibit
1001	U.S. Patent No. 11,880,207 (“’207 Patent”)
1002	File History of the ’207 patent (“’207FH”)
1003	Declaration of Jason Janét, Ph.D. (“Janét”)
1004	Curriculum Vitae of Jason Janét, Ph.D.
1005	Chinese Patent Application Publication No. CN1540119A (“Cui”)
1006	German Patent Application Publication No. DE102007053310A1 (“Knoll”)
1007	Chinese Patent Application 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	U.S. Patent Application Publication No. 2013/0024025 A1 (“Hsu”)
1012	U.S. Patent Application Publication No. 2008/0048870 A1 (“Laitta”)

LISTING OF CHALLENGED CLAIMS

11,880,207 B2
Claim 1
1[pre] A self-propelled pool cleaning system 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 for capturing an image of at least a first object within the swimming pool; and
1[e][i] e. a controller (i) in electronic communication with the at least one camera and
1[e][ii] (ii) 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 object.
Claim 2
2[pre] A pool system comprising:
2[a] at least one piece of equipment for a swimming pool or spa;
2[b] one or more cameras configured to capture video or images of at least a portion of a location including the swimming pool or spa; and
2[c][i] a controller in communication with the at least one piece of equipment and the one or more cameras,

2[c][ii] the controller configured to receive visual data from the one or more cameras and determine a control action for the at least one piece of equipment based on the received visual data.

Claim 3

3. The pool system of claim 2, wherein the at least one piece of equipment comprises a cleaning device with one or more propulsion mechanisms, the cleaning device configured to travel adjacent to submerged or water-containing surfaces of the swimming pool or spa and to perform a cleaning operation.

Claim 5

5. The pool system of claim 2, wherein the one or more cameras are mounted on the at least one piece of equipment.

Claim 6

6. The pool system of claim 2, wherein the one or more cameras are submersible or submerged within the swimming pool or spa.

Claim 7

7. The pool system of claim 2, wherein the controller is configured to detect a characteristic of the location based on the visual data and control the piece of equipment based on the detected characteristic.

Claim 8

8. The pool system of claim 7, wherein the characteristic comprises a cleanliness of a surface of the swimming pool, and wherein the controller is configured to control the piece of equipment based on the detected cleanliness being outside of a threshold.

Claim 10

10. The pool system of claim 2, wherein the controller is further configured to present a graphical depiction on a remote device based on the received visual data as the control action.

Claim 12
12[pre] A method for monitoring a pool system, the method comprising
12[a] receiving images of at least a portion of a location including a swimming pool or spa from one or more cameras;
12[b] determining a target area and detecting a characteristic of the target area based on the images; and
12[c] generating a control response based on the detected characteristic of the target area.
Claim 13
13[a] The method of claim 12, wherein the target area comprises a portion of a surface of the swimming pool or spa, and
13[b] wherein the characteristic comprises a cleanliness characteristic of the portion of the surface of the swimming pool or spa.
Claim 14
14. The method of claim 12, wherein generating the control response comprises controlling an operation of a piece of equipment of the swimming pool or spa.
Claim 15
15. The method of claim 12, wherein generating the control response comprises generating an alert on a remote device.
Claim 16
16. The method of claim 12, wherein generating the control response comprises wirelessly communicating with a piece of equipment for the swimming pool or spa or a remote device.
Claim 17

17[a]. The method of claim 12, wherein generating the control response comprises prompting a user on a remote device, and

17[b] wherein the method further comprises receiving a control input from the user on the remote device for controlling a piece of equipment of the swimming pool or spa.

Claim 19

19[a] The method of claim 12, wherein generating the control response comprises controlling operation of a cleaning device configured to travel adjacent to submerged or water-containing surfaces of the swimming pool or spa and to perform a cleaning operation,

19[b] wherein controlling operation of the cleaning device comprises one or more of controlling a path or route of the cleaning device, an aggressiveness of cleaning chemicals deployed, an aggressiveness of mechanical cleaning, or a speed of the cleaning device.

I. INTRODUCTION

Petitioner requests *inter partes* review (“IPR”) of claims 1-3, 5-8, 10, 12-17, and 19 (“Challenged Claims”) of U.S. Patent No. 11,880,207B2 (“’207 Patent,” EX1001).

II. IPR REQUIREMENTS

A. Standing

The ’207 Patent is available for IPR, and Petitioner is not barred or estopped from requesting IPR.

B. Challenged claims and relief requested

Petitioner respectfully requests cancellation of the challenged claims under 35 U.S.C. §103.

1. Prior art

Petitioner relies on Exhibits listed in the Exhibit Table and Dr. Jason A. Janét’s declaration (EX1003, “Janét”). Specific invalidity grounds are listed in the table below, where all the references are prior art under AIA 35 U.S.C. §102(a)(1)-(2) or pre-AIA 35 U.S.C. §102(b).

§103	Claims	Reference(s)
1A	<u>1</u> , <u>2</u> , 3, 5-8, <u>12</u> , 13-14, 19	Cui
1B	8, 16	Cui, Fu-007
1C	10, 17	Cui, Hsu
2A	<u>1</u> , <u>2</u> , 3, 5-7, <u>12</u> , 14, 19	Knoll

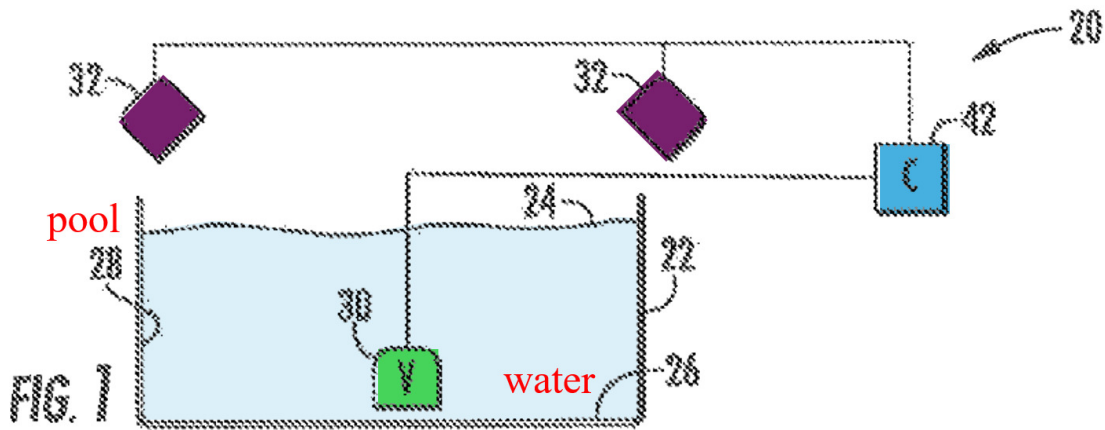
§103	Claims	Reference(s)
2B	7-8, <u>12</u> , 13-14, 19	Knoll, Fu-007
2C	10, 17	Knoll, Hsu
3	<u>2</u> , 4, 7, 10, <u>12</u> , 14-16	Laitta

III. THE '207 PATENT

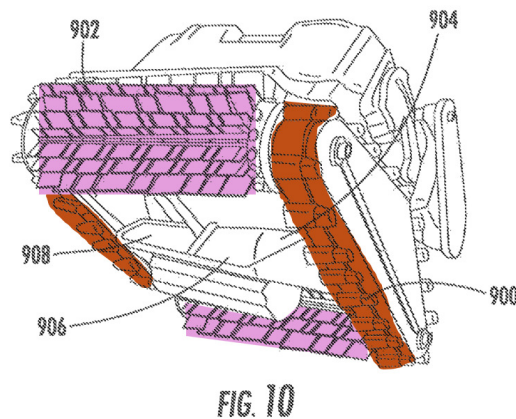
A. Overview

The '207 Patent describes a pool system that uses camera-based image analysis to detect pool conditions and generate control responses. EX1001, Abstract. The system includes at least a “**camera 32**”¹ positioned to capture images of a swimming pool or spa, a “**controller 42**” that analyzes the images and generates control responses for pool equipment (e.g., **vehicle 30** for cleaning). *Id.*, 2:64-5:9; FIG. 1 (annotated below).

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



The system includes a cleaning device—vehicle 30 —having a body, a **drive system**, and cleaning equipment (e.g., **brushes**). *Id.*, 10:11-30, FIG. 10 (annotated below).



The controller analyzes the images from the cameras, determines the cleanliness of submerged pool surfaces, and generates control signals to adjust the operation of the cleaning vehicle. *Id.*, 8:27-9:59.

B. Prosecution History

The '207 Patent claims priority to U.S. Patent Application No. 13/545,918 filed on July 10, 2012, which is assumed to be the priority date for all Challenged Claims for purposes of this Petition. EX1001, field (63).

The Examiner issued a Non-Final Office Action rejecting the sole pending Claim 20 for nonstatutory double patenting. EX1002, pp.82-90. Applicant filed a Terminal Disclaimer and added new Claims 21-39, which the Examiner then allowed. *Id.*, pp.92-105.

Fu-007, used in this petition, was cited in an Information Disclosure Statement (IDS) (EX1002, pp.55, 72) but was not used as a basis for claim rejections or otherwise discussed during the prosecution. Fu-007's use here is not cumulative, because Fu-007 is used here in combination with other references and the Examiner lacked expert testimony regarding the use of Fu-007 in combination with other references.

C. Level of Ordinary Skill

As of the '207 Patent's alleged priority date, a POSITA would have had 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. Janét, ¶30.

D. Claim Construction

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

When a claim uses “means” or “module” and recites an associated function, it is presumably MPF. *See* pre-AIA 35 U.S.C. §112 ¶6 or AIA 35 U.S.C. §112(f); MPEP §2181; *TriMed, Inc. v. Stryker Corp.*, 514 F.3d 1256, 1259-60 (Fed. Cir. 2008).

Claim 1 recites a claim limitation in form of “*means for moving...*” and recites a claimed function of “moving the vehicle body within the swimming pool.” EX1001, 10:50-64; Janét, ¶67. The corresponding structure described in the specification of the ’207 Patent includes 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; Janét, ¶67.

The above described structures in the specification of the ’207 Patent are the corresponding structures for the “means for moving...” Janét, ¶68.

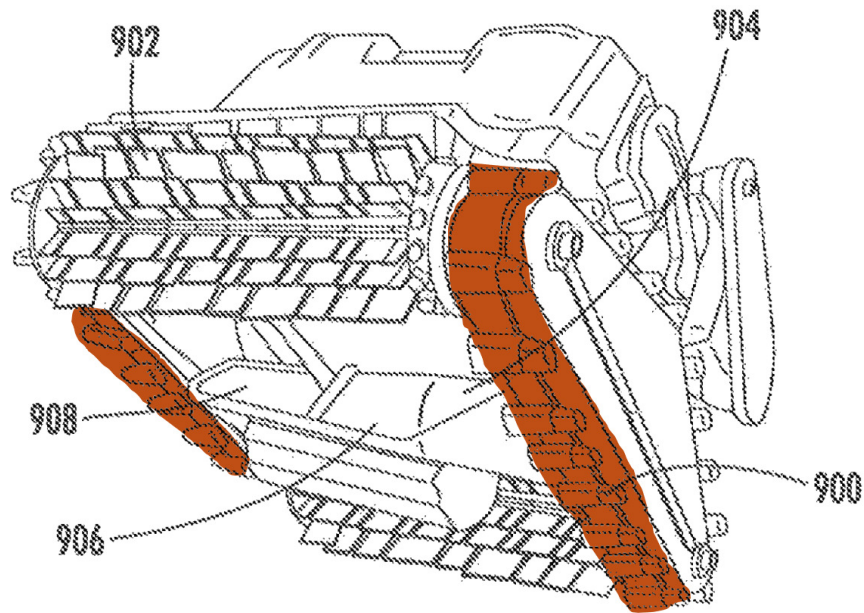


FIG. 10

IV. SPECIFIC GROUNDS

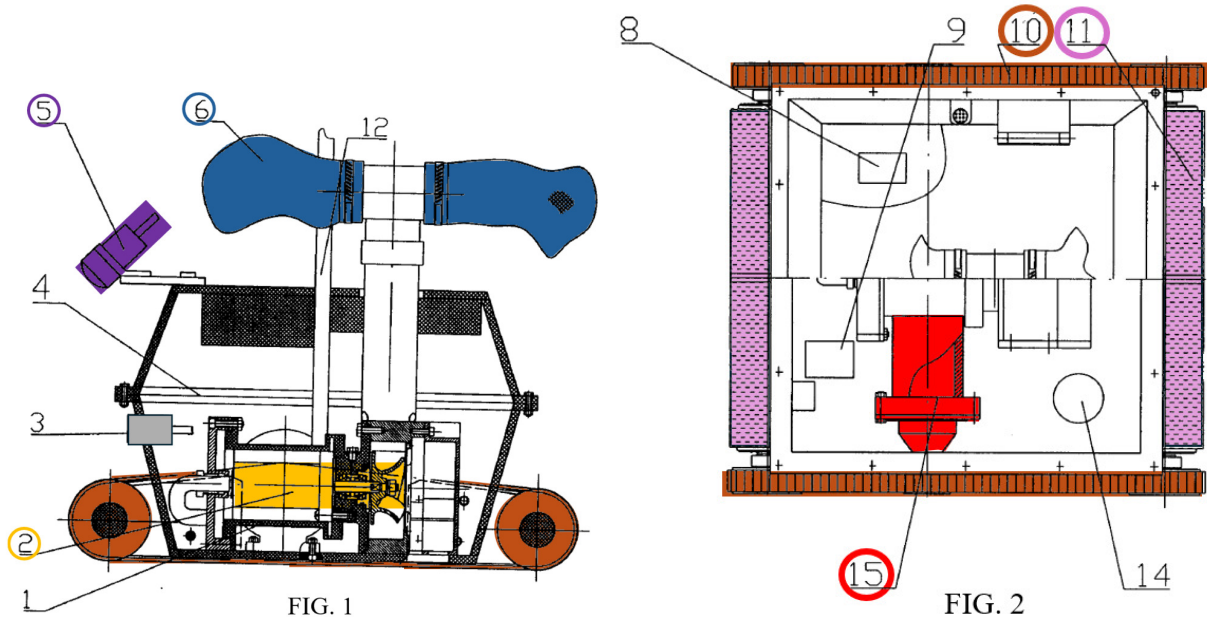
A. Ground 1A: Claims 1-3, 5-8, 12-14, and 19 are unpatentable over Cui

1. Cui

Cui (EX1005), which is analogous art, discloses a pool cleaner with debris detection capability. Cui, Title, Abstract. Cui's pool cleaner uses a camera to capture images of pool surfaces, compares them with pre-stored images of clean surfaces,

and controls the cleaner's operation based on detected debris levels/distributions. *Id.*, Abstract, pp.5-7².

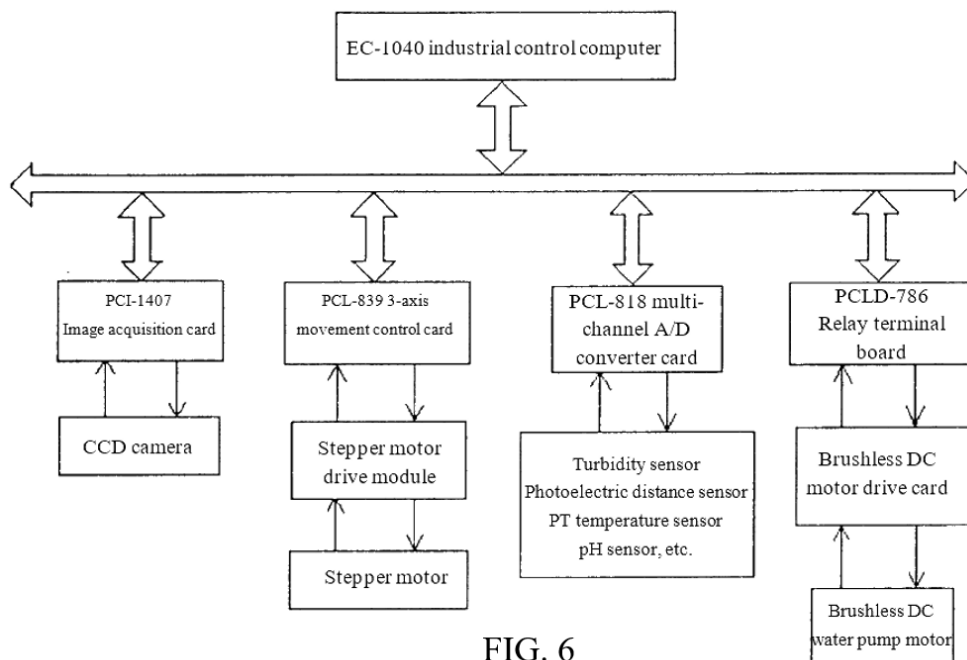
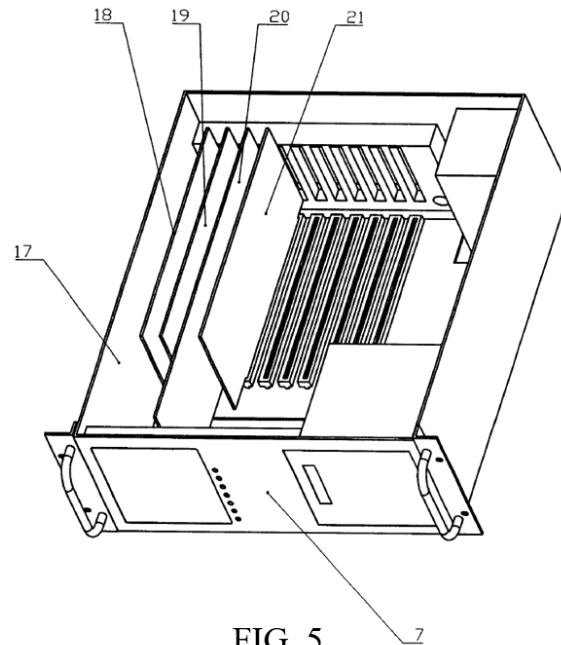
Cui's pool cleaner comprises a housing 4 containing various components including a **water pump motor 2**, a **distance sensor 3**, a **camera 5**, a **filter bag 6**, a computer 7, sensors 8-9, a **track-type crawling mechanisms 10**, **brushes 11**, and **motors 15**. Cui, Claim 1, pp.4-5, FIGS. 1-2 (annotated below).



Cui's computer 7 processes images and generates control signals that adjust the crawling speed based on detected debris levels/distributions. Cui, pp.4-7, FIGS.

² Page citations to Cui are to the original pagination in the bottom center of each page.

5-6 (below). Greater sediment/debris levels produce larger grayscale differences, causing computer 7 to adjust speed of motors 15 via relay board 20, controlling crawling speed and cleaning force. *Id.*



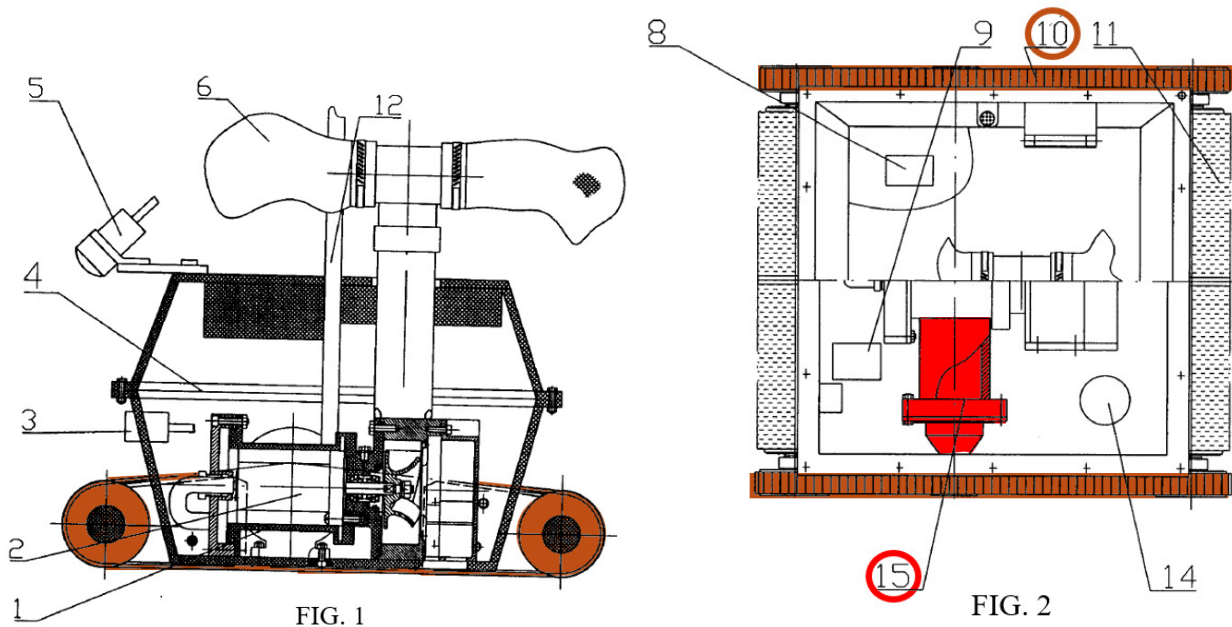
2. Claim 1

Cui discloses or suggests Claim 1. Janét, ¶¶74-100.

a. 1[pre]

Cui discloses or suggests 1[pre]. Janét, ¶¶75-78.

Cui discloses a system designed for pools, including an underwater cleaning vehicle with a **track-type crawling mechanisms 10** powered by a **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).



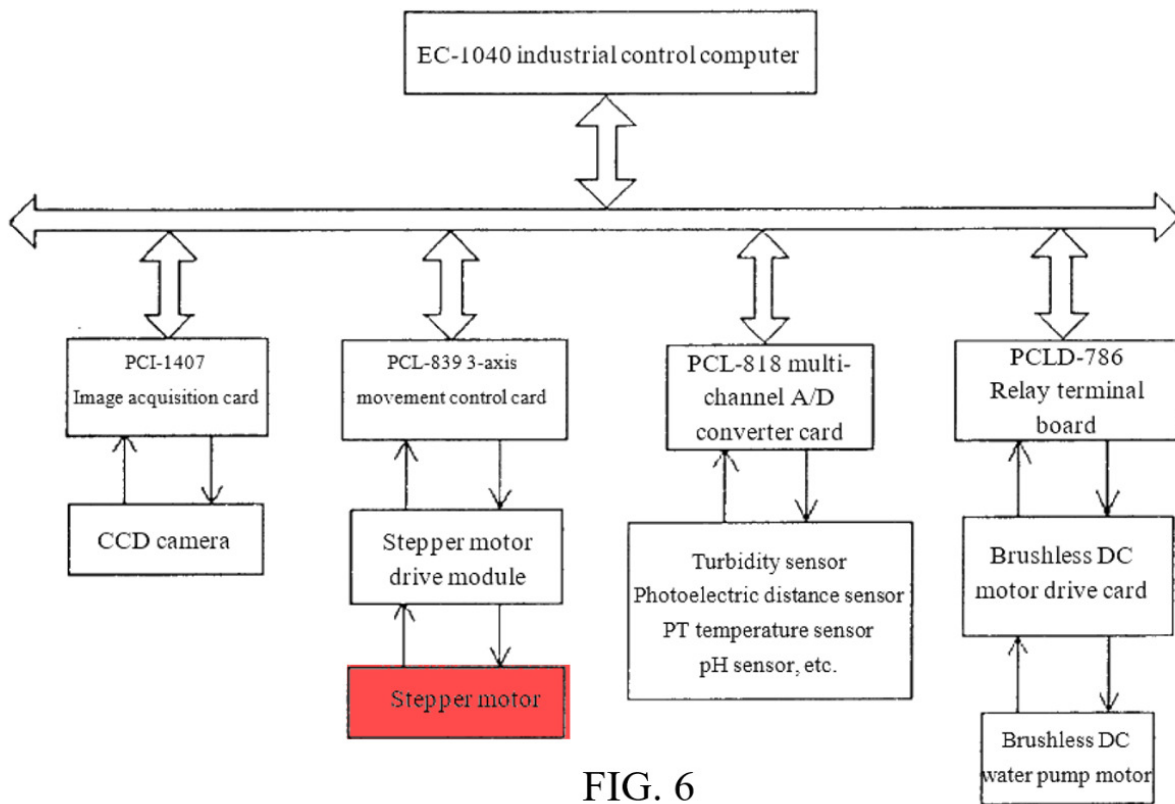


FIG. 6

Cui's cleaning vehicle is self-propelled, because under computer 7's control, motors 15 drive crawling mechanisms 10 to move it across pool surfaces. Cui, Claim 1, pp.5-6. Janét, ¶¶77.

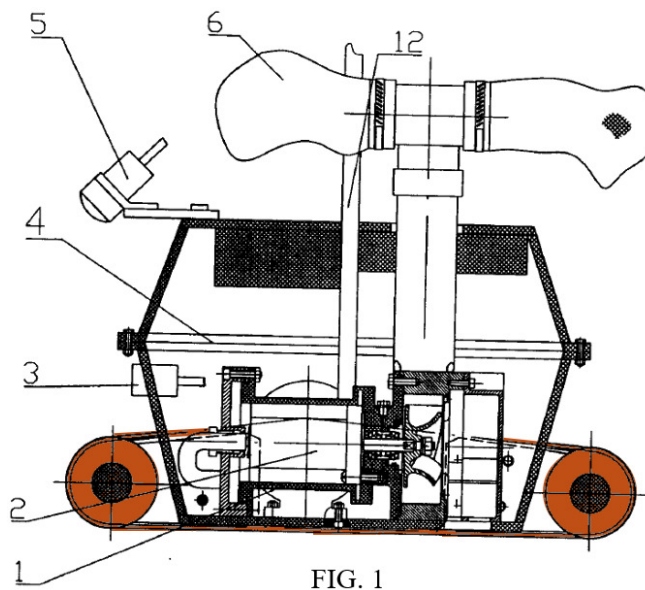
Cui's system detects debris by capturing images with camera 5 and comparing them (via computer 7) with "pre-stored standard image information of a clean pool bottom"—"when there is a lot of sediment at the pool bottom, the grayscale level of the real-time captured image(s) is greatly different from the grayscale level of the original standard image(s)." Cui, Abstract, pp.4-7. Cui's system collects and cleans

debris using “roller brush (11),” “water pump motor (2),” and “filter bag (6).” Cui, Claim 1, pp.5-7; Janét, ¶¶78.

b. 1[a]

Cui discloses or suggests 1[a]. Janét, ¶¶79-80.

Cui’s pool cleaner includes a vehicle body, including housing 4 with 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); Janét, ¶¶80.



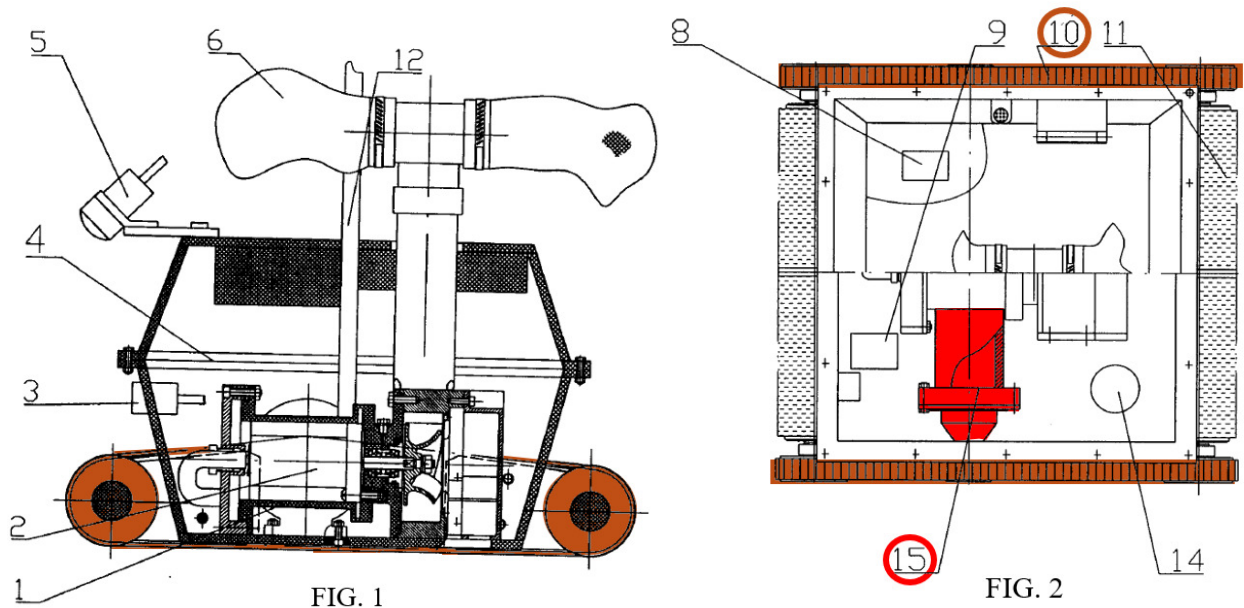
c. 1[b]

Cui discloses or suggests 1[b]. Janét, ¶¶81-84.

Limitation 1[b] invokes §112(f)/¶6. As explained in §III.D, the recited function is “moving the vehicle body within the swimming pool,” and the

corresponding structures include “wheels, rollers, tracks, other surface contacting members powered by a motor.” EX1001, 3:33-45, 10:15-17, FIGS.9-10; Janét, ¶82.

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. *Id.*; Janét, ¶83.

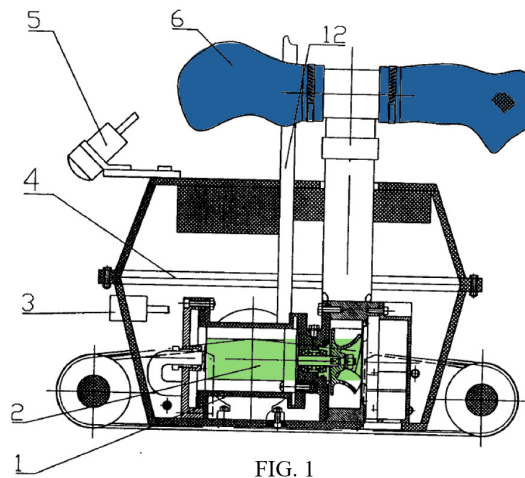


A POSITA would have understood that Cui’s **track-type** crawling mechanisms 10 powered by motors 15 are substantially the same as the ’207 Patent’s disclosed “**tracks**...powered by a motor.” Janét, ¶84. Cui’s structure performs the claimed function, because motors 15 drive track-type crawling mechanisms 10, which propel the vehicle body within the pool. Cui, pp.5-7, FIGS. 1-3; EX1001, 3:33-45; Janét, ¶84.

d. 1[c]

Cui discloses or suggests 1[c]. Janét, ¶¶85-86.

Cui's system includes **filter bag 6** and **water pump motor 2**. Cui, Claim 1, p.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. Janét, ¶86. Thus, Cui's filter bag 6 is a filter that retains debris collected from the submerged surface. *Id.*



e. 1[d]

Cui discloses or suggests 1[d]. Janét, ¶¶87-90.

Cui's pool cleaner includes **camera 5** positioned at the upper front end of housing 4 to observe pool surfaces ahead of the cleaner. Cui, Claim 2, FIG.1 (annotated below), pp.5-6; Janét, ¶¶88.

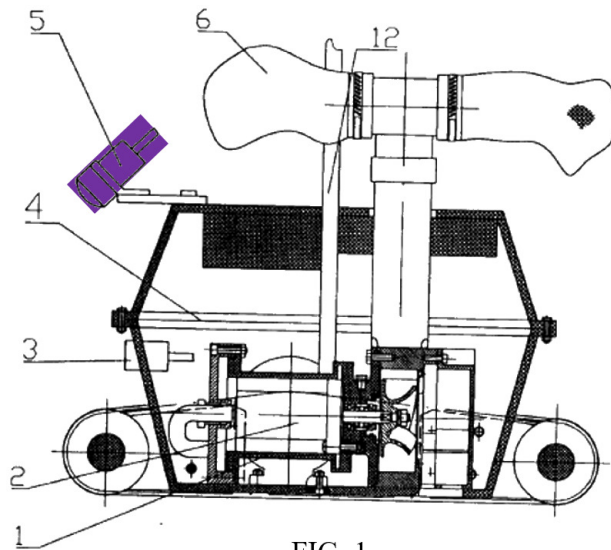


FIG. 1

Cui's camera "continuously captures images of areas to be cleaned located directly in front and below a crawling direction of the cleaner," including images showing "sediment **at the pool bottom.**" Cui, pp.6-7; Janét, ¶¶89.

A POSITA would have understood that Cui's camera captures images of "at least a first object within the swimming pool" because the camera observes the pool bottom surface and debris/sediment on that surface (both are physical objects within the pool), and these surfaces and debris are within the swimming pool as the cleaner operates while submerged. Janét, ¶¶90.

f. 1[e][i]

Cui discloses or suggests 1[e][i]. Janét, ¶¶91-94.

Cui's FIGS. 5-6 (annotated below) shows computer 7 (controller) connected to **camera 5** through **image acquisition card 21**. Cui, p.6, FIGS. 5-6.

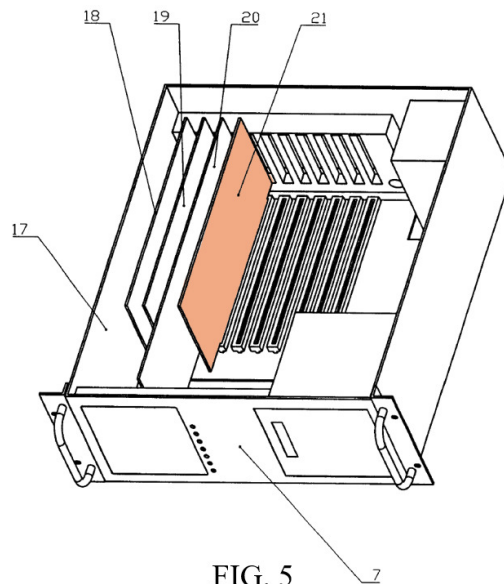


FIG. 5

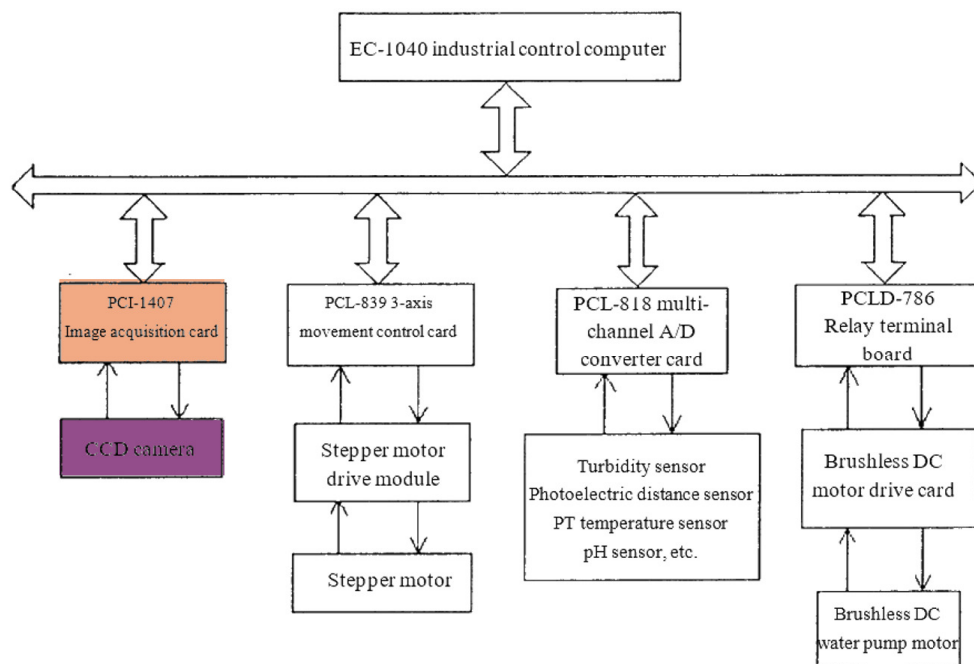


FIG. 6

Cui's camera 5 captures images of pool surfaces and debris. Cui, pp.6-7; Janét, ¶93. Cui's computer 7 processes these captured images. *Id.* Specifically, Cui describes that during operation, "the video signal undergoes A/D conversion through the high-speed image acquisition card 21 and...is compared with the original

standard image(s) of the pool bottom stored in the industrial control computer 7.” Cui, pp.6-7; Janét, ¶93. Computer 7 processes the camera images to determine debris levels and generates control signals for the vehicle’s motors. *Id.* A POSITA would have understood that Cui’s computer 7 is “in electronic communication with” camera 5, because it receives camera images (via image acquisition card 21) to process them and determine debris levels. *Id.*

g. 1[e][ii]

Cui discloses or suggests 1[e][ii]. Janét, ¶¶95-99.

As explained in §IV.A.2.f (1[e][i]), Cui’s computer 7 (controller) processes images from camera 5 and generates control signals in response to the images. Specifically, Cui describes that computer 7 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 from the grayscale level of the original standard image(s), resulting in a high comparison output voltage.” Cui, pp.6-7; Janét, ¶96. Based on this image-derived voltage signal corresponding to debris levels, “[a] pulse signal command output after processing goes through the relay terminal board 20 to separately control the drive of the two hybrid stepper motors 15.” *Id.* These are “control signal[s]” generated “in response to the captured image.” *Id.*

As explained in §IV.A.2.c (1[b]), motors 15 drive track-type crawling mechanisms 10 that move the vehicle body. Janét, ¶¶97. The control signals adjust motor speed, thereby controlling movement. Cui, Abstract, pp.6-7; Janét, ¶¶97.

Cui's control signals cause movement "to...the first object." Janét, ¶¶98. As explained in §IV.A.2.e (1[d]), the "first object" includes debris or an area on a pool surface. *Id.* Camera 5 captures images "of the areas to be cleaned located directly in front and below the crawling direction of the cleaner." Cui, Abstract, pp.5-7; Janét, ¶¶98. These are images of debris ahead of the cleaner. *Id.* When the controller generates control signals adjusting movement speed based on detected debris in an area of a pool surface in these forward-looking images, the robot continues moving forward toward the detected debris location—i.e., the control signals cause movement "to" the first object (debris or area of a pool surface). *Id.*

The claim limitation uses the disjunctive "or" between "to" and "away from," meaning the limitation is satisfied by teaching either alternative. Because Cui teaches control signals that cause movement "to" the first object, Cui discloses or suggests this element. Janét, ¶¶99.

3. Claim 2

Cui discloses or suggests Claim 2. Janét, ¶¶100-115.

a. 2[pre]

Cui discloses or suggests 2[pre]. Janét, ¶¶101-102.

Cui discloses a pool cleaning system designed for “professional or commercial swimming pools” comprising an underwater cleaning vehicle with camera 5, computer 7, sensors, motors, and cleaning mechanisms operating within a swimming pool. Cui, Title, Abstract, Claim 1, pp.5-7, FIGS. 1-6; Janét, ¶102; *see also* §IV.A.2.a (1[pre]).

b. 2[a]

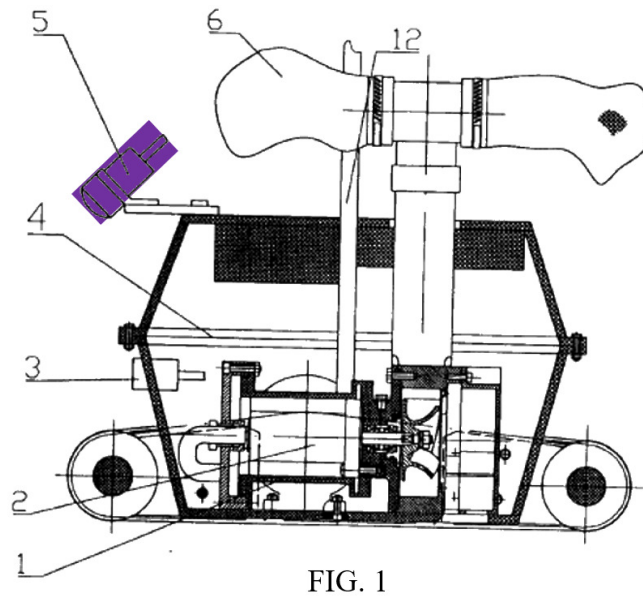
Cui discloses or suggests 2[a]. Janét, ¶¶103-104.

Cui discloses a piece of equipment for a swimming pool in the form of the pool cleaner, which is designed for “professional or commercial swimming pools” and includes camera 5, motors, filter bag 6, roller brushes 11, and other cleaning components operating within the swimming pool. Cui, Title, Abstract, Claim 1, pp.5-7, FIGS.1-3; Janét, ¶104; §IV.A.2.a (1[pre]).

c. 2[b]

Cui discloses or suggests 2[b]. Janét, ¶¶105-107.

Cui’s pool cleaner includes camera 5, which “continuously captures images of areas to be cleaned located directly in front and below a crawling direction of the cleaner.” Cui, p.5, FIGs.1 (annotated below), 3; Janét, ¶106; §IV.A.2.e (1[d]).

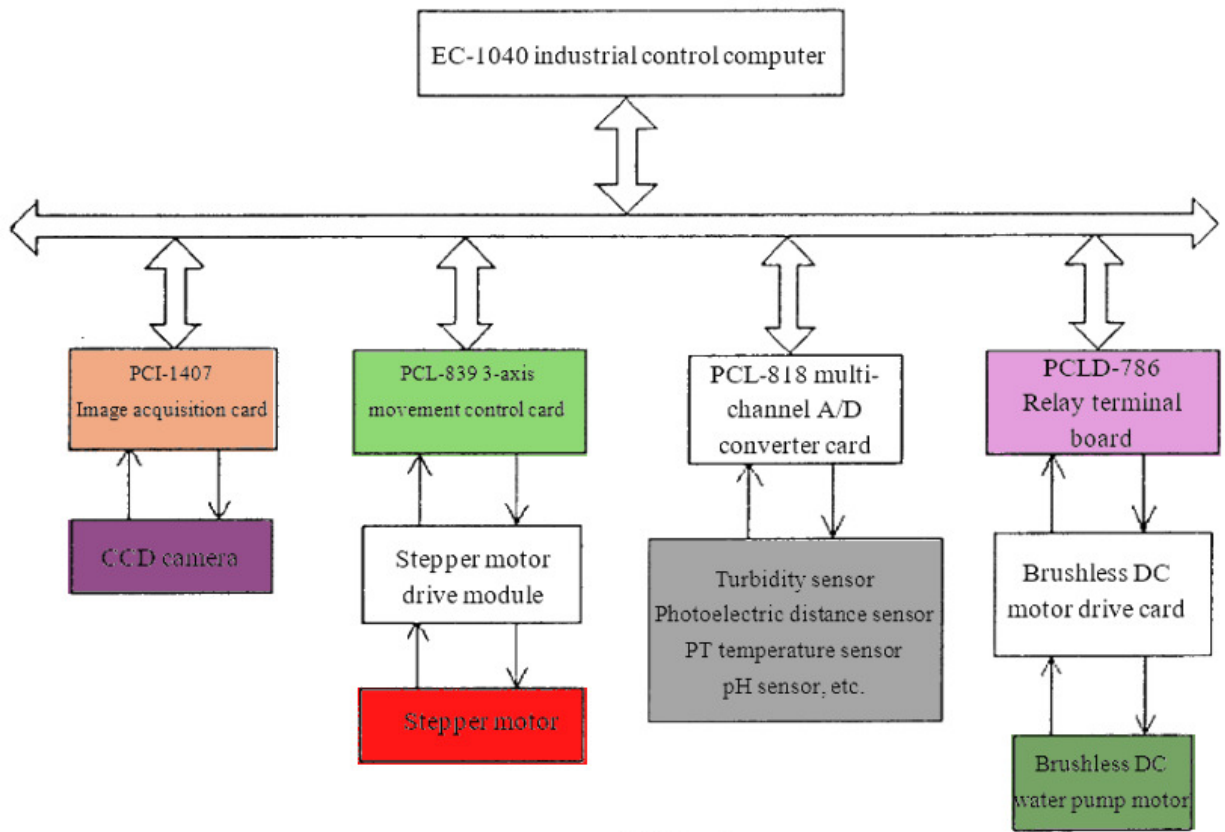
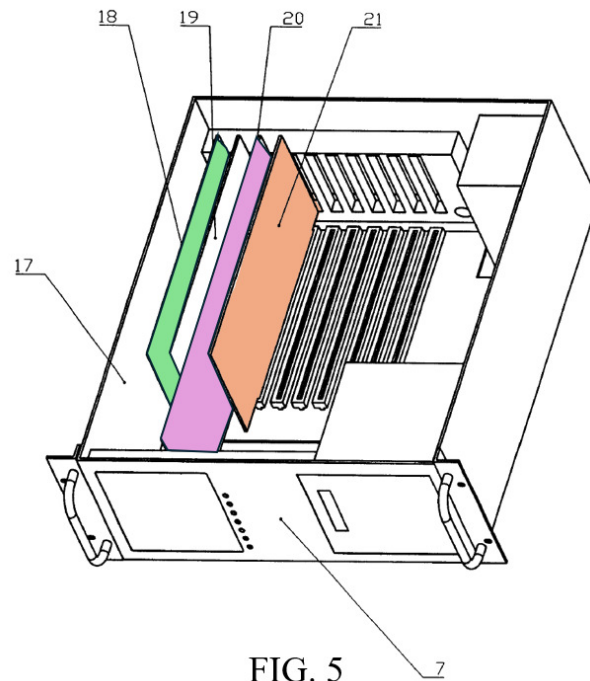


A POSITA would have understood that these “areas to be cleaned” on the pool bottom constitute “a portion of a location including the swimming pool” because the pool bottom is a physical surface within the “swimming pool.” Janét, ¶107.

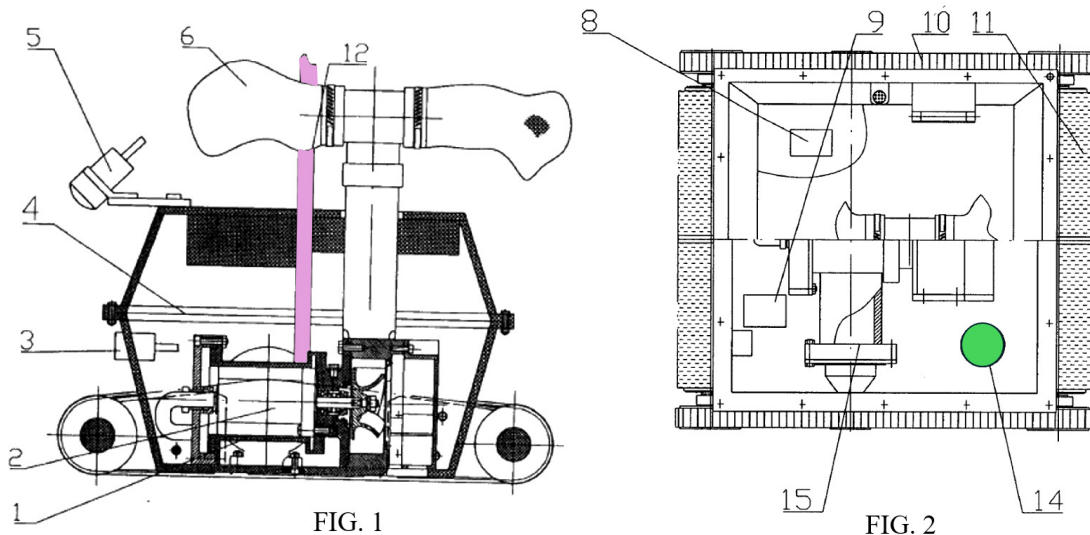
d. 2[c][i]

Cui discloses or suggests 2[c][i]. Janét, ¶¶108-111.

Cui’s FIGS. 5-6 (annotated below) shows industrial control computer 7 (controller) connected to pool cleaner components, including **CCD camera 5**, **stepper motors 15**, sensors, and **brushless DC water pump motor 2**, via interface cards including **image acquisition card 21**, **relay terminal board 20**, and **three-axis stepper motor control card 18**. Cui, pp.5-6, FIGS. 5-6.



Cui's 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); Janét, ¶110. Computer 7 is in communication with the pool cleaner (the equipment; *see* §IV.A.3.b) also because computer 7 controls the cleaner's motors based on processed sensor data—"a pulse signal command output after processing ...to separately control the drive of the two hybrid stepper motors 15." Cui, pp.6-7; Janét, ¶110.



Computer 7 is in electronic communication with camera 5, because it receives and processes camera images through image acquisition card 21. Cui, pp.4-7, Claim 3; Janét, ¶111; *see also* §IV.A.2.f (1[e][i]).

e. 2[c][ii]

Cui discloses or suggests 2[c][ii]. Janét, ¶¶112-114.

Specifically, Cui's computer 7 (controller) receives images (visual data) from camera 5 through image acquisition card 21. Cui, pp.4-5, FIGS. 5-6; Janét, ¶113; *see also* in §IV.A.2.f (1[e][i]), §IV.A.3.d (2[c][i]). Then, Cui's computer 7 processes the images (visual data) to determine debris levels—"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), resulting in a high comparison output voltage." Cui, pp.6-7; Janét, ¶113; *see also* §IV.A.2.g (1[e][ii]).

Based on the received visual data, Cui's controller 7 determines a control action for the pool cleaner (equipment), e.g., adjustment of the cleaner's motor/crawling speed. Cui, pp.6-7; Janét, ¶114; *see also* §IV.A.2.g (1[e][ii]).

4. Claim 3

Claim 3 depends from Claim 2. Cui discloses or suggests Claim 3. Janét, ¶¶116-119.

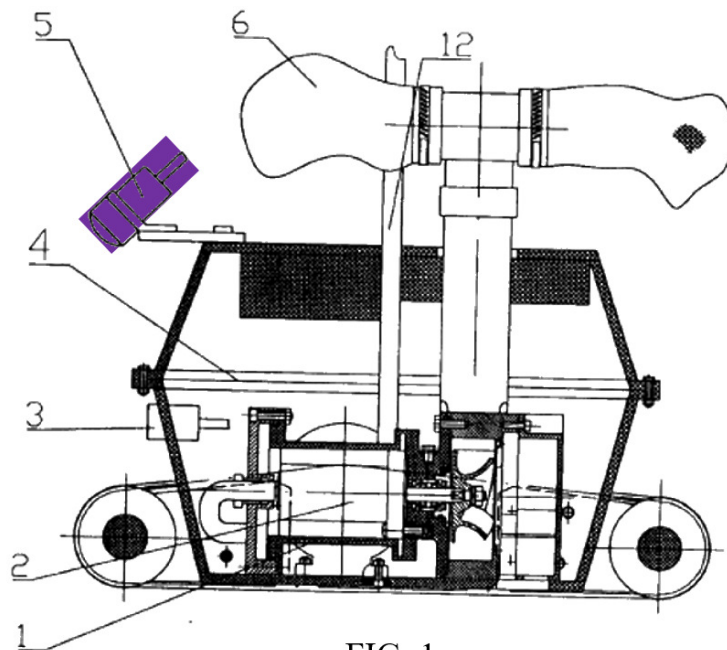
Cui's pool cleaner (equipment) is a cleaning device that includes track-type crawling mechanisms 10 and hybrid stepper motors 15 (propulsion mechanisms), roller brushes 11, water pump motor 2, and filter bag 6 for cleaning operations. Cui, Title, Claim 1, pp.4-6; Janét, ¶117; *see also* §IV.A.3.b (2[a]).

A POSITA would have understood that Cui's pool cleaner is "configured to travel adjacent to submerged or water-containing surfaces and to perform a cleaning operation" because it travels on pool bottoms and walls, and removes debris from pool surfaces as it travels, and these surfaces are submerged when the pool is filled with water. Janét, ¶¶118-119; *see also* §IV.A.2.a (1[pre]), §IV.A.3.b (2[a]).

5. Claim 5

Claim 5 depends from Claim 2. Cui discloses or suggests Claim 5. Janét, ¶¶120-123.

Cui describes that its **camera 5** is "mounted at the upper front end of the housing 4" of the cleaner (equipment). Cui, pp.5-6, FIG.1 (annotated below); Janét, ¶¶121-122.



Because camera 5 is mounted on housing 4 (part of the pool cleaner), camera 5 is mounted on the equipment as claimed. Cui, pp.5-6, Claim 1, FIG.1; Janét, ¶122.

6. Claim 6

Claim 6 depends from Claim 2. Cui discloses or suggests Claim 6. Janét, ¶¶124-126.

Cui's pool cleaner operates within filled pools to clean pool surfaces. Cui, Claim 1, p.7; Janét, ¶125; *see also* §IV.A.2.a (1[pre]). Cui's camera 5 is mounted on the pool cleaner. Cui, pp.5-6; FIG.1, Janét, ¶125; *see also* §IV.A.5 (Claim 5). Therefore, a POSITA would have understood that camera 5 is “submergible or submerged within the swimming pool” because it is mounted on the pool cleaner that operates submerged within the swimming pool. Janét, ¶125.

7. Claim 7

Claim 7 depends from Claim 2. Cui discloses or suggests Claim 7. Janét, ¶¶127-129.

Cui's computer 7 (controller) processes images to detect debris level/distribution on the pool area to be cleaned, and control the cleaner (equipment), e.g., its moving speed, based on detected debris level/distribution. Cui, pp.5-7, FIGS. 5-6; Janét, ¶128; *see also* §IV.A.3.e (2[c][ii]). A POSITA would have understood this debris level/distribution is a “characteristic of the location” because it describes the physical state—i.e., the cleanliness—of that pool area. Janét, ¶128.

8. Claim 8

Claim 8 depends from Claim 7, which depends from Claim 2. Cui discloses or suggests Claim 8. Janét, ¶¶130-135.

a. 8[a]

Cui discloses or suggests 8[a]. Janét, ¶¶130-131. Cui’s computer 7 (controller) detects debris level/distribution (characteristic) on pool surfaces by comparing captured images with stored “clean surface” standard images. Cui, pp.5-7; Janét, ¶131; *see also* §IV.A.7 (Claim 7). A POSITA would have understood that debris levels indicate pool surface cleanliness—heavy debris indicates less clean surfaces, and minimal debris indicates cleaner surfaces. Janét, ¶131.

b. 8[b]

Cui discloses or suggests 8[b]. Janét, ¶¶132-135.

Cui’s computer 7 (controller) compares captured images with stored “clean surface” images and adjusts motor speeds when detected cleanliness differs from that standard—“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)**, resulting in a high comparison output voltage” that controls motor speeds. Cui, pp.5-7; Janét, ¶133; *see also* §IV.A.3.e (2[c][ii]). A POSITA would have understood that Cui’s “pre-stored standard image information of a clean pool bottom” constitutes a “cleanliness threshold,” because it represents

the baseline of “cleanliness” against which the current state is measured. Cui, pp.5-7; Janét, ¶133.

Furthermore, a POSITA would have understood that Cui’s system determines that the cleanliness is “outside of a threshold” when the real-time image deviates from this standard image (i.e., “greatly different”). Cui’s control action (adjusting motor speed) is triggered specifically because the detected cleanliness level has deviated from (i.e., outside) the standard defined by the stored image. Janét, ¶134. Accordingly, Cui’s system controls the equipment based on the deviation from the standard (the threshold), thus satisfying the limitation. *Id.*, ¶¶134-135.

9. Claim 12

Cui discloses or suggests Claim 12. Janét, ¶¶136-146.

a. 12[pre]

Cui discloses or suggests 12[pre]. Janét, ¶¶137-138.

Cui discloses “a pool system” that includes a pool cleaner and computer 7. Cui, pp.5-7, FIGS. 5-6; Janét, ¶138; *see also* §IV.A.3.a (2[a]). A POSITA would have understood that Cui’s method, including, among others, capturing images, detecting debris based on the images, and controlling cleaner movements based on detected debris constitutes “monitoring a pool system.” *Id.*

b. 12[a]

Cui discloses or suggests 12[a]. Janét, ¶¶139-140.

Cui discloses that camera 5 captures images of pool surfaces ahead of the cleaner, and computer 7 receives the video signals (comprising multiple images captured over time) from camera 5 through image acquisition card 21 for processing. Cui, Abstract, Claim 3, pp.5-7; Janét, ¶138; *see also* §§IV.A.3.c-IV.A.3.d (2[b]-[c][i]).

c. 12[b]

Cui discloses or suggests 12[b]. Janét, ¶¶141-142.

Cui's method includes its computer 7 (controller) receiving images from camera 5, detecting debris level (characteristic) of an area based on the images, and adjusting the cleaner's crawling speed in that specific area based on the detected characteristic. Cui, pp.4-7, FIGS. 5-6; Janét, ¶142; *see also* §§IV.A.2.e-IV.A.2.g (1[d]-1[e][ii]), §§IV.A.7-IV.A.8 (Claims 7-8). Because Cui system's control action (adjusting the speed) is applied to a specific area in response to the debris detected in that same area, a POSITA would have understood or found it obvious that Cui's system determines the area, from which the images are captured, and in which the movement control will be applied, as a target area (e.g., a target area for application of updated movement controls). Janét, ¶142.

d. 12[c]

Cui discloses or suggests 12[c]. Janét, ¶¶143-146.

Cui's computer 7 assesses debris levels and generates pulse signal commands that control motor speeds to adjust cleaning force—"a corresponding cleaning force can be selected according to a varying distribution of debris on the pool bottom." Cui, Abstract, p.5; Janét, ¶144; *see also* §§IV.A.3.e&IV.A.7 (2[c])[ii], Claim 7).

A POSITA would have understood that Cui's pulse signal commands constitute "a control response" generated "based on the detected characteristic" (debris level or cleanliness) of the target area. Janét, ¶145.

10. Claim 13

Claim 13 depends from Claim 12. Cui discloses or suggests Claim 13. Janét, ¶¶147-152.

a. 13[a]

Cui discloses or suggests 13[a]. Janét, ¶¶148-149.

Cui's target area is the specific area of the pool surface which computer 7 determines contains debris. Cui, pp.6-7; Janét, ¶149; *see also* §IV.A.9.b-IV.A.9.d (12[b]-[c]).

b. 13[b]

Cui discloses or suggests 13[b]. Janét, ¶¶150-151.

Cui's computer 7 detects debris level (cleanliness characteristic) of the target area, which is a "portion of the pool surface." Cui, pp.5-7; Janét, ¶151; *see also* §§IV.A.7-IV.A.8.a (Claim 7, 8[a]).

11. Claim 14

Claim 14 depends from Claim 12. Cui discloses or suggests Claim 14, because Cui's computer 7 generates pulse signal commands (control response) that control movement (operation) of a pool cleaner (equipment of the swimming pool). Cui, pp.5-7; Janét, ¶¶153-154; §IV.A.9.d (12[c]), §IV.A.3.b (2[a]).

12. Claim 19

Claim 19 depends from Claim 12. Cui discloses or suggests Claim 19. Janét, ¶¶155-160.

a. 19[a]

Cui discloses or suggests 19[a], because Cui's system generates pulse signal commands (control response) that controls motors and movement (operation) of the pool cleaner (equipment). Cui, pp.6-7; Janét, ¶156; *see also* §§IV.A.9.d (12[c]), IV.A.11 (Claim 14). Cui's pool cleaner is configured to travel adjacent to a bottom of (submerged or water-containing surfaces) of the swimming pool and performs a cleaning operation. Cui, pp.5-7; Janét, ¶156; *see also* §§IV.A.2.a (1[pre]), IV.A.4 (Claim 3), IV.A.6 (Claim 6).

b. 19[b]

Cui discloses or suggests 19[b]. Janét, ¶¶157-160.

Cui's system generates pulse signal commands (control responses) that control rotational speed of hybrid stepper motors 15, which a POSITA would have

understood controls “the crawling speed of the cleaner” (speed of the cleaning device). Cui, p.7; Janét, ¶158; *see also* §IV.A.9.d (12[c]). Cui teaches that “the crawling speed of the cleaner indirectly reflects the magnitude of the cleaning force.” Cui, pp.6-7, FIG.7. Although stated in the context of Cui’s turbidity-based embodiment, Cui further explains the relationship: when “the crawling speed of the cleaner slows down...the cleaning force increases.” Cui, Abstract, p.9, FIG.7; Janét, ¶158. A POSITA would have understood this relationship between crawling speed and cleaning force to apply equally to Cui’s image-based debris detection embodiment, as both embodiments use the same mechanical cleaning components (roller brushes 11, track-type crawling mechanisms 10) and both aim to achieve “different cleaning forces” corresponding to “different distributions of debris.” Cui, Abstract, pp.4-5, 7; Janét, ¶158.

Additionally, Cui describes directional control enabling the cleaner to “move forward, backward, or turn left and right” and execute “180° turns” near pool walls “until the entire pool is cleaned,” which constitutes controlling the cleaner’s path. Cui, p.7; Janét, ¶159.

B. Ground 1B: Claims 8 and 16 are Unpatentable over Cui and Fu-007

1. Fu-007

Fu-007 (EX1007), which is analogue art and in the same field as the '207 Patent, discloses an underwater cleaning robot for swimming pools that operates in remote control and autonomous modes. Fu-007, Title, Abstract; Janét, ¶161.

Fu-007's system includes **monitoring camera 2** and central processing unit (controller) housed in **control system enclosure 8**, and cleaning and moving platform with **cleaning drive wheels 3** and drainage devices. Fu-007, pp.12-14,³ Claims 1, 3, FIGS. 1-3 (annotated below); Janét, ¶162.

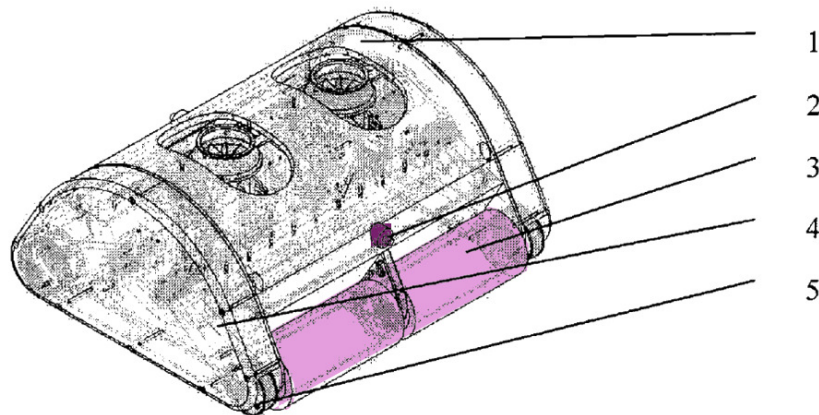
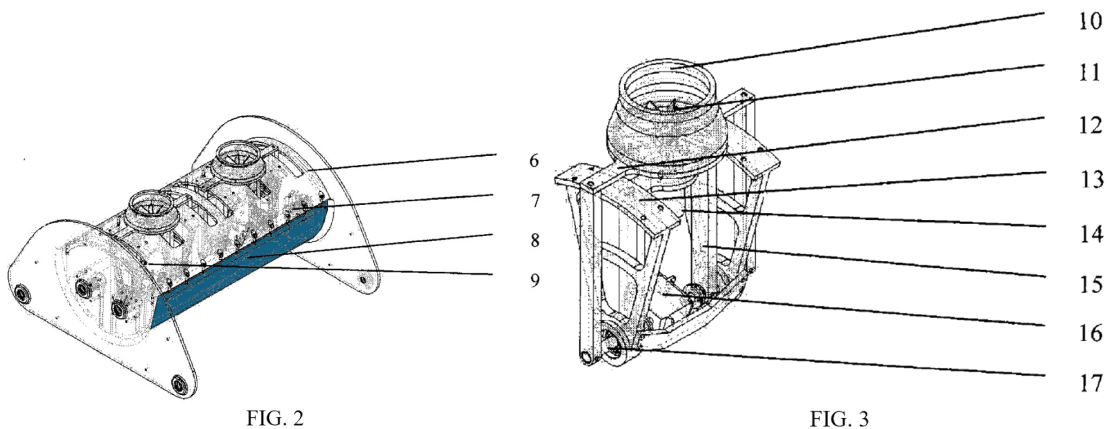


FIG. 1

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



Fu-007's central processing unit compares the images captured by camera 2 with a "cleanliness image threshold" to determine cleanliness level, and operates cleaning drive wheels and drainage device accordingly. Fu-007, pp.14-16, Claims 4, 7; Janét, ¶163.

Fu-007 also teaches wireless communication capability through a control signal 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.8-10, 12-16, Claims 4-5, 7, FIG. 8 (annotated below); Janét, ¶164. Fu-007 teaches controlling the robot "with the cable" for "long-term global cleaning" and using the "control signal buoyant antenna 27" to "wirelessly communicate" for "short-term local cleaning." Fu-007, pp.9-10, 14, Claim 5; Janét, ¶164.

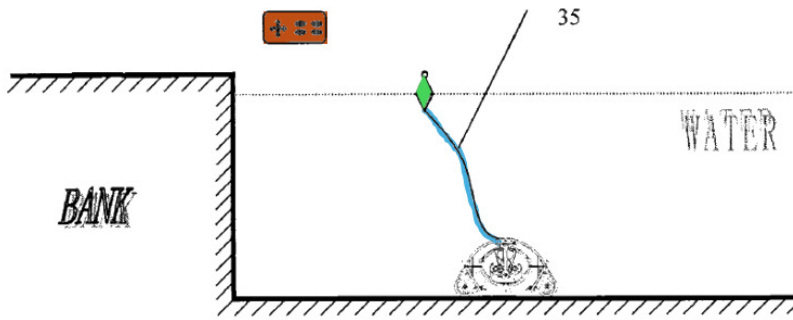


FIG. 8

2. Motivation to Combine

Both Cui and Fu-007 disclose underwater cleaning robots for swimming pools using camera-based control, and both sought to improve autonomous pool cleaning operations. Janét, ¶165. Cui describes a pool cleaner using “intelligent adaptive technology with computer control” to autonomously adjust cleaning force based on debris distribution. Cui, pp.5-7. Fu-007 similarly describes an underwater cleaning robot. Fu-007, p.11. A POSITA would have been motivated to combine their complementary teachings to improve autonomous pool cleaning. Janét, ¶165.

A POSITA would have recognized that the teachings in Cui and Fu-007 are directed to the same pool cleaning technical field and provide similar technical solutions to address similar technical issues. Janét, ¶¶166-168. Specifically, both use a controller to generate, in response to captured images, control signals to cause movement of the pool cleaning body with motorized drive mechanisms. *Compare* Cui, pp.5-7, FIGS. 1-3, 5-7, *with* Fu-007, pp.8-10, 12-16, Claims 1-4, 7, FIGS.1, 6.

Accordingly, a POSITA would have investigated their teachings to seek guidance when designing pool cleaning systems. Janét, ¶168.

Cui teaches an image comparison approach that compares captured images with stored “clean surface” standard images to produce a comparison output voltage. Cui, pp.5-7. Fu-007 employs a threshold-based approach that sets “a swimming pool cleanliness image threshold” and “plans a cleaning movement” based on the comparison. Fu-007, pp.10, 14-16, Claim 7. Additionally, Cui teaches wired communication via cable assembly 12 (Cui, pp.5-6, FIGS. 1-3), and Fu-007 discloses both wired and wireless communication modes (Fu-007, pp.8-10, 12-16, FIG. 8). These represent known design alternatives in autonomous pool cleaning systems. Janét, ¶169.

A POSITA would have been motivated to modify Cui by incorporating Fu-007’s teachings of threshold-based control and wireless communication capacity to advance Cui’s stated goals of “intelligent adaptive technology,” “high reliability,” and “strong applicability.” Cui, Abstract, p.5; Janét, ¶170.

A POSITA would have had a reasonable expectation of success in making these modifications because both employ similar camera-based systems, and combining Fu-007’s teachings with Cui would have involved routine software and hardware modifications to Cui’s existing system, yielding predictable results. Cui, pp.5-7; Fu-007, pp.10, 12-16; Janét, ¶171.

3. Claim 8

173. Claim 8 depends from Claim 7, which depends from Claim 2. The Cui-Fu-007 combination discloses or suggests Claim 8. Janét, ¶¶172-179.

a. 8[a]

Cui discloses or suggests 8[a]. *See* §IV.A.8.a (8[a]).

b. 8[b]

To the extent that this element is found not to be taught or suggested by Cui, it is disclosed or suggested by the Cui-Fu-007 combination. Janét, ¶¶174-179.

As explained in §§IV.A.7 (Claim 7) and IV.A.8.b (8[b]), Cui discloses that its computer 7 (controller) controls the cleaner (equipment) based on the detected debris level (cleanliness).

As explained in §IV.B.1, Fu-007 teaches threshold-based cleanliness control by setting “a swimming pool cleanliness image threshold,” determining “a cleanliness level of the bottom of the swimming pool by comparing the image(s) with the threshold,” and adjusting “operating conditions of the four cleaning drive wheels...to complete the cleaning task” based on the comparison. Fu-007, pp.10, 14-16, Claim 7; Janét, ¶176.

As explained in §IV.B.2, a POSITA would be motivated to incorporate Fu-007’s cleanliness-threshold control logic into Cui’s system, such that the modified system would set “a swimming pool cleanliness image threshold,” “determine a

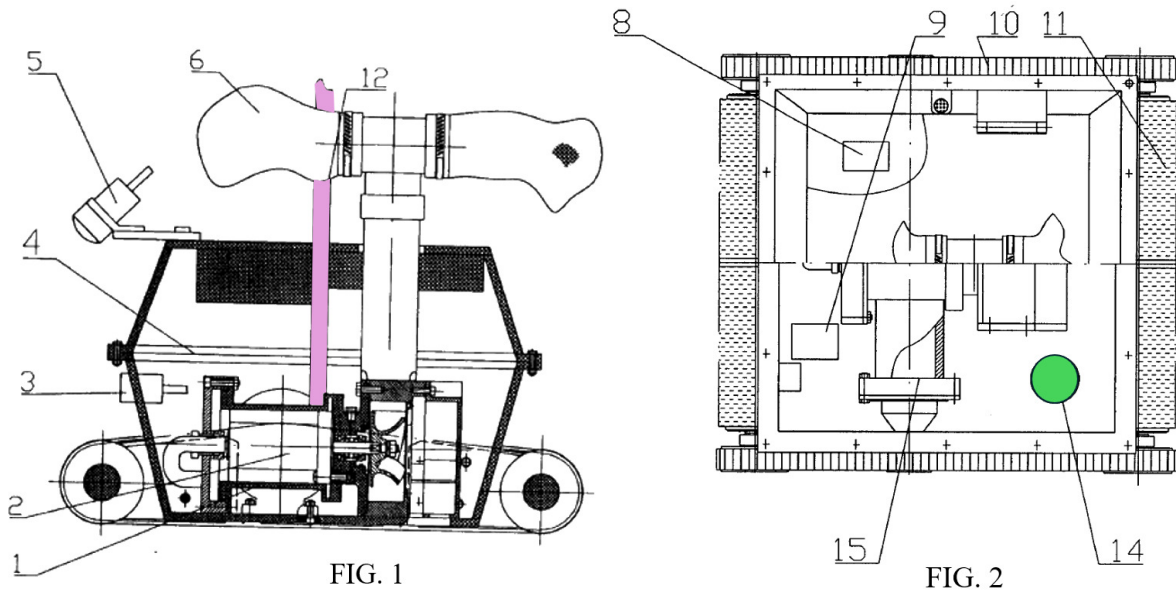
cleanliness level” from the images from Cui’s camera, and compare this “cleanliness level” to the “threshold” to “plan[] a cleaning movement.” Fu-007, pp.10, 14-16; Janét, ¶177.

179. In addition to the reasons explained in §IV.B.2, a POSITA would have recognized that Fu-007’s “threshold” comparison allows the controller to “determine[] a cleanliness level” and, as a result, “autonomously plan[]” a “path and an action.” Fu-007, pp.10, 14-16; Janét, ¶178. A POSITA would have understood this as an enhancement to move beyond Cui’s control (slowing down for debris) and implement more energy-saving cleaning plans (e.g., cleaning only the areas outside the “threshold”), resulting in a more efficient, reliable autonomous cleaner. Janét, ¶178.

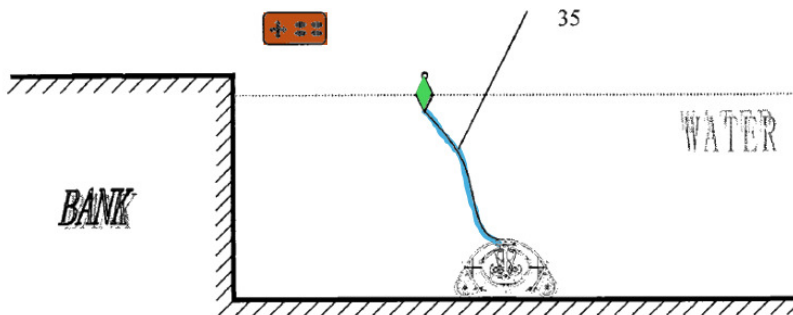
4. Claim 16

Claim 16 depends from Claim 12. The Cui-Fu-007 combination discloses or suggests Claim 16. Janét, ¶¶180-186.

Cui’s computer 7 is remote from the pool cleaner, connected via **cable assembly 12** and **plug assembly 14**. Cui, pp.5-6, FIGS. 1-2 (annotated below); Janét, ¶181; *see also* §IV.A.3.d (2[c][i]).



As explained in §IV.B.1, Fu-007 discloses a pool cleaning robot with wireless communication capability through a control signal buoyant antenna 27. Fu-007, pp.8-10, 12-16, Claims 4-5, 7, FIG. 8 (annotated below); Janét, ¶182. Fu-007 teaches controlling the robot “with the cable” for “long-term global cleaning” and using wireless communication for “short-term local cleaning.” Fu-007, pp.9-10, 14, Claim 5.



As explained in §IV.B.2, a POSITA would have been motivated to combine the teachings of Cui and Fu-007 with a reasonable expectation of success. Janét, ¶184. In the modified system, Cui's computer 7 (controller) would have dual-mode (wired and wireless) communication capability, allowing it to generate control signals and communicate them either via the existing cable assembly 12 or wirelessly via Fu-007's buoyant antenna 27 to a remote device. *Id.*

In addition to the reasons explained in §IV.B.2, a POSITA would have been motivated to make this modification because adding Fu-007's wireless communication as an alternative to Cui's wired connection would have improved Cui's stated goal of "high reliability" (Cui, Abstract, p.5) by providing a redundant communication path, allowing the cleaner to be controlled even if the primary cable connection was impractical or unavailable. Janét, ¶185.

C. Ground 1C: Claims 10 and 17 are Unpatentable over Cui and Hsu

1. Hsu

Hsu (EX1011) is analogous art to the '207 Patent because Hsu addresses autonomous robotic cleaners that display cleaning coverage for user monitoring, using cameras to detect environment conditions. Hsu, Abstract, [0018]; EX1001, Abstract, 1:26-31, 9:26-47; Janét, ¶187. Additionally, Hsu explicitly states its technology "is not limited to indoor spaces," demonstrating applicability to outdoor pool cleaning environments like Cui's system. Hsu, [0019]; Janét, ¶187.

Hsu discloses a cleaning robot that includes **environment information detection device 10**, which can be “a camera, a video camera,” and **map construction module 20** that constructs “an environment map based on the environment information detected by the environment information detection device.”
Hsu, Abstract, [0017]-[0018], [0037]-[0038], Claim 1, FIGs. 1, 5 (S12) (annotated below).

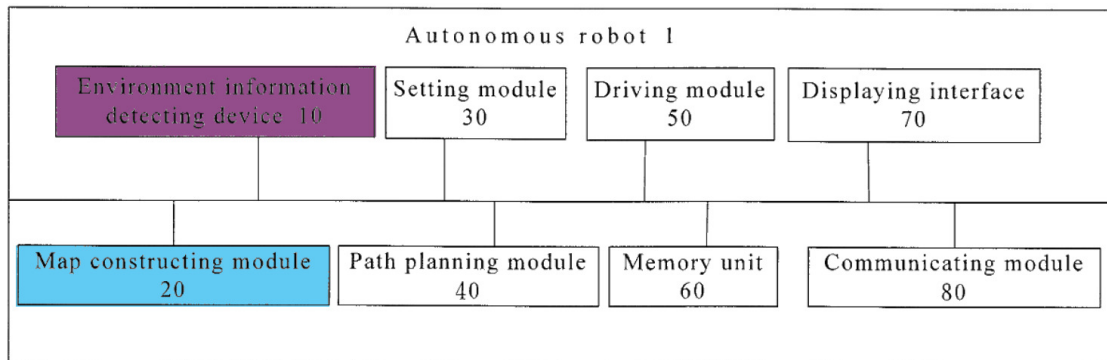


FIG. 1

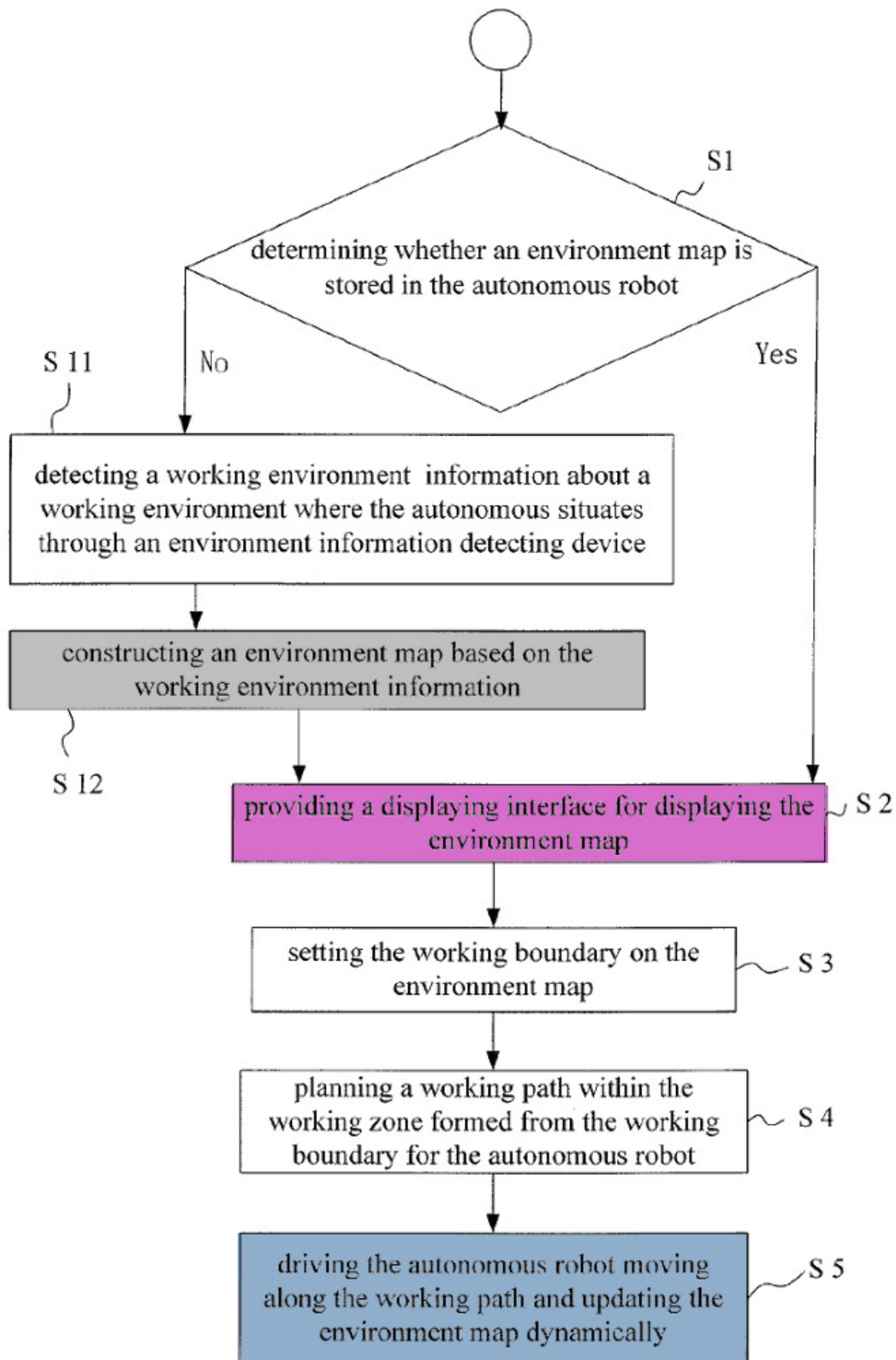


FIG. 5

Hsu's environment map 120 shows the working environment including working zones, and is "updated dynamically" based on "real-time working environment information detected by the environment information detection device" while the robot is moving, which "increase[s] the accuracy of the environment map" and allows the robot to "avoid...obstacles." Hsu, [0020], [0033]-[0034], Claims 3, 6, 8-9, 12, 15-16, FIGS. 2-3, 5 (**S5**) (annotated above).

Hsu describes "The environment map 120 can be transmitted to the display screen on an external **electronic device 130** or an **electronic device 130a** by...**autonomous robot 1** via a communication platform 110." Hsu, [0021], [0028], Claim 7, FIGS. 4-5 (**S2**) (annotated below).

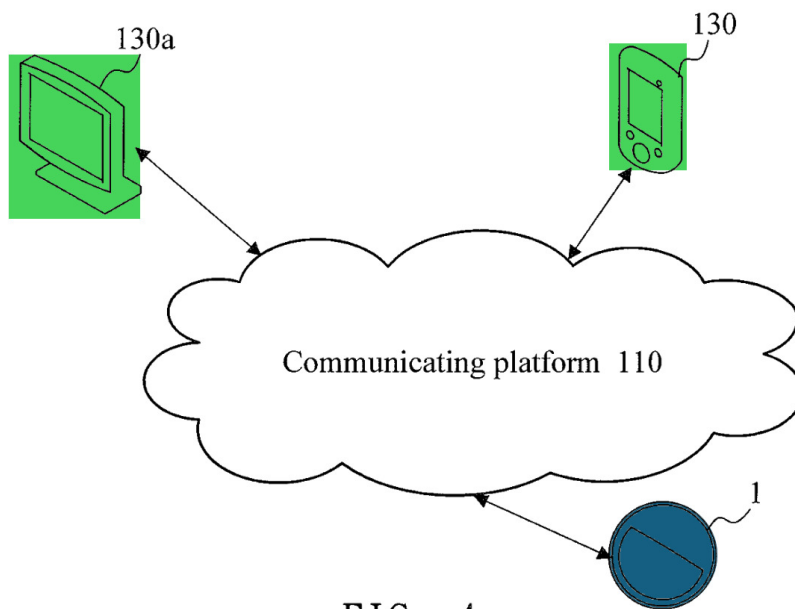


FIG. 4

2. Motivation to Combine

Both Cui and Hsu disclose autonomous cleaning robots using cameras and controllers to monitor and display cleaning progress to users. Janét, ¶191. Cui provides interface 16 so that “the working status of the cleaner can be seen at a glance.” Cui, p.6. Hsu similarly provides a display interface showing an environment map that is “updated dynamically” during cleaning operations. Hsu, [0018]-[0022], [0033]-[0034]. A POSITA would have been motivated to combine the complementary teachings of Cui and Hsu to achieve improved visual monitoring of autonomous cleaning operations. Janét, ¶191.

A POSITA would have been motivated to apply Hsu’s camera-based map construction to Cui’s system for the following reasons. First, this modification would have advanced Cui’s functionality to provide visual information to users. Janét, ¶192. Cui’s camera 5 already captures images “of the areas to be cleaned,” providing visual data showing actual surface conditions. Cui, pp.5-7. Using camera-captured visual data to construct the graphical depiction (per Hsu) would have allowed more accurate environment representation. Janét, ¶192.

Second, a POSITA would have been motivated to make such modification to enhance Cui’s “high reliability.” Cui, Abstract, p.5; Janét, ¶193. In the modified system, Cui’s camera would continuously capture images of the areas to be cleaned and provide dynamically updated visual ground truth of pool surface conditions,

thereby “increase[ing] the accuracy of the environment map.” Hsu, [0020], [0033]-[0034]; Janét, ¶193. This would use Cui’s existing camera for dual purposes: debris detection (per Cui’s existing functionality) and coverage verification (per Hsu’s functionality). Moreover, Hsu’s “real-time working environment information” would have allowed the cleaner to avoid obstacles and increase reliability. Hsu, [0020]; Janét, ¶193.

A POSITA would have reasonably expected success because Cui already has the necessary hardware—camera 5 and controller 7 with image processing and storage capabilities (Cui, pp.5-7, FIGS. 5-6), and the modification would have involved software changes to Cui’s logic to use Hsu’s camera image analysis, yielding the predictable result of camera-based coverage display. Janét, ¶194.

3. Claim 10

Claim 10 depends from Claim 2. The Cui-Hsu combination discloses or suggests Claim 10. Janét, ¶¶195-203.

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” based on a motor-tracking formula. Cui, pp.6-7, Claim 3, FIG. 4.

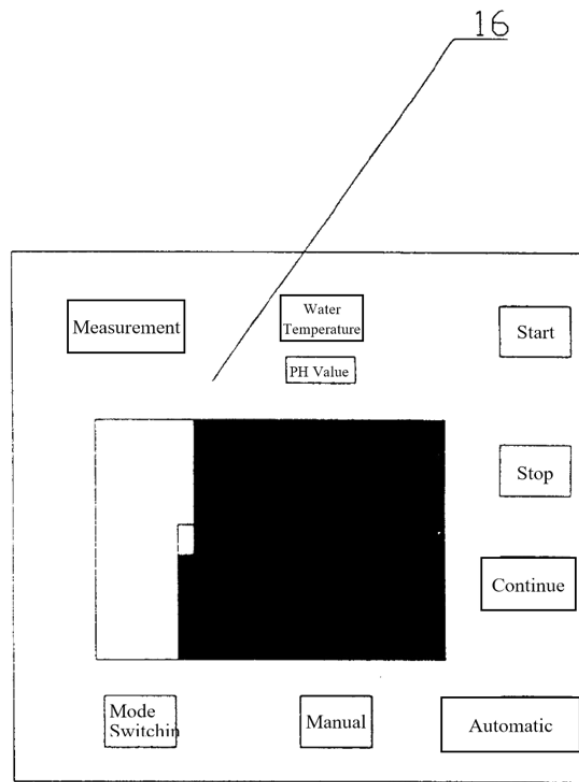
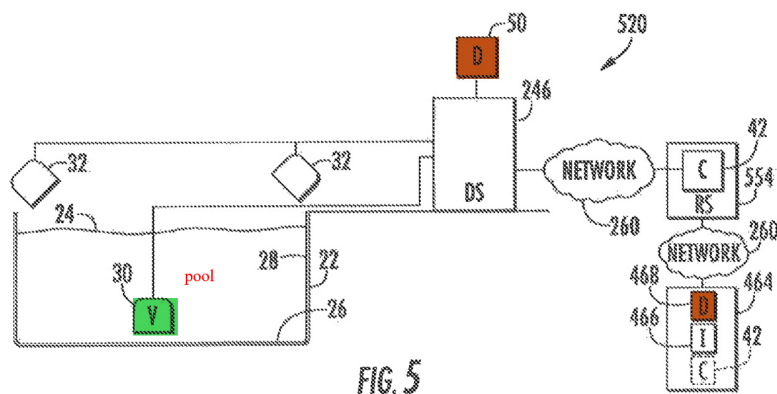
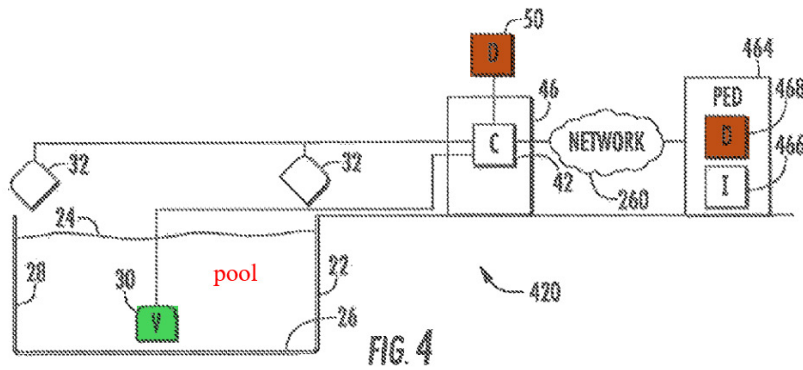
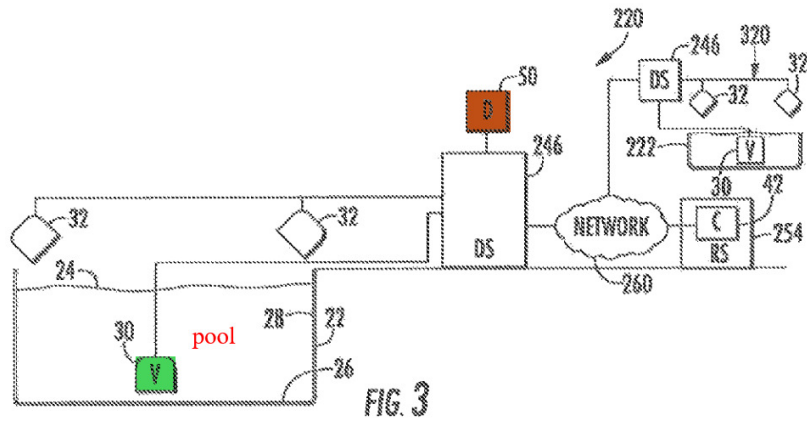
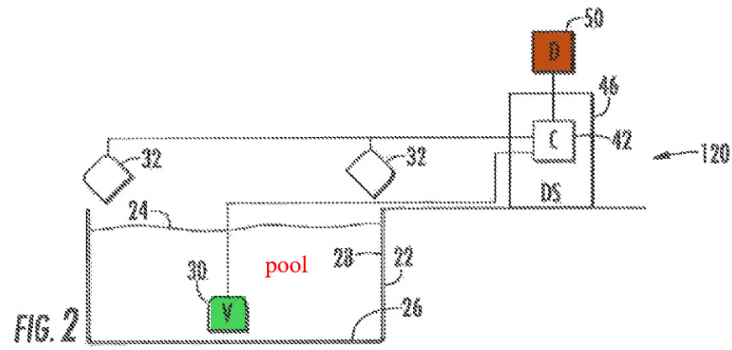
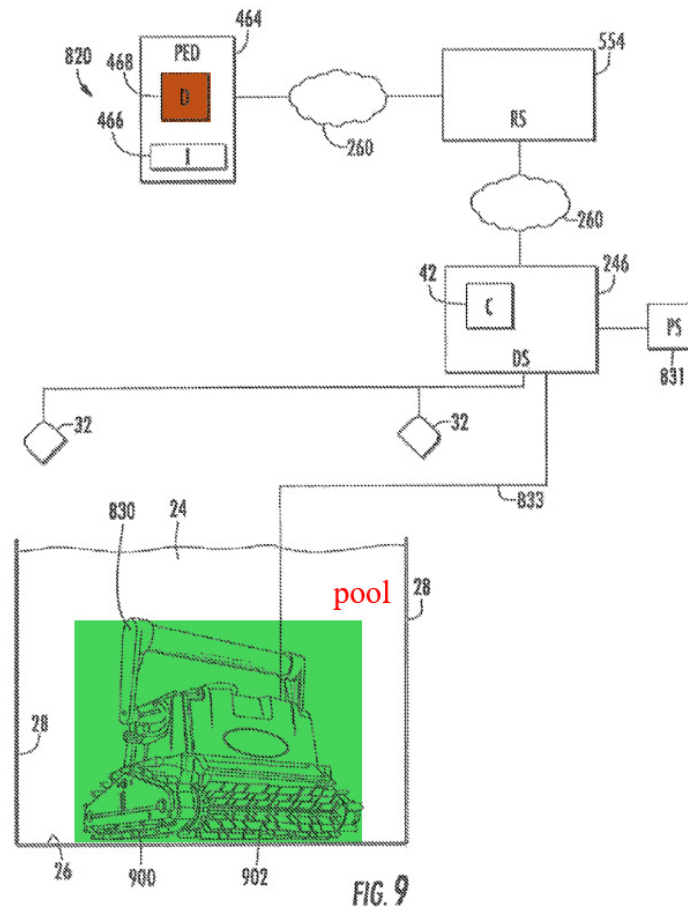


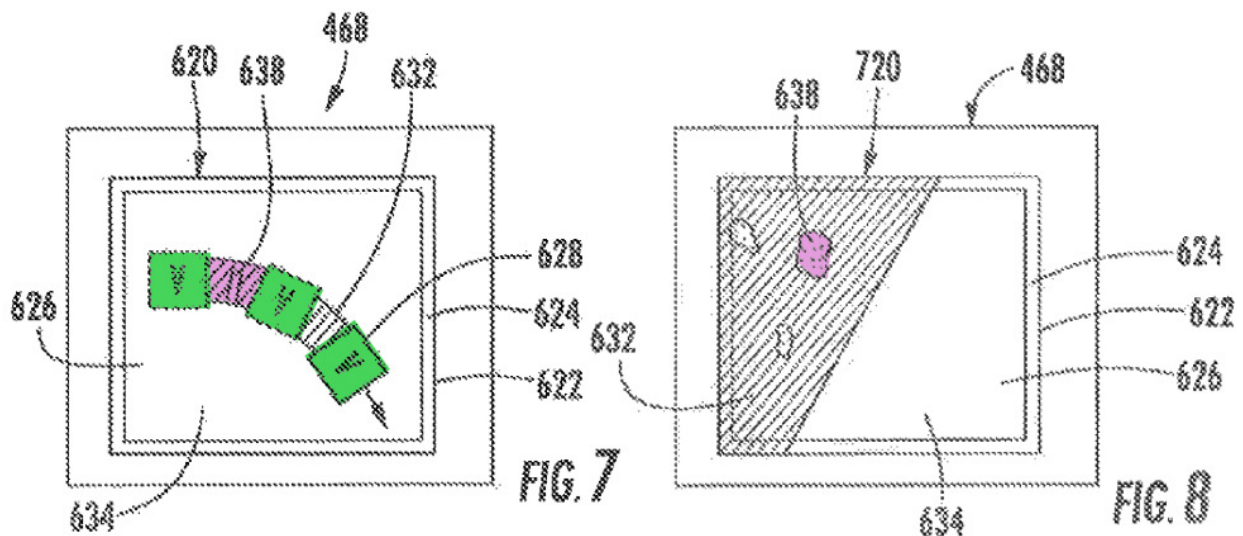
FIG. 4

Computer 7 is physically separated and accordingly remote from the pool cleaner configured to perform cleaning operations in water-filled pools. Cui, pp.4-5, FIGS. 5-6; *see also* §IV.A.2.a, IV.A.5-IV.A.6, (1[pre], Claims 5-6). Interface 16 of computer 7 displays the working status of the cleaner to a user. Cui, p.6, FIG. 4. A POSITA would have understood that interface 16 is outside the pool and physically separated and accordingly remote from the pool cleaner, constituting a remote device. Janét, ¶197. This is consistent with the '207 Patent describing **display 50/468** is outside the pool and physically separated and remote from **vehicle 30/830**. EX1001, 5:27-51, FIGS. 2-5, 9 (annotated below).





The '207 Patent similarly uses remote display 50/468 to “depict the progress of **vehicle 30** in cleaning pool 22.” EX1001, 5:52-61, FIGS. 7-8 (annotated below).



Hsu describes that its environment map displays the environment including working zones and is “updated dynamically” during cleaning, and that “environment map 120 can be transmitted to the display screen on an external electronic device 130 or an electronic device 130a by... autonomous robot 1 via a communication platform 110.” Hsu, [0018]-[0022], [0033]-[0034], Claims 3, 6-8, 12, 15-16, FIGS. 2, 4-5 (annotated below); §IV.C.1.

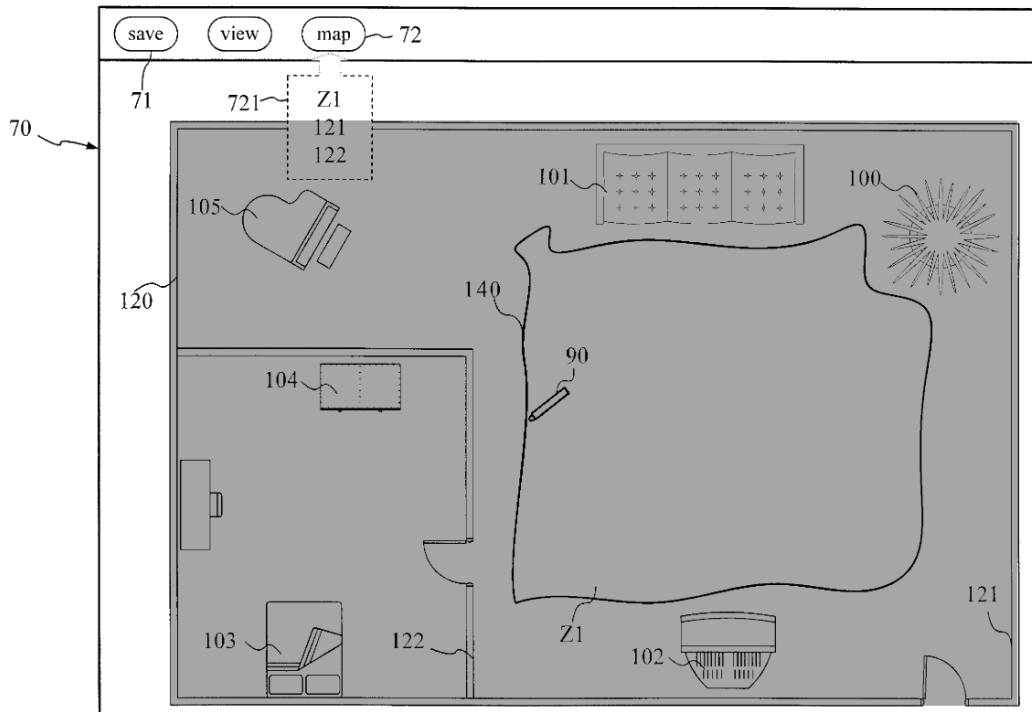


FIG. 2

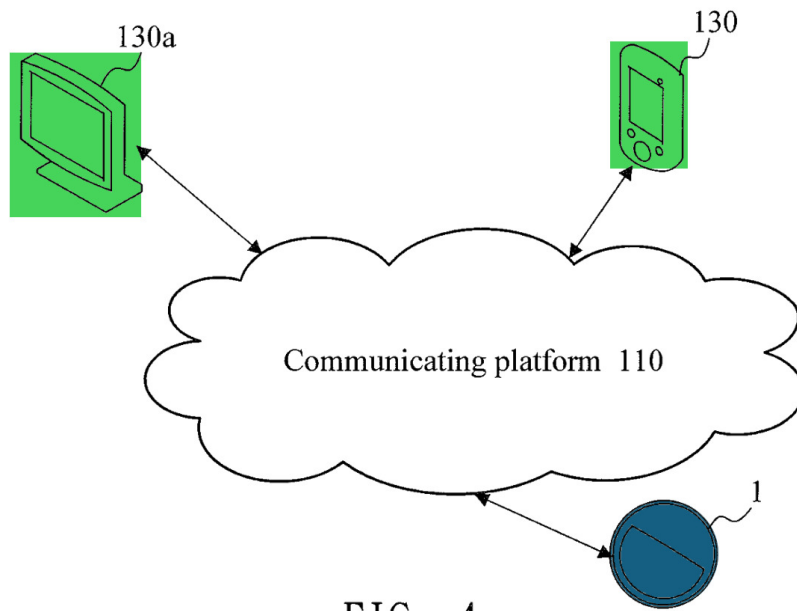


FIG. 4

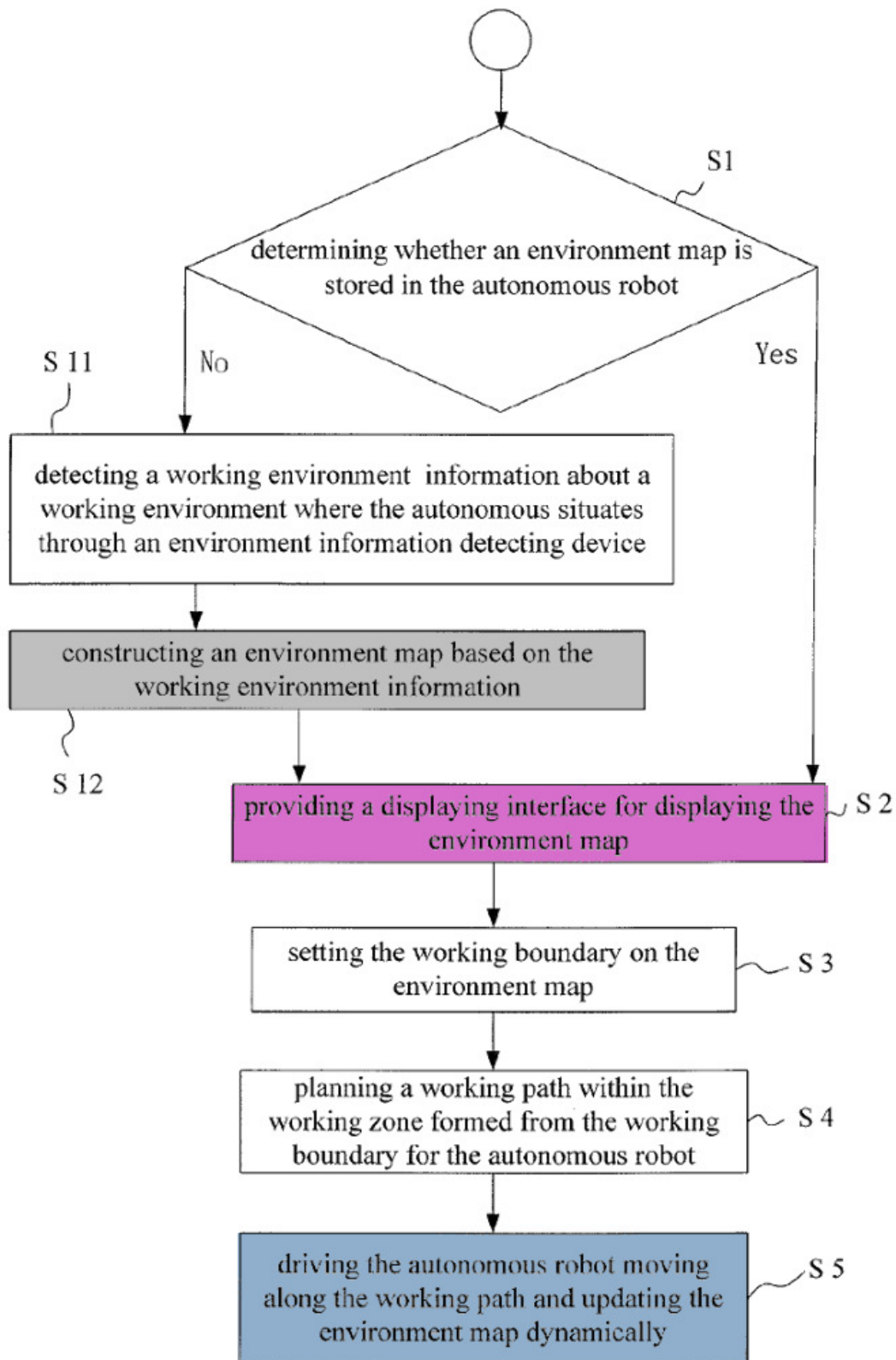


FIG. 5

As explained in §IV.C.2, a POSITA would have been motivated to add Hsu's functionalities for map construction from camera data to Cui's system. Janét, ¶201. In such modified system, Cui's controller 7 would receive images from camera 5, process the images to determine a control action, and execute that control action by constructing and presenting a graphical depiction showing cleaned versus uncleaned areas based on the images (per Hsu). Hsu, [0018]-[0022], [0033]-[0034], [0037]-[0038], FIGS. 2, 4-5; Janét, ¶201. This camera-based graphical depiction—a dynamically updated map—would be presented on interface 16 (Cui's remote device) and transmitted to external devices 130/130a (Hsu's remote device) as the control action. Cui, p.6; Hsu, [0021], [0033]-[0034], Claims 3, 6-8, 12, 15-16, FIG.5; Janét, ¶201.

As explained in §IV.C.2, a POSITA would have reasonably expected success in making such modification. Janét, ¶202.

4. Claim 17

Claim 17 depends from Claim 12. The Cui-Hsu combination discloses or suggests Claim 17. Janét, ¶¶204-210.

a. 17[a]

The Cui-Hsu combination discloses or suggests 17[a]. Janét, ¶¶205-207.

Cui, as modified by Hsu, presents a graphical depiction—a dynamically updated map showing cleaned versus uncleaned areas during cleaning operations—

on interface 16 (remote device) based on camera-captured visual data. Cui, pp.6-7, FIG. 4; Hsu, [0020], [0033]-[0034], Claims 3, 6, 8-9, 12, 15-16, FIGS. 2-3, 5; Janét, ¶206; *see also* §IV.C.3 (Claim 10). Additionally, Cui teaches that interface 16 displays **icons** (e.g., “Automatic,” “Manual”), allowing users to control the cleaner. Cui, p.6, FIG. 4 (annotated below); Janét, ¶206.

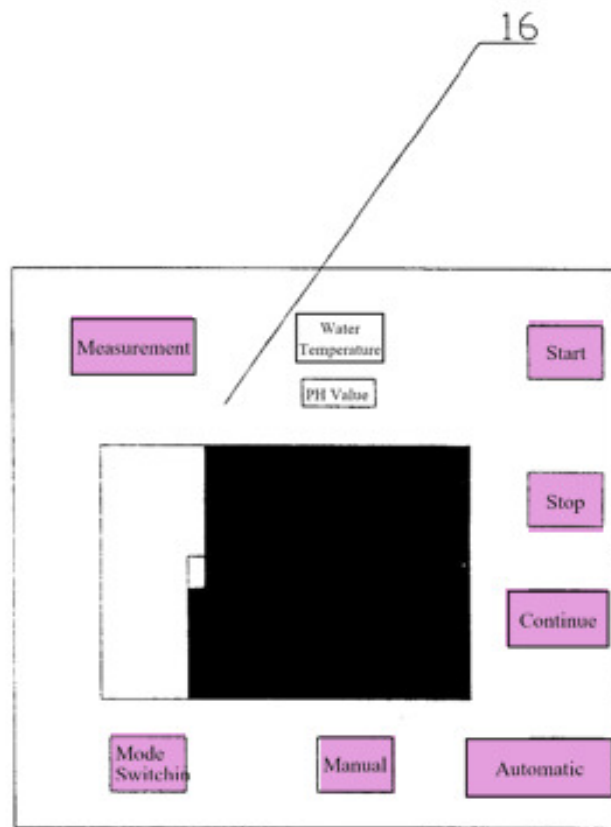


FIG. 4

A POSITA would have been motivated to combine Cui and Hsu, as explained in §IV.C.2. A POSITA would have understood or found it obvious that in the Cui-Hsu combination, dynamically updating the map and displaying these actionable icons on interface 16 (remote device) constitutes “prompting a user” because the

interface presents the active status and specific options, inviting users to select a command (e.g., prompting users to decide whether to “Stop” or select “Manual” mode based on the map). Janét, ¶207. Thus, generating the display with these control options serves as the control response that prompts users on a remote device. *Id.*

b. 17[b]

Cui discloses or suggests 17[b]. Janét, ¶¶208-210.

As explained above in §IV.C.4.a (17[a]), Cui’s interface 16 includes interactive icons allowing user selections. A POSITA would have understood that Cui’s system receives a control input from users when they, e.g., clicks the “Start” icon on the remote device, and this received input is used to control the pool cleaner (equipment). Cui, p.6, FIG.4; Janét, ¶209.

D. Ground 2A: Claims 1-3, 5-7, 12, 14, and 19 are Unpatentable over Knoll

1. Knoll

Knoll (EX1006), which is analogous art, discloses an autonomous robotic pool cleaning vehicle. Knoll, Title, Abstract, [0001]-[0002], [0007], [0021], [0027], FIG. 1 (reproduced below); Janét, ¶211.

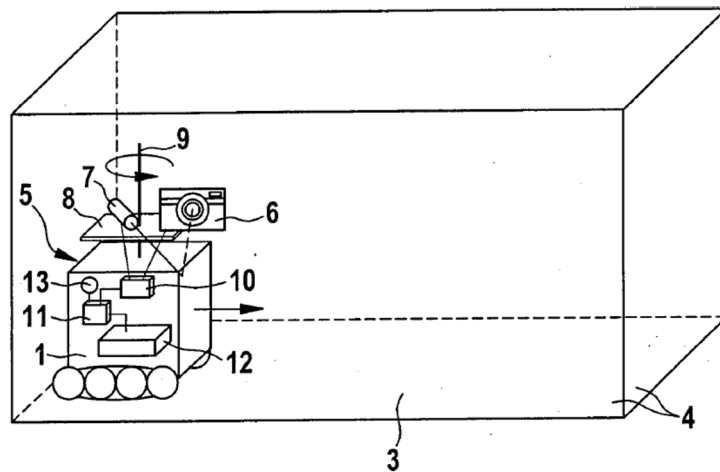


Fig. 1

Knoll's system includes robotic vehicle 1 with drive means 12, digital camera 6, and control unit 11 for controlling the drive means. Knoll, [0007], [0027]-[0028], Claim 1, FIG.1. 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). Knoll, [0007], [0027]-[0028], FIG.2 (reproduced below).

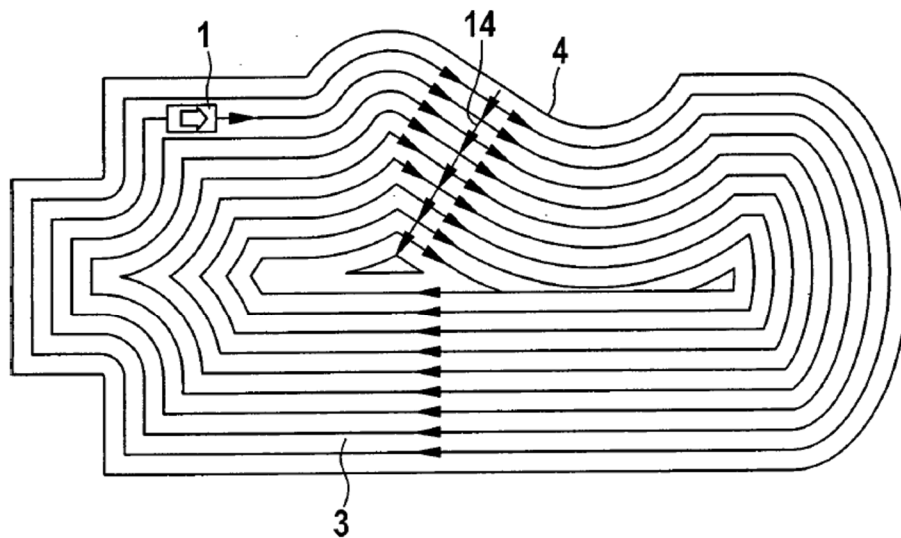


Fig. 2

2. Claim 1

Knoll discloses or suggests Claim 1. Janét, ¶¶214-243.

a. 1[pre]

Knoll discloses or suggests 1[pre]. Janét, ¶¶215-218.

Knoll discloses an “autonomous robotic vehicle 1 designed as a pool cleaning vehicle” with a **control unit 11** that controls **drive means 12** “for driving and steering.” Knoll, Abstract; [0027]-[0028]; Claims 2, 4, 14, FIG. 1 (annotated below).

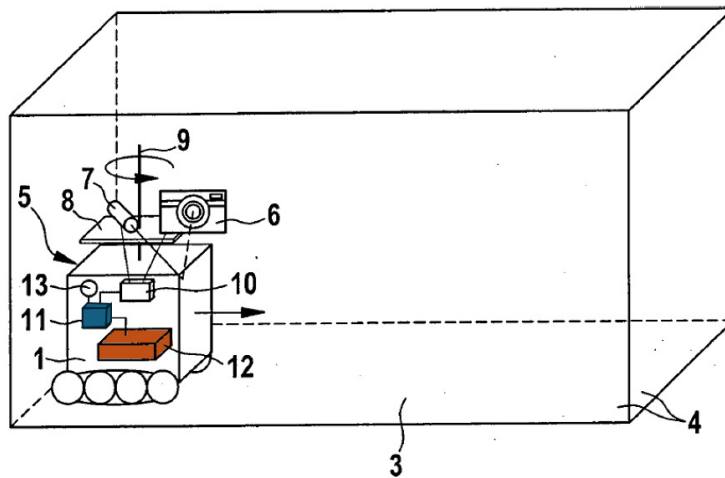


Fig. 1

Knoll's robotic vehicle is a self-propelled pool cleaning system, because it includes "suction and/or filter and/or cleaning device" and its "drive means" propels the vehicle under the control of the control unit. Knoll, [0007], [0028]; Janét, ¶217.

Knoll's robotic vehicle cleans debris from a submerged surface of a swimming pool, because it includes a suction/filter/cleaning device and operates on a working area 3 formed by the pool bottom. Knoll, [0021], [0027]-[0028], FIG. 1 (below); Janét, ¶218. A POSITA would have understood that Knoll's robotic vehicle is intended to operate in filled pools and thus cleans debris from submerged pool surfaces. Janét, ¶218.

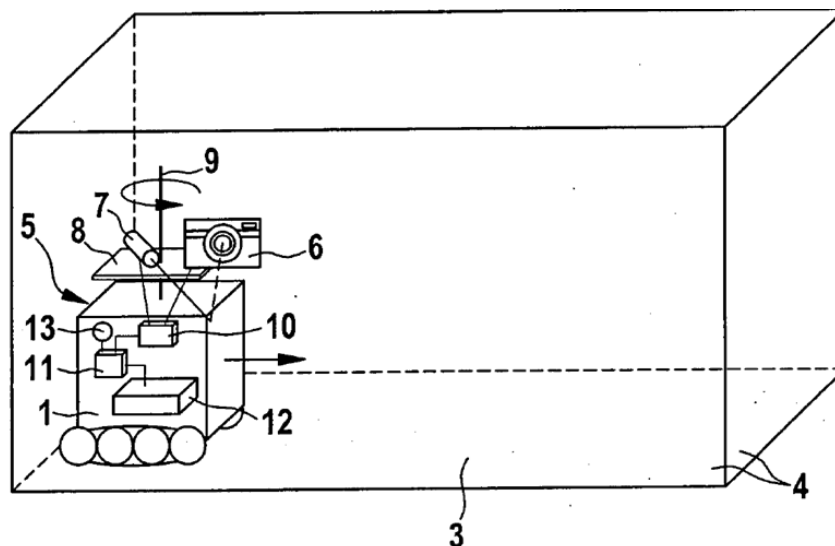
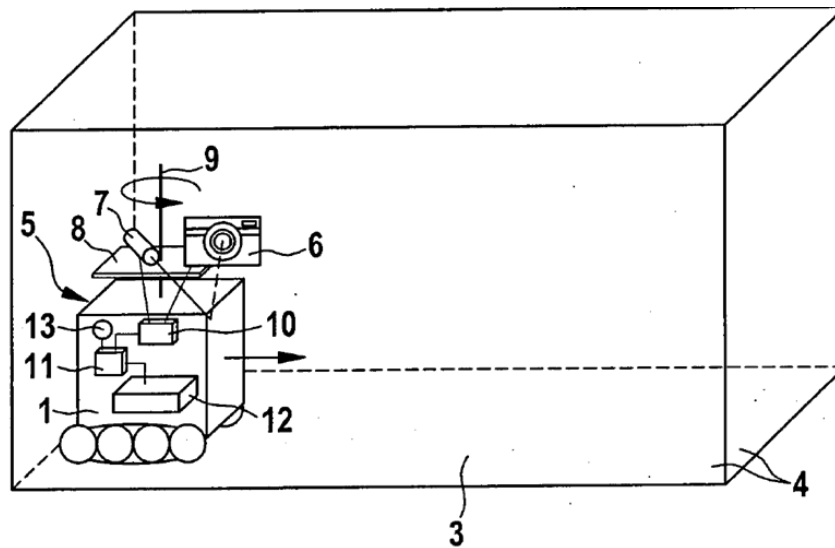


Fig. 1

b. 1[a]

Knoll discloses or suggests 1[a]. Janét, ¶¶219-220.

Knoll's robotic vehicle 1 (pool cleaning system) includes, among others, drive means 12 "for generating propulsion and for steering," control unit 11 that "controls the drive means," and "suction and/or filter and/or cleaning device." Knoll, Abstract, [0007], [0021], [0027]-[0028], Claims 1-2, 14, FIG.1 (below). A POSITA would have understood that Knoll's robotic vehicle includes a "vehicle body" containing these components. Janét, ¶220.



c. **1[b]**

Knoll discloses or suggests 1[b]. Janét, ¶¶221-224.

The format and content of 1[b] invokes §112(f)/¶6. As explained in §III.D, the function is “moving the vehicle body within the swimming pool,” and the corresponding structures include wheels, rollers, tracks, other surface contacting members powered by a motor. EX1001, 3:33-45, 10:15-17, FIGS. 9-10; Janét, ¶222.

Knoll's FIG. 1 (annotated below) shows robotic vehicle 1 with **drive means 12** and **wheels** contacting the pool bottom surface.

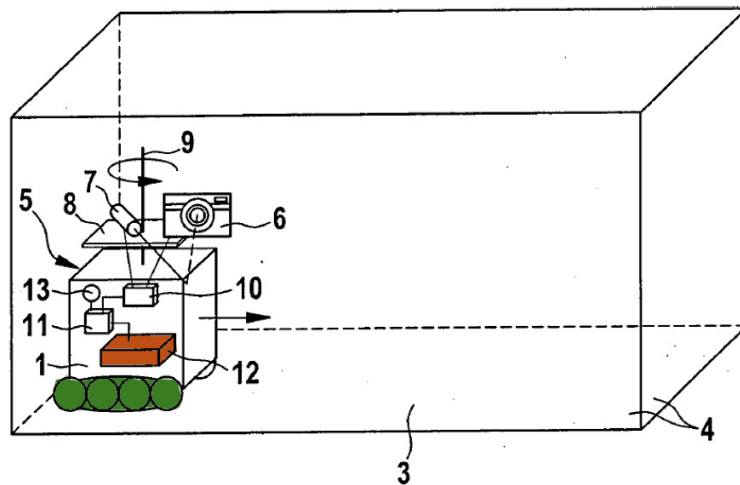


Fig. 1

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, Claims 1, 14, [0028]; Janét, ¶224. Knoll’s drive means 12 and wheels constitute the claimed corresponding structure, because they would be powered by a motor to propel the vehicle body to travel on the pool’s submerged surfaces. *See* EX1001, 3:33-39 (describing wheels that propel the vehicle “along the submerged pool surfaces” and are “powered by a motor”); Knoll, Abstract, Claims 1, 14, [0028], FIG. 1 (showing wheels); Janét, ¶224. Knoll’s motor-powered wheel structure also performs the claimed function of “moving the vehicle body within the swimming pool.” *Id.*

d. 1[c]

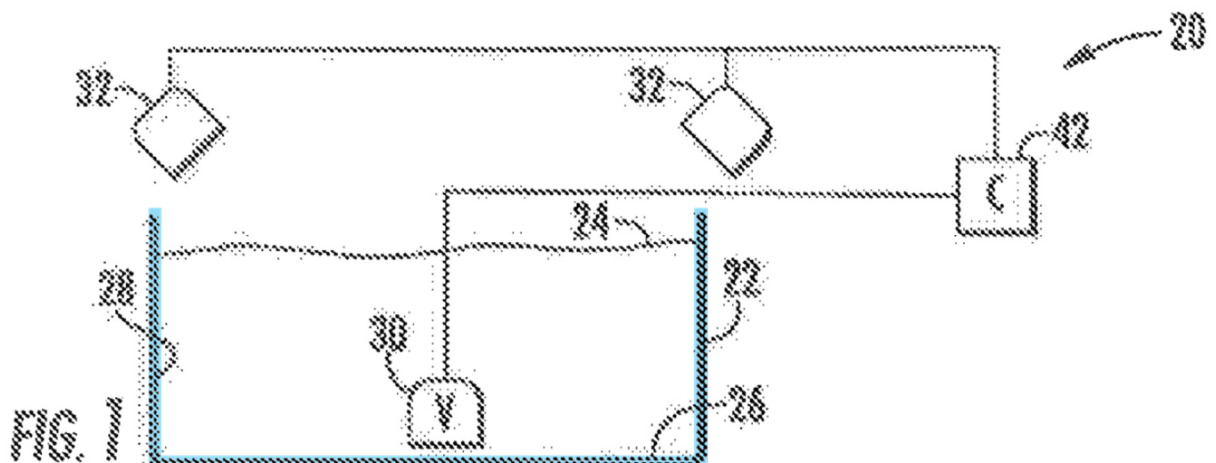
Knoll discloses or suggests 1[c]. Janét, ¶¶225-227.

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]. A POSITA would have understood that Knoll’s filter device retains debris collected by its suction device from the submerged pool surface, because Knoll’s robot operates on the bottom of the pool, and Knoll’s filter device captures and retains debris while allowing clean water to pass through. Janét, ¶227.

e. 1[d]

Knoll discloses or suggests 1[d]. Janét, ¶¶228-233.

While the ’207 Patent does not explicitly define “first object,” it describes that “[i]n other implementations, cameras 32 merely capture images of **submerged surfaces 26, 28** of pool 22,” which are the bottom and side walls of the pool. EX1001, 3:53-55; FIG. 1 (annotated below).



Similarly, Knoll teaches capturing images of substantially similar features by its **camera 6**—boundary surface 4 (and boundary lines) formed by pool walls that delimit “working area 3.” Knoll, [0018], [0028], FIG. 1 (annotated below); Janét, ¶¶230-231.

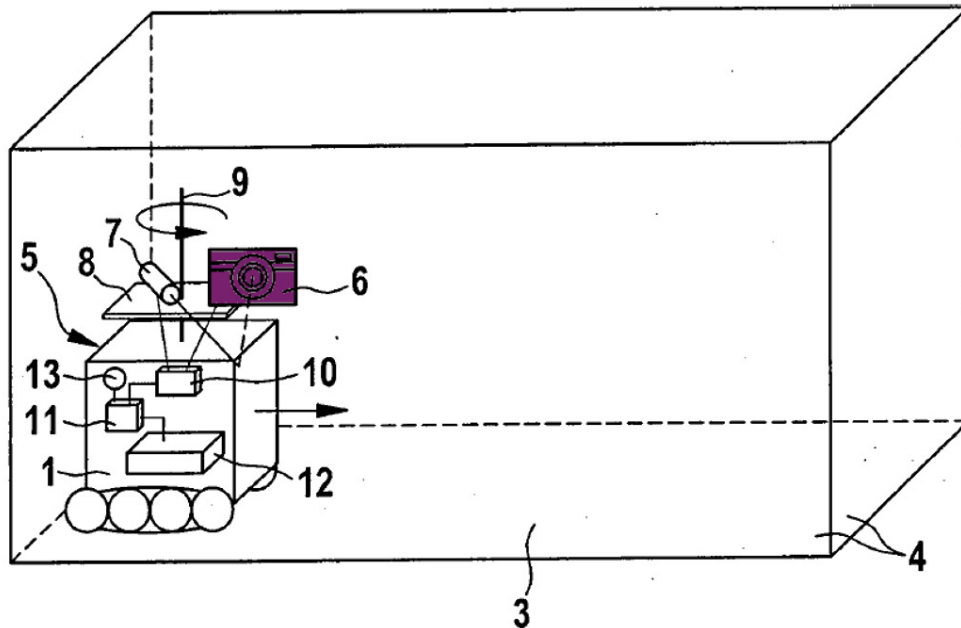


Fig. 1

Knoll describes that “a light beam is focused on the boundary line or boundary surface and **observed with a camera**,” and explains 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” when the “distance of the boundary line or the boundary surface (measurement object) from the sensor (e.g., a camera) changes.” Knoll, [0018]. Knoll explains that the boundary line/surface can be “arranged at a distance from the outer boundaries of the working area” and thus within the pool. Knoll,

[0007]. Knoll further describes a “digital camera” detecting “obstacles” (first object) when “the obstacles reflect the light beam into the digital camera.” Knoll, [0015].

A POSITA would have understood that Knoll’s camera captures images of the boundary line/surface or obstacle (first object) within the pool, because the “image” on the photo sensor of the camera includes the light reflected off the boundary line/surface or obstacle. Janét, ¶233.

f. 1[e][i]

Knoll discloses or suggests 1[e][i]. Janét, ¶¶234-237.

Knoll’s control unit 11 constitutes a “controller,” because it “has a controlling effect on the... drive means 12 for generating propulsion and for steering the robotic vehicle 1” and “automatically determine[s]” the vehicle’s trajectory. Knoll, [0028]-[0029]; Janét, ¶235.

Control unit 11 (controller) is in electronic communication with camera 6, because, to calculate distance values from images captured on camera 6, control unit 11 would receive data from camera 6. Knoll, [0018], [0028] (describing its “distance-determining device uses the rotating light beam source and the rotating **camera** to determine the distance to the boundary line or boundary surface” 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.”), FIG. 1 (annotated below, illustrating **evaluation unit 10** (part of **control unit 11**) is connected to **camera 6** via a **wire/cable**); Janét, ¶¶236-237.

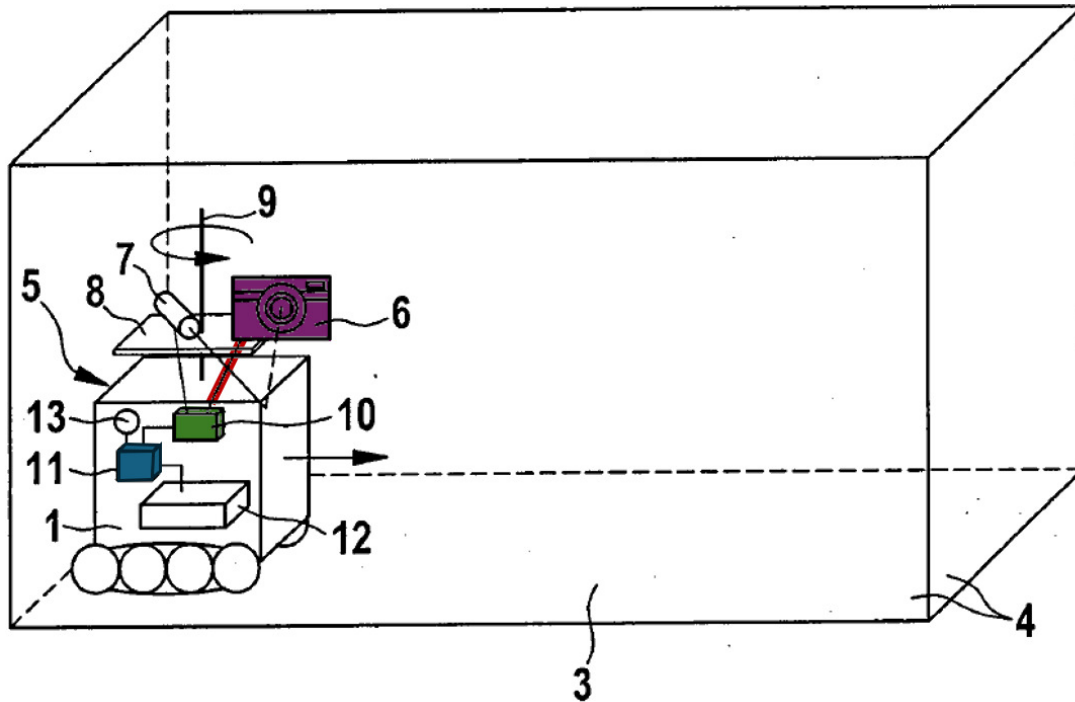


Fig. 1

g. 1[e][ii]

Knoll discloses or suggests 1[e][ii]. Janét, ¶¶238-242.

Knoll teaches that control unit 11 “controls the drive means 12 as a function of...determined smallest distance measurement values” to the boundary line or boundary surface. Knoll, [0028]. The “control signal” is generated “in response to the captured image” because, as explained in §IV.D.2.e (1[d]), the distance measurement values that form the basis for the control signal generation are derived

from **images captured by digital camera 6** observing the boundary surface (the first object). Janét, ¶239.

Knoll explains that the “trajectory for the robotic vehicle 1...was automatically determined by the control unit 11 on the basis of the determined distance to the boundary surface 4.” Knoll, [0029], FIG. 2 (reproduced below).

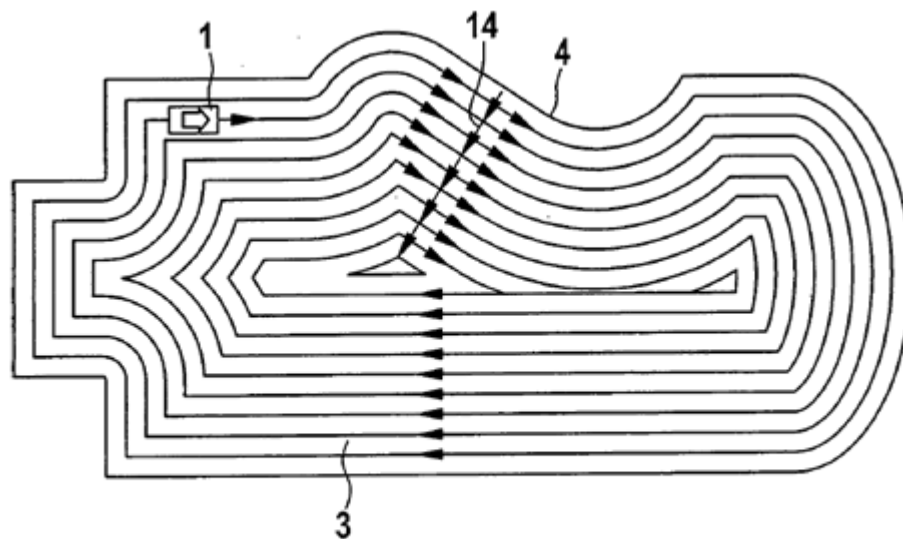


Fig. 2

A POSITA would have understood that the trajectory in Figure 2—comprising path segments following the contour of boundary line/surface 4 at different offsets—results from control unit 11’s repeatedly adjusting drive means 12 (based on the measured distance, which is, in turn, determined using image data) to maintain an appropriate spacing from boundary line/surface 4. Knoll, [0029], FIG. 2; Janét, ¶241. A POSITA also would have understood that, to maintain that spacing from the boundary line/surface, Knoll’s control unit 11 would generate drive-control

signals that adjust the vehicle movement based on the measured distance—causing the vehicle body to *move away* from the boundary line/surface (first object) when the measured distance becomes too small and *toward* the boundary line/surface when the measured distance becomes too large. *Id.* In this way, Knoll’s control unit 11 is configured to generate, in response to the images captured by camera 6, control signals causing the vehicle movement to, or away from Knoll’s boundary line/surface(first object). Janét, ¶¶241.

Additionally, Knoll teaches that its camera detects obstacles that “reflect the light beam into the digital camera,” and the control unit is configured to cause the robot “to drive around the obstacle.” Knoll, [0015]. A POSITA would have understood that to “drive around” a detected obstacle (first object), Knoll’s control unit would generate signals causing the vehicle body to move *away from* the obstacle. Janét, ¶¶242.

3. Claim 2

Knoll discloses or suggests Claim 2. Janét, ¶¶244-263.

a. 2[pre]

Knoll discloses or suggests 2[pre]. Janét, ¶¶245-247.

Knoll discloses a pool cleaning system operating within a swimming pool, because it discloses “autonomous robotic vehicle 1 designed as a pool cleaning vehicle” with a **control unit 11**, **drive means 12**, and distance-determining device

5 comprising a **camera 6** that operates within a swimming pool. Knoll, [0027]-
[0028], FIG. 1 (annotated below); *see also* §IV.D.2.a (1[pre]); Janét, ¶246.

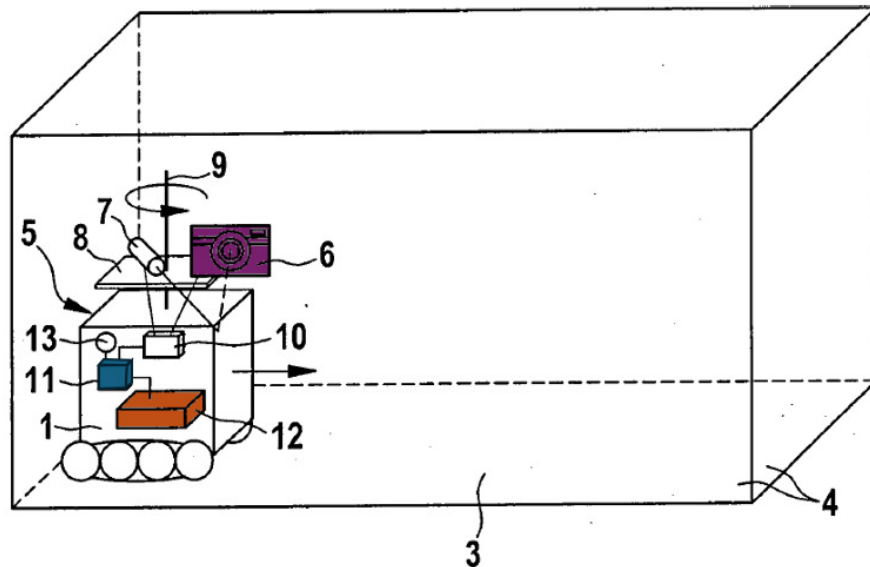


Fig. 1

b. 2[a]

Knoll discloses or suggests 2[a]. Janét, ¶¶248-249.

Knoll discloses an “autonomous robotic vehicle 1 designed as a pool cleaning vehicle” with “drive means (12)” that propel the vehicle under control of “control unit 11.” Knoll, Abstract; [0027]-[0028], Claims 2, 4, 14, FIG. 1; *see also* §IV.D.2.a (1[pre]). A POSITA would have understood that Knoll’s robotic vehicle (and/or various components thereof) is “equipment for a swimming pool” because it operates within the swimming pool to clean pool surfaces. Janét, ¶249.

c. 2[b]

Knoll discloses or suggests 2[b]. Janét, ¶¶250-251.

Knoll's robotic vehicle 1 includes camera 6 that captures images of the boundary line/surface (a portion of a location) of the swimming pool. Knoll, Claim 8, [0015], [0018], [0027]-[0028], FIG. 1.; *see also* §IV.D.2.e (1[d]).

d. 2[c][i]

Knoll discloses or suggests 2[c][i]. Janét, ¶¶252-255.

Knoll discloses **control unit 11** as a controller for robotic vehicle 1. Knoll, [0028], FIG. 1 (annotated below); Janét, ¶253; *see also* §§IV.D.2.a, IV.D.2.f (1[pre], 1[e][i]).

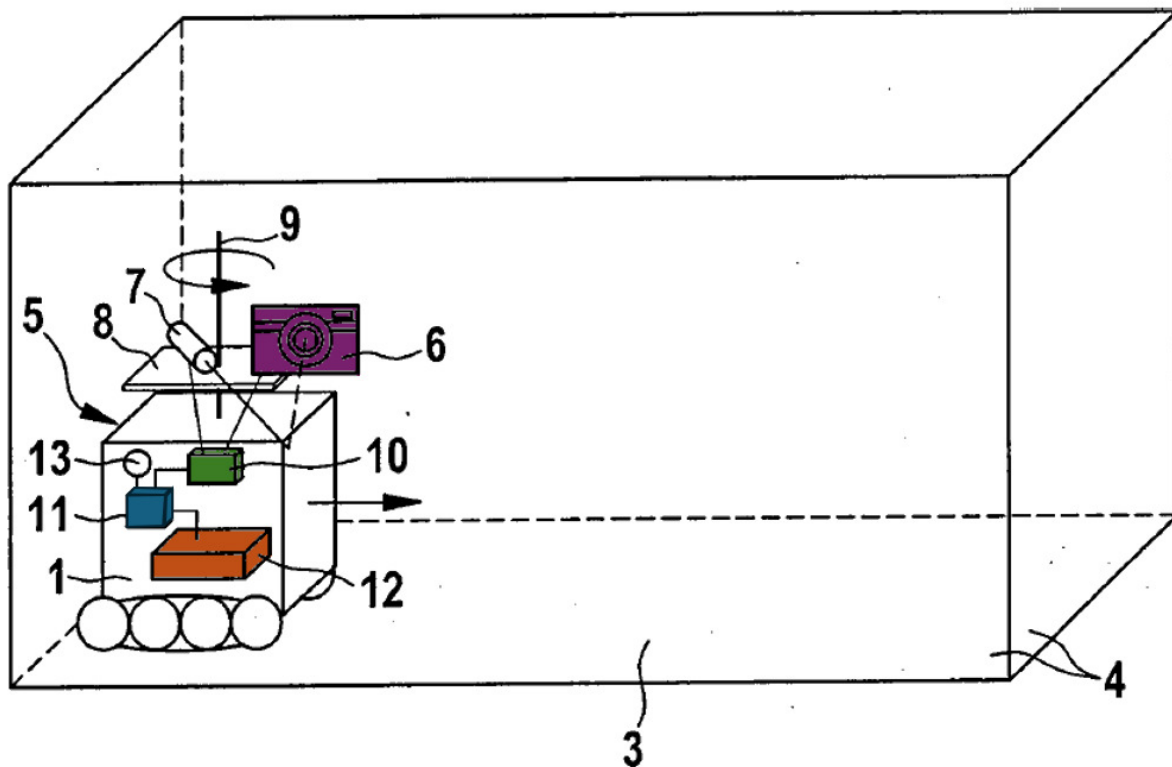


Fig. 1

Knoll's control unit controls **drive means 12** to move robotic vehicle 1 in the pool based on image-derived distance values. Knoll, [0028]-[0029], FIG. 2; Janét, ¶254; *see also* §§IV.D.2.a, IV.D.2.g (1[pre], 1[e][ii]). A POSITA would have understood that, to control drive means 12, control unit 11 would be in communication with drive means 12, and thus with vehicle 1 (equipment) because drive means 12 is part of the vehicle. Janét, ¶254.

Further, control unit 11 (controller) is in communication with **camera 6** to receive images. *See* §IV.D.2.f (1[e][i]).

e. 2[c][ii]

Knoll discloses or suggests 2[c][ii], because Knoll's controller receives images (visual data) from camera 6, and determines and generates control signal (control action) to control movement of vehicle 1 (equipment) based on the images. *See* §§IV.D.2.f-IV.D.2.g (1[e][i]-1[e][ii]); Janét, ¶¶256-263. Specifically, Knoll discloses a "control unit 11" acting as the claimed "controller" that exerts a controlling effect on the drive means 12 to automatically determine vehicle trajectory (Knoll, [0028]-[0029]). This controller is in electronic communication with digital camera 6 via an evaluation unit 10, which processes captured image data to calculate distances through triangulation by observing the position of reflected light on the camera's photo sensor ([0018], [0028], FIG. 1). Consequently, the controller generates control signals in response to these captured images to adjust

movement "to" or "away from" a first object (such as boundary surface 4 or a detected obstacle) to maintain a defined spacing or execute bypass maneuvers ([0015], [0028], [0029], FIG. 2). A POSITA would recognize this as a closed-loop feedback mechanism where image-derived distance values directly drive steering actuation to correct for navigation errors relative to objects within the pool. Janét, ¶¶256-263.

4. Claim 3

Claim 3 depends from Claim 2. Knoll discloses or suggests Claim 3. Janét, ¶¶264-267.

Knoll's robotic vehicle 1 (equipment) is "designed as a pool cleaning vehicle" with "drive means (12) for driving and steering the robotic vehicle (1)" that are "for generating propulsion and for steering." Knoll, [0027]-[0028], Abstract, Claims 1, 14, FIG. 1.

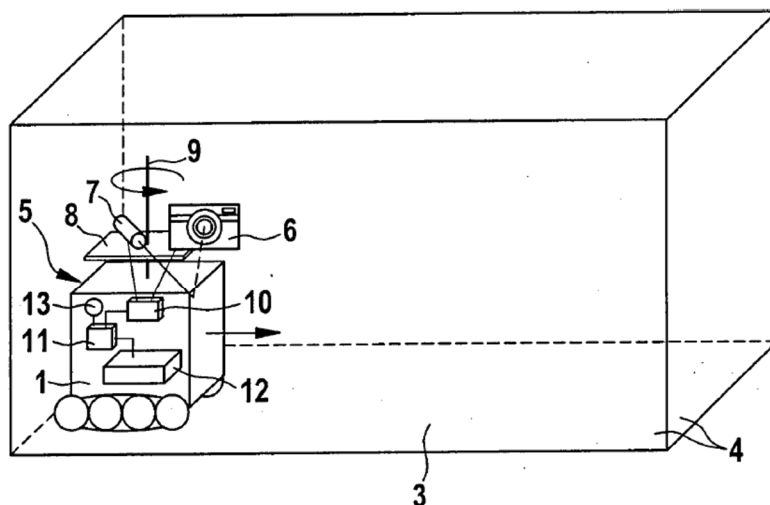


Fig. 1

The robotic vehicle includes “suction and/or filter and/or cleaning device” and operates on “working area 3...formed by the bottom of the pool” that is “delimited by four pool walls...forming a circumferential boundary surface 4.” Knoll, [0027]-[0028], FIG. 1. A POSITA would have understood that Knoll’s robotic vehicle comprises a “cleaning device with one or more propulsion mechanisms” because it includes suction/filter/cleaning devices and drive means configured for generating propulsion and steering. *Id.*; Janét, ¶266. A POSITA would have also understood that this cleaning device is “configured to travel adjacent to submerged or water-containing surfaces of the swimming pool” because it operates on the pool bottom and is controlled to maintain a defined distance from the pool walls (traveling adjacent to these surfaces), and these surfaces are submerged when the pool is filled with water (the normal operational environment for pools). *Id.* A POSITA would have further understood that the cleaning device “perform[s] a cleaning operation,” because its suction/filter/cleaning devices remove debris from pool surfaces as it travels thereon. Janét, ¶266.

5. Claim 5

Claim 5 depends from Claim 2. Knoll discloses or suggests Claim 5. Janét, ¶¶268-270.

A POSITA would have understood Knoll's **camera 6** mounted on the vehicle (equipment) because it is "arranged on a **mounting plate 8**" attached to the vehicle body. Knoll, [0028], FIG. 1 (annotated below); Janét, ¶269.

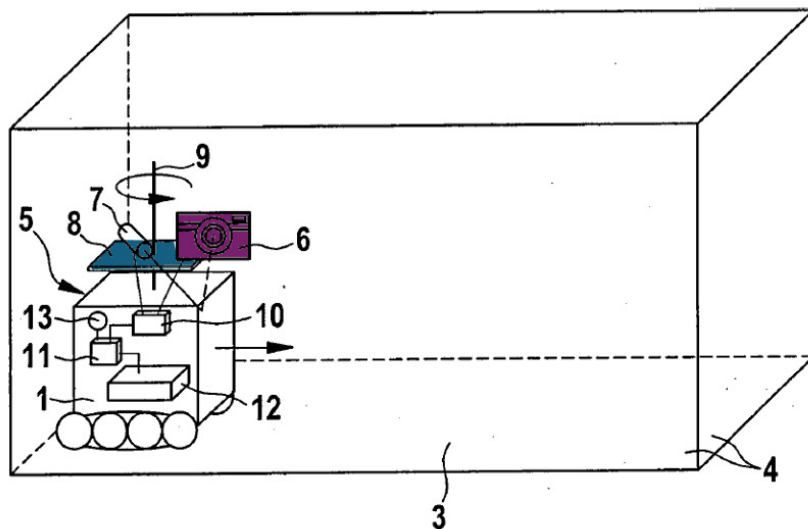


Fig. 1

6. Claim 6

Claim 6 depends from Claim 2. Knoll discloses or suggests Claim 6. Janét, ¶¶271-274.

Knoll's pool cleaning vehicle operates within the swimming pool to clean pool surfaces. *See* Knoll, [0027], [0021]; Janét, ¶272; *see also* §IV.D.3.b (2[a]). Camera 6 is mounted on robotic vehicle 1, which operates on "working area

3...formed by the **bottom of the pool.**” Knoll, [0027], FIG.1; *see also* §IV.D.5 (Claim 5).

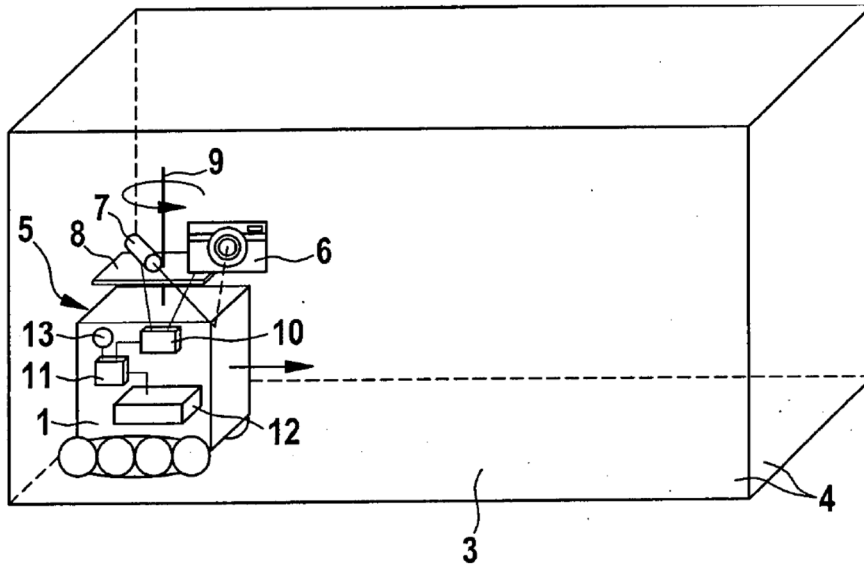


Fig. 1

A POSITA would have understood that Knoll’s camera 6 is “submergible or submerged within the swimming pool” because the camera is mounted on robotic vehicle 1, which is submerged in a pool filled with water (the normal operational environment for pool cleaning devices). Janét, ¶273.

7. Claim 7

Claim 7 depends from Claim 2. Knoll discloses or suggests Claim 7. Janét, ¶¶275-277.

Knoll describes that control unit 11 (controller) **detects** presence of an obstacle (characteristic) within the working area 3 “formed by the bottom of the pool” (location) based on a captured image (visual data) and **controls** movement of vehicle

1 (equipment) based on the detected characteristic—to bypass the obstacle. *See* Knoll, [0015], [0028]. Janét, ¶276; *see also* §§IV.D.2.e-IV.D.2.g, IV.D.3.c-IV.D.3.e (1[d]-1[e][ii], 2[b]-2[c][ii]).

8. Claim 12

Knoll discloses or suggests Claim 12. Janét, ¶¶278-287.

a. 12[pre]

Knoll discloses or suggests 12[pre]. Janét, ¶¶279-281.

Knoll discloses an autonomous robotic pool cleaning system that includes a control unit processing visual data from a digital camera to detect and measure distance to boundary line/surface and/or obstacles for navigation and control. *See* Knoll, Abstract, [0027]-[0028], Claims 1-2, FIGS. 1-2; Janét, ¶280; *see also* §§IV.D.2.g and IV.D.3.d (1[e][ii]&2[c][i]).

A POSITA would have understood that Knoll’s system performs the claimed method for “monitoring a pool system,” because Knoll’s system observes and detects swimming pool environment—specifically, the pool’s boundary surfaces/lines and obstacles—to control the robot’s navigation and perform its pool cleaning operations. *See, e.g.*, Knoll, [0027]-[0028]; Janét, ¶281.

b. 12[a]

Knoll discloses or suggests 12[a]. Janét, ¶¶282-283.

Knoll's control unit 11 (controller) receives visual data (images) of boundary surfaces/lines and/or obstacles from digital camera 6. *See* Knoll, [0028], FIG. 1; Janét, ¶283; *see also* §IV.D.3.d (2[c][i]). A POSITA would have understood that the visual data is “images of at least a portion of a location including a swimming pool,” because the camera captures images of the boundary line/surface of the working area or obstacles within the pool. Knoll, [0018], [0027]-[0028], FIG. 1; Janét, ¶283; *see also* §IV.D.3.c (2[b]).

c. 12[b]

Knoll discloses or suggests 12[b]. Janét, ¶¶284-285.

Knoll's control unit 11 receives images from camera 6, detects presence of an obstacle (characteristic) in an area within working area 3 based on the images, and based on this detected obstacle presence, controls vehicle 1 to bypass or “drive around the obstacle at a constant distance” in that specific area. Knoll, [0015]; Janét, ¶285; *see also* §§IV.D.2.e-IV.D.2.g, IV.D.3.c-IV.D.3.e, IV.D.7 (1[d]-1[e][ii], 2[b]-2[c][ii], Claim 7). A POSITA would have understood or found it obvious that Knoll's system determines the area containing the obstacle as a “target area,” because its control action (to cause bypassing motion) is applied with respect to the specific area where an obstacle is detected. Janét, ¶285.

d. 12[c]

Knoll discloses or suggests 12[c]. Janét, ¶¶286-287.

Knoll's control unit 11 detects obstacle presence (characteristic) and generates control signals that control drive means 12 (part of vehicle 1) to steer vehicle 1 to bypass or "drive around the obstacle." Knoll, [0015], [0028]; *see also* §§IV.D.3.e&IV.D.7 (2[c][ii], Claim 7). A POSITA would have understood that Knoll's control signals to control vehicle 1 constitute "a control response" generated "based on the detected characteristic" (obstacle presence) of the target area (the area where the obstacle is located). Janét, ¶¶287.

9. Claim 14

Claim 14 depends from Claim 12. Knoll discloses or suggests Claim 14. Janét, ¶¶288-290.

Knoll's control unit 11 generates the control response by controlling the operation of drive means 12 (part of robotic vehicle 1 (equipment)) to steer robotic vehicle 1 based on the detected presence of an obstacle. *See* Knoll, [0015], [0028], FIG. 1; Janét, ¶289; *see also* §§IV.D.3.e, IV.D.8.d (2[c][ii], 12[c]).

10. Claim 19

Claim 19 depends from Claim 12. Knoll discloses or suggests Claim 19. Janét, ¶¶291-297.

a. 19[a]

Knoll discloses or suggests 19[a]. Janét, ¶¶292-294.

Knoll's control unit 11 generates the control response by controlling drive means 12 to steer robotic vehicle 1 (cleaning device). *See* Knoll, [0028], [0011], [0015]; Janét, ¶293; *see also* §§IV.D.3.e, IV.D.8.d, IV.D.9 (2[c][ii], 12[c], Claim 14).

Knoll's robotic vehicle 1 is a cleaning device with propulsion mechanisms (drive means) configured to operate on the pool bottom and maintain a distance from the boundary surface 4 (and boundary lines) formed by or on pool walls (travel adjacent to submerged or water-containing surfaces of the swimming pool), and to remove debris from pool surfaces with its suction/filter/cleaning devices (perform a cleaning operation). *See* Knoll, [0007], [0011], [0015], [0021], [0027]-[0028], FIGS. 1-2; Janét, ¶294; *see also* §IV.D.4 (Claim 3).

b. 19[b]

Knoll discloses or suggests 19[b]. Janét, ¶¶295-297.

Knoll's control unit 11 controls drive means 12 to steer vehicle 1 (controlling a path or route of the cleaning device) based on detected presence of an obstacle. *See* Knoll, [0015], [0028]; Janét, ¶296; *see also* §IV.D.8.d, IV.D.9 (12[c], Claim 14).

E. Ground 2B: Claims 7, 8, 12-14, and 19 are Unpatentable over Knoll and Fu-007

Claims 7, 8, 12-14, 19, and 20 are unpatentable over Knoll and Fu-007. Janét, ¶¶298-349.

1. Motivation to Combine

Both Knoll and Fu-007 disclose autonomous underwater pool cleaning robots using cameras and controllers to perform cleaning operations. *See, e.g.*, Knoll, Abstract, [0027]-[0028], FIG. 1; Fu-007, Abstract, pp.8-9, 12-14, Claim 4, FIG. 6; Janét, ¶299. A POSITA would have been motivated to combine the complementary teachings of Knoll and Fu-007 to achieve improved autonomous pool cleaning systems. Janét, ¶299.

A POSITA would have recognized that the teachings in Knoll and Fu-007 are directed to the same pool cleaning technical field, address similar technical challenges, and provide complementary technical solutions. Janét, ¶300. Specifically, both use a controller to process captured images and generate control signals to cause movement of the pool cleaning robot within the swimming pool. *Compare* Knoll, [0015], [0028], FIG. 1, *with* Fu-007, pp.10, 12-16, Claims 4, 7, FIG.6. Additionally, both teach motorized drive mechanisms to cause and control movement of the pool cleaner during operation. *Compare* Knoll, Abstract, [0028], Claim 1, *with* Fu-007, pp.8-10, 12-16, Claims 1, 3-4. Accordingly, a POSITA would have investigated the technical teachings in both Knoll and Fu-007 to seek guidance when designing pool cleaning systems. Janét, ¶¶301-302.

Knoll uses camera-based distance measurement (via triangulation) for navigation and obstacle avoidance. Knoll, [0015], [0018]. Fu-007 employs

threshold-based cleanliness control by determining “a cleanliness level of the bottom of the swimming pool by comparing the image(s) with [a swimming pool cleanliness image] threshold” and operating “the four cleaning drive wheels...to complete the cleaning task.” Fu-007, pp.10, 14-16, Claim 7. These represent complementary approaches—Knoll providing navigation control and Fu-007 providing cleaning intensity control—that a POSITA would have combined. Janét, ¶¶303-305.

Knoll’s camera 6 acquires images of boundary surface 4 for distance measurement. Knoll, [0015], [0018], [0028], FIG. 1. A POSITA would have recognized that images captured by Knoll’s camera contain visual information about pool surfaces. A POSITA seeking to improve Knoll’s cleaning effectiveness would have been motivated to add Fu-007’s cleanliness detection and threshold-based control functionalities for the following reasons. Janét, ¶¶306-308.

First, this modification would have advanced Knoll’s stated goal to achieve “complete and efficient cleaning of a pool floor and/or the pool walls.” Knoll, [0007]; Janét, ¶309. A POSITA would have recognized that with Fu-007’s cleanliness-based control, Knoll’s system would apply more aggressive cleaning to dirtier areas and lighter cleaning to cleaner areas, thereby improving cleaning effectiveness by adapting operations based on actual surface conditions. Janét, ¶309.

Second, Fu-007 teaches that its system achieves “energy conservation, economical efficiency” by adjusting operating conditions based on detected

cleanliness (Fu-007, Abstract, p.11), and a POSITA would have been motivated to add Fu-007's functionalities to provide these benefits to Knoll's robotic vehicle. Janét, ¶310. This modification would also extend operational run-time and reduce wear on mechanical components. Janét, ¶310.

A POSITA would have had a reasonable expectation of success, because both references employ similar camera-based systems in the same pool operational environment, e.g., cameras capturing images of pool surfaces, controllers processing captured images, and motor drivers controlling drive mechanisms based on controller outputs. Knoll, [0015], [0028], FIG. 1; Fu-007, pp.8-10, 14-16, Claim 7, FIG. 6. Adding Fu-007's threshold comparison logic to Knoll's existing image processing would have been a routine software modification within ordinary skill. Janét, ¶¶311-317.

2. Claim 7

Claim 7 depends from Claim 2. Alternative to §IV.D.7, the Knoll-Fu-007 combination discloses or suggests Claim 7. Janét, ¶¶318-323.

Knoll discloses control unit 11 (controller) that processes visual data from camera 6. *See* Knoll, [0028], [0018], FIG. 1; *see also* §§IV.D.2.f-g (1[e][i]-[ii]).

Fu-007 teaches using “monitoring camera 2” to capture images of pool surfaces and determining “a cleanliness level of the bottom of the swimming pool” (characteristic of the location) “by comparing the image(s)” to “a swimming pool

cleanliness image threshold.” Fu-007, pp.10, 14-16, Claim 7, FIG. 6; Janét, ¶320; *see also* §IV.B.1 (Cui-Fu-007, 8[b]).

As explained in §IV.E.1, a POSITA would have been motivated to combine the teachings of Knoll and Fu-007. Janét, ¶321. In the combined system, Knoll’s robotic vehicle 1 would operate with control unit 11 processing images from camera 6 for dual purposes: (1) distance measurement for navigation (per Knoll), and (2) cleanliness detection (per Fu-007). *See* Knoll, [0015], [0018], [0028]; Fu-007, pp.10, 14-16; Janét, ¶321. Knoll’s control unit 11 would determine the robot’s position relative to boundary line/surface 4 (using Knoll’s triangulation method) and also determine cleanliness levels of pool surfaces in the captured images (using Fu-007’s threshold comparison method). *Id.* Based on detected cleanliness levels (characteristic) of pool surfaces (location), control unit 11 would control operating conditions of drive means 12 of vehicle 1 (equipment), implementing Fu-007’s teaching of varying “rotational speed of each wheel” and adjusting cleaning intensity based on pool surface cleanliness. Fu-007, pp.14-16; Knoll, [0028]; Janét, ¶321. As such, areas with higher debris levels would receive more aggressive cleaning, while already-clean areas would receive lighter treatment. *Id.*

As explained in §IV.E.1, a POSITA would have reasonably expected success in combining Knoll with Fu-007, because applying Fu-007’s control logic to Knoll’s

existing hardware would be a routine software programming modification to Knoll's existing controller. Janét, ¶322.

3. Claim 8

Claim 8 depends from Claim 7. Knoll-Fu-007 combination discloses or suggests Claim 8. Janét, ¶¶324-329.

a. 8[a]

The Knoll-Fu-007 combination discloses or suggests 8[a]. Janét, ¶325. Specifically, as explained in §IV.E.1 (Claim 7), the Knoll-Fu-007 combination would detect a cleanliness (characteristic) of “the bottom of the swimming pool.” Fu-007, pp.10, 14-16, Claims 7; Janét, ¶325; *see also* §IV.B.1 (Cui-Fu-007, 8[b]).

b. 8[b]

The Knoll-Fu-007 combination discloses or suggests 8[b]. Janét, ¶¶326-329.

Fu-007 teaches using “monitoring camera 2” to capture images of pool surfaces and determining “a cleanliness level of the bottom of the swimming pool” (characteristic of the location) “by comparing the image(s)” to “a swimming pool cleanliness image threshold.” Fu-007, pp.10, 14-16, Claim 7; Janét, ¶327; *see also* §IV.B.1 (Cui-Fu-007, 8[b]).

As explained in §§IV.E.1&IV.E.1 (Knoll-Fu-007, Claim 7), with a reasonable expectation of success, a POSITA would have been motivated to add Fu-007's functionalities into Knoll's controller 11, allowing the modified controller 11 to be

configured to control operating conditions of drive means 12 of vehicle 1 (equipment) to vary “rotational speed of each wheel” and adjust cleaning intensity based on the detected cleanliness being outside of the “cleanliness image threshold.” Fu-007, pp.10, 12-16; Knoll, [0028]; Janét, ¶328.

4. Claim 12

Knoll, in view of Fu-007, discloses or suggests Claim 12. Janét, ¶¶330-337. As explained in §IV.E.1, a POSITA would have been motivated to combine Knoll and Fu-007, with a reasonable expectation of success.

a. 12[pre]

Knoll discloses or suggests 12[pre]. *See* §IV.D.8.a (Knoll, 12[pre]).

b. 12[a]

Knoll discloses or suggests 12[a]. *See* §IV.D.8.b (Knoll, 12[a]).

c. 12[b]

The Knoll-Fu-007 combination discloses or suggests 12[b]. Janét, ¶¶333-334.

As explained in §§IV.E.1-3, the Knoll-Fu-007 combination’s control unit 11 receives images from camera 6, detects cleanliness levels (characteristic) of pool surface areas based on the images by comparing them to a threshold, and based on this detected cleanliness, controls drive means 12 to adjust cleaning intensity (e.g., motor speed) in the specific areas. Fu-007, pp.10, 12-16; Knoll, [0028]; Janét, ¶334.

A POSITA would have understood or found it obvious that the Knoll-Fu-007 system would determine an area that contains the debris as a “target area” because it was the area being sensed by the camera for purposes of, among other things, detecting cleanliness levels. Janét, ¶334.

d. 12[c]

The Knoll-Fu-007 discloses or suggests 12[c]. Janét, ¶¶335-337.

As explained in §§IV.E.1-3, the Knoll-Fu-007 combination’s control unit 11 detects cleanliness levels (characteristic) and generates control signals that control drive means 12 (part of vehicle 1) of vehicle 1 to adjust wheel speeds and cleaning intensity based on detected cleanliness levels. Fu-007, pp.10, 12-16; Knoll, [0028]; Janét, ¶336. A POSITA would have understood that the Knoll-Fu-007 combination’s control signals that control drive means 12 of vehicle 1 are “a control response” that is generated “based on the detected characteristic” (cleanliness level) of the target area (the determined specific pool surface area where the cleanliness is detected). Janét, ¶336.

5. Claim 13

Claim 13 depends from Claim 12. The Knoll-Fu-007 combination discloses or suggests claim 13. Janét, ¶¶338-341. As explained in §IV.E.1, a POSITA would have been motivated to combine Knoll and Fu-007, with a reasonable expectation of success. *Id.*

a. 13[a]

As explained in §IV.E.4.c (12[b]), the Knoll-Fu-007 combination teaches or suggests determining a target area of the pool for sensing of cleanliness of “the **bottom** of the swimming pool.” Fu-007, pp.10, 14-16, Claim 7; Janét, ¶339; *see also* §§IV.E.2-3 (Knoll-Fu-007, Claims 7-8). Thus, Knoll-Fu-007 combination teaches or suggests the target area comprises a portion of a surface (bottom) of the swimming pool. Janét, ¶339.

b. 13[b]

The Knoll-Fu-007 combination discloses or suggests 13[b], because as explained in §IV.E.4.c (12[b]), the Knoll-Fu-007 combination detects a cleanliness level (characteristic) of the bottom (portion of the surface) of the swimming pool. Fu-007, pp.10, 14-16, Claim 7; Janét, ¶340; *see also* §§IV.E.2-3 (Claims 7-8).

6. Claim 14

Claim 14 depends from Claim 12. The Knoll-Fu-007 combination discloses or suggests Claim 14. Janét, ¶¶342-343. As explained in §IV.E.1, a POSITA would have been motivated to combine Knoll and Fu-007, with a reasonable expectation of success. Specifically, Knoll’s robotic vehicle 1 constitutes the “piece of equipment” for the swimming pool. Janét, ¶342; *see also* §IV.D.3.b (2[a]). Further, as explained above, a POSITA would have been motivated to add Fu-007’s functionalities to Knoll’s control unit 11 to Fu-007, thus generating a control response that controls

the operation of drive means 12 (part of robotic vehicle 1) to move robotic vehicle 1 based on the detected cleanliness levels. Fu-007, pp.10, 12-16, Claim 7; Knoll, [0028]; Janét, ¶342; *see also* §IV.E.4.d (12[c]).

7. Claim 19

Claim 19 depends from Claim 12. The Knoll-Fu-007 combination discloses or suggests Claim 19. Janét, ¶¶344-349. As explained in §IV.E.1, a POSITA would have been motivated to combine Knoll and Fu-007, with a reasonable expectation of success. *Id.*

a. 19[a]

The Knoll-Fu-007 combination discloses or suggests 19[a]. Janét, ¶¶345-346.

As explained above, the Knoll-Fu-007 combination's control unit 11 generates the control response by controlling the drive means 12, which move and steer robotic vehicle 1 (cleaning device), which is “a cleaning device configured to travel adjacent to submerged or water-containing surfaces of the swimming pool or spa and to perform a cleaning operation.” Fu-007, pp.10, 12-16, Claim 7; Knoll, [0028]; Janét, ¶346; *see also* §§IV.E.4.d, IV.E.6 (Knoll-Fu-007, 12[c], Claim 14), §§IV.D.4, IV.D.10.b (Knoll, Claim 3, 19[b]).

b. 19[b]

The Knoll-Fu-007 combination discloses or suggests 19[b]. Janét, ¶¶347-349.

As explained above, the Knoll-Fu-007 combination's control unit 11 controls drive means 12 to adjust wheel speeds and cleaning intensity of robotic vehicle 1 based on detected cleanliness levels. Fu-007, pp.10-11, 15; Knoll, [0028]; Janét, ¶348; *see also* §§IV.E.4.d, IV.E.6 (Knoll-Fu-007, 12[c], Claim 14). Specifically, Fu-007 teaches that “the rotational speed of each wheel 3 is adjustable” and “[t]hrough different wheel speed combinations, cleaning actions with different cleaning intensities can be implemented,” thereby varying mechanical cleaning force based on detected surface conditions. Fu-007, pp.10, 14-16, Claim 7; Janét, ¶348. This constitutes controlling both the speed of the cleaning device (through adjustable wheel speeds) and the aggressiveness of mechanical cleaning (through variable cleaning intensities) as claimed. Janét, ¶348.

F. Ground 2C: Claims 10 and 17 are Unpatentable over Knoll, Fu-007, and Hsu

1. Motivation to Combine

Knoll, Fu-007, and Hsu all disclose autonomous cleaning robots using cameras and controllers to perform cleaning operations with user monitoring and control capabilities. Janét, ¶350. The Knoll-Fu-007 combination provides a pool cleaning robot with camera-based navigation (Knoll) and wireless communication capability via Fu-007's control signal buoyant antenna 27 that “floats on a water surface to wirelessly communicate” with control keyboard 31. Knoll, [0015], [0028];

Fu-007, pp.8-16, Claims 4-5, 7, FIG. 8; §IV.E.1; Janét, ¶351. Hsu provides a display interface showing a map that is “updated dynamically” and “can be transmitted to the display screen on an external electronic device,” where users can interact with the map to control the robot. Hsu, [0018]-[0022], [0033]-[0034], Claims 3, 6-8, 12, 15-16, FIGS. 1-5; §IV.C.1. A POSITA would have been motivated to combine the complementary teachings of Knoll-Fu-007 and Hsu to achieve improved visual monitoring and user control of cleaning operations. Janét, ¶353.

A POSITA would have been motivated to apply Hsu’s camera-based map construction, remote display, and user interaction functionalities to the Knoll-Fu-007 combination. Janét, ¶¶354-357. First, this modification would have advanced Knoll’s stated goal to achieve “complete and efficient cleaning of a pool floor and/or the pool walls,” with the working area being “optimized and/or completely covered.” Knoll, [0007]; Janét, ¶355. A POSITA would have recognized that adding Hsu’s remote map display would enable users to verify that Knoll’s “complete” coverage is being achieved by visually monitoring the robot’s location and progress. Janét, ¶357.

Second, a POSITA would have been motivated to make such modification to provide users with remote monitoring and control. Janét, ¶¶358-361. Hsu teaches that the map “can be transmitted to the display screen on an external electronic device 130,” and that users can interact with the display to control the robot. Hsu,

[0019], [0021], Claims 7, 16, 20, FIGS. 4-5. Fu-007 similarly teaches remote user control via control keyboard 31 “to directly or indirectly control the underwater cleaning robot.” Fu-007, pp.8-10, 14, Claim 5. A POSITA would have recognized that combining Hsu’s graphical map display with Fu-007’s user control functionality would allow users to both monitor cleaning progress and send control commands from a remote device. Janét, ¶¶361.

A POSITA would have reasonably expected success, because the Knoll-Fu-007 combination already has the necessary components: camera 6 capturing images of pool surfaces (Knoll), control unit 11 with image processing capabilities (Knoll), and wireless communication with a user control interface (Fu-007’s antenna 27 and control keyboard 31). Knoll, [0015], [0028]; Fu-007, pp.9-10, 14; Janét, ¶¶362-370. The modification would involve routine software changes to implement Hsu’s camera-based map construction and transmit the map to external devices for display and user interaction—a straightforward task yielding predictable results. *Id.*

2. Claim 10

Claim 10 depends from Claim 2. The combination of Knoll, Fu-007, and Hsu discloses or suggests Claim 10. Janét, ¶¶371-378.

Knoll teaches that control unit 11 (controller) receives images (visual data) from camera 6. Knoll, [0018], [0028], FIG. 1. Control unit 11 processes images from

camera 6 for distance measurement, obstacle detection, and navigation control. Knoll, [0015], [0018], [0028], FIG.1; Janét, ¶372; §§IV.D.2.f-IV.D.2.g, IV.D.3.d (1[e][i]-1[e][ii], 2[c][i]-2[c][ii]).

As explained in §IV.B.1, Fu-007 teaches wireless communication via control signal buoyant antenna 27 that “floats on a water surface to wirelessly communicate.” Fu-007, pp.8-10, 12-16, Claims 4-5, 7, FIG. 8.

As explained in §IV.C.1, Hsu teaches that a map is constructed and “updated dynamically...based on the real-time working environment information,” and “can be transmitted to the display screen on an external electronic device 130 [e.g., a PDA].” Hsu, Abstract, [0018]-[0021], [0024], [0033]-[0034], Claims 3, 6-9, 12, 15-16, FIGS. 1-5. Hsu also teaches that the dynamically updated map reflects “real-time working environment information” including detected obstacles. Hsu, [0020].

As explained in §IV.F.1, a POSITA would have been motivated to combine Knoll, Fu-007, and Hsu with a reasonable expectation of success. Janét, ¶375. In the combined system, Knoll’s control unit 11 would receive images from camera 6 (visual data), construct a graphical map (graphical depiction; per Hsu) showing working area 3, boundary surface 4, robot position, and detected obstacles based on the camera images, and transmit this graphical map via Fu-007’s wireless communication system to external electronic device 130 (remote device; per Hsu) for display. Knoll, [0015], [0018], [0028]; Hsu, [0018]-[0021], Claims 7, 16, FIGS.

1-4; Fu-007, pp.9-10, 14, Claim 4, FIG. 8; Janét, ¶375. The map would be updated dynamically as robot 1 moves and camera 6 captures images during cleaning operations. Hsu, [0020], [0033]-[0034], Claims 3, 6, 8-9, 12, 15-16; Janét, ¶375.

Hsu's external electronic devices 130/130a constitute "remote device" as claimed. Hsu, [0021], FIG. 4; Janét, ¶376. A POSITA would have understood that presenting the graphical map on the remote device display constitutes the "control action" based on visual data from camera 6, as recited in Claim 10. Janét, ¶376.

As explained in IV.F.1, a POSITA would have reasonably expected success in make such modification. Janét, ¶377.

3. Claim 17

Claim 17 depends from Claim 12. The Knoll-Fu-007-Hsu combination discloses or suggests Claim 17. Janét, ¶¶379-392.

a. 17[a]

The Knoll-Fu-007-Hsu combination discloses or suggests 17[a]. Janét, ¶¶380-384. As explained in §IV.F.1, a POSITA would have been motivated to combine Knoll, Fu-007, and Hsu with a reasonable expectation of success.

As explained in §IV.F.1 (Claim 10), the combined system displays a dynamically updated map of the working area on an external electronic device (remote device). Additionally, Hsu teaches that this remote interface allows users to

actively “set a working boundary” on the display screen and control the robot through electronic device 130. Hsu, [0019], [0021]; Janét, ¶382.

A POSITA would have understood that displaying this interactive map on the remote device constitutes “prompting a user,” because the interface presents the user with the current status (e.g., robot position, existing boundaries) and provides the option to modify boundaries or control the robot, thereby soliciting user engagement and inviting a control decision. Janét, ¶383. Thus, the act of generating the display with these interactive boundary-setting options on a remote device serves as the control response that prompts the user on that device. *Id.*

As explained in IV.F.1, a POSITA would have reasonably expected success in make such modification. Janét, ¶384.

b. 17[b]

The Knoll-Fu-007-Hsu combination discloses or suggests 17[b]. Janét, ¶¶385-392.

Knoll teaches that “a boundary line and/or boundary surface within the meaning of the invention is not necessarily to be understood as a line or surface directly delimiting the working area,” but rather “it is also possible to realize an embodiment in which the boundary line and/or the boundary surface is/are arranged at a distance from the outer boundaries of the working area.” Knoll, [0007]. *See also*

§IV.D.1. Thus, Knoll contemplates user-defined working boundaries that can be set within the pool area, not just following physical pool walls. Janét, ¶386.

Fu-007 discloses “control signal buoyant antenna 27” that “floats on a water surface to wirelessly communicate with the control keyboard 31.” Fu-007, pp.8-10, 12-16, Claims 4-5, 7, FIG. 8. Fu-007 further teaches that “a control signal is sent by manual operation using the control keyboard, to directly or indirectly control the underwater cleaning robot via the control signal buoyant antenna.” Fu-007, pp.8-10, 14, Claim 5; §IV.B.1.

Hsu teaches that “users can set a working boundary for the autonomous robot 1 on the display screen on the electronic device 130” and that “autonomous robot 1...can be controlled remotely such that users can assign a working zone for the autonomous robot 1 or control the autonomous robot 1 through the electronic device 130...via the communication platform 110.” Hsu, [0021], FIG. 4; §IV.C.1.

In the Knoll-Fu-007-Hsu combination, users would provide control input by setting a working boundary on external electronic device 130 (remote device), defining the working zone for Knoll’s robotic vehicle 1 to clean. Hsu, [0021]; Janét, ¶389. This control input would be transmitted via Hsu’s communication platform 110 and Fu-007’s wireless communication system (buoyant antenna 27) to Knoll’s control unit 11, which would then control robotic vehicle 1 (equipment) to operate within the user-defined working zone. Hsu, [0021]; Fu-007, pp.9-10, 14, FIG. 8;

Knoll, [0027]-[0028]; Janét, ¶389. This constitutes “receiving a control input from the user on the remote device for controlling a piece of equipment of the swimming pool.” Janét, ¶389.

A POSITA would have been motivated to make this combination, in addition to the reasons explained in §IV.F.1, to achieve Knoll’s stated goal of optimizing “the working area” by enabling users to define custom working boundaries “arranged at a distance from the outer boundaries of the working area” via Hsu’s remote interface. Knoll, [0007]; Hsu, [0021]; Janét, ¶390. This modification would have allowed users to specify particular areas requiring cleaning without physically adjusting pool-side equipment—a practical benefit that a POSITA would have recognized. Janét, ¶390.

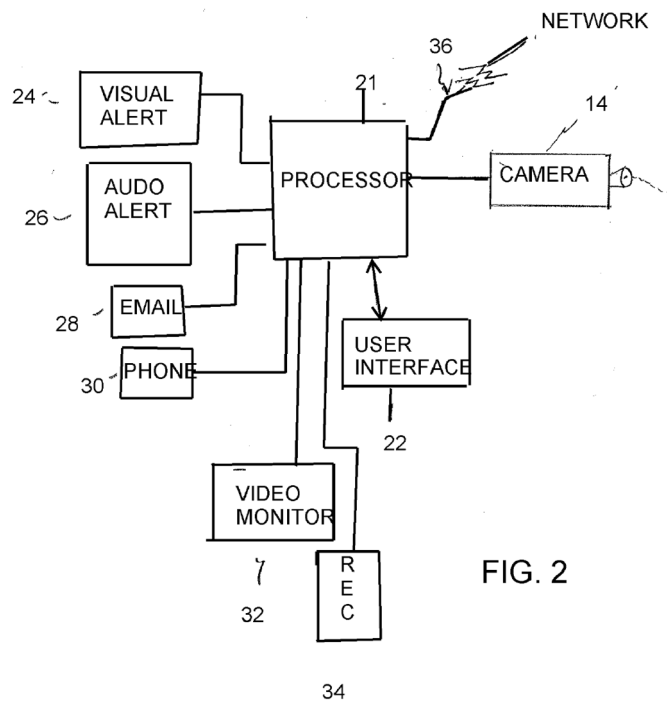
As explained in IV.F.1, a POSITA would have reasonably expected success in make such modification. Janét, ¶391.

G. Ground 3: Claims 2, 4, 7, 12, and 14-16 are Unpatentable over Laitta

1. Laitta

Laitta (EX1012) discloses a “pool video safety...system” for monitoring “swimming pool areas.” *Id.*, Abstract, [0001].

Laitta’s system monitors pool 12 using a camera 14 that is “positioned to have a view of the area being observed.” *Id.*, [0016]-[0017], FIGS. 1-2 (reproduced below).



Laitta discloses that “[o]n detection of an alert condition as viewed by camera 14 and interpreted by processor 21,” an alarm, e.g., “a visual alert” or “audio alert” may be provided. *Id.*, [0018]. Laittai’s processor utilizes criteria such as “motion,” “size of object,” and “speed” to “determine whether an alarm event has taken place.” *Id.*, [0020].

2. Claim 2

Laitta discloses or suggests Claim 2. Janét, ¶¶393-407.

a. 2[pre]

Laitta discloses or suggests 2[pre]. Janét, ¶¶394-395.

Laitta discloses a “pool video safety...system.” Laitta, Abstract, [0001]. Laitta’s system monitors “pool 12” using cameras and control equipment. Laitta, [0016], FIG. 2 (below).

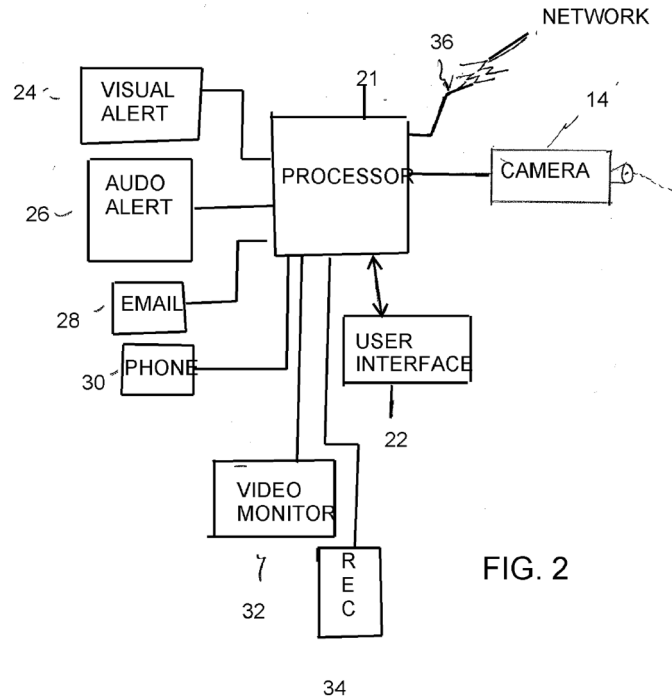


FIG. 2

b. 2[a]

Laitta discloses or suggests 2[a]. Janét, ¶¶396-397.

The '207 Patent does not define “equipment for a swimming pool or spa,” but describes some device outputting “an alert...upon the **person’s detected presence.**” EX1001, 3:56-64. Similarly, Laitta’s system includes alert devices—“a visual alert (flashing light...)” and “audio alert (horn, bell...)”—triggered “[o]n detection of an alert condition.” Laitta [0016]-[0018]. Laitta’s alert devices constitute “equipment

for a swimming pool” because they operate to detect entry into the pool’s monitoring area. EX1001, 3:56-64; Laitta [0016]-[0018]; Janét, ¶¶397.

c. 2[b]

Laitta discloses or suggests 2[b]. Janét, ¶¶398-400.

Laitta’s pool system includes camera(s) 14 that observe pool 12 and are “positioned to have a view of the area being observed.” Laitta, [0016]-[0017], FIG. 1 (below).

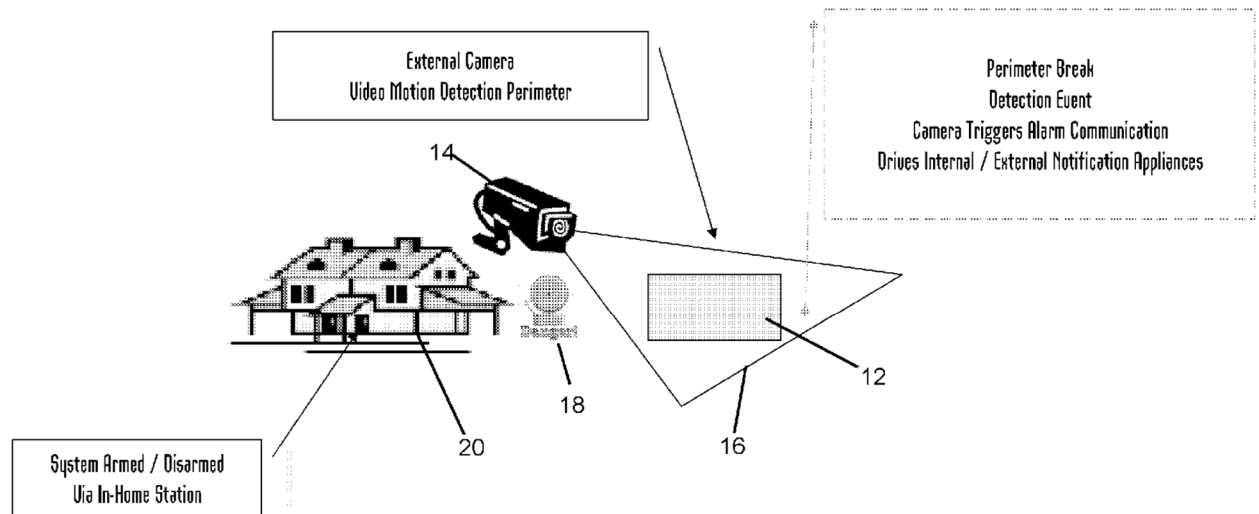
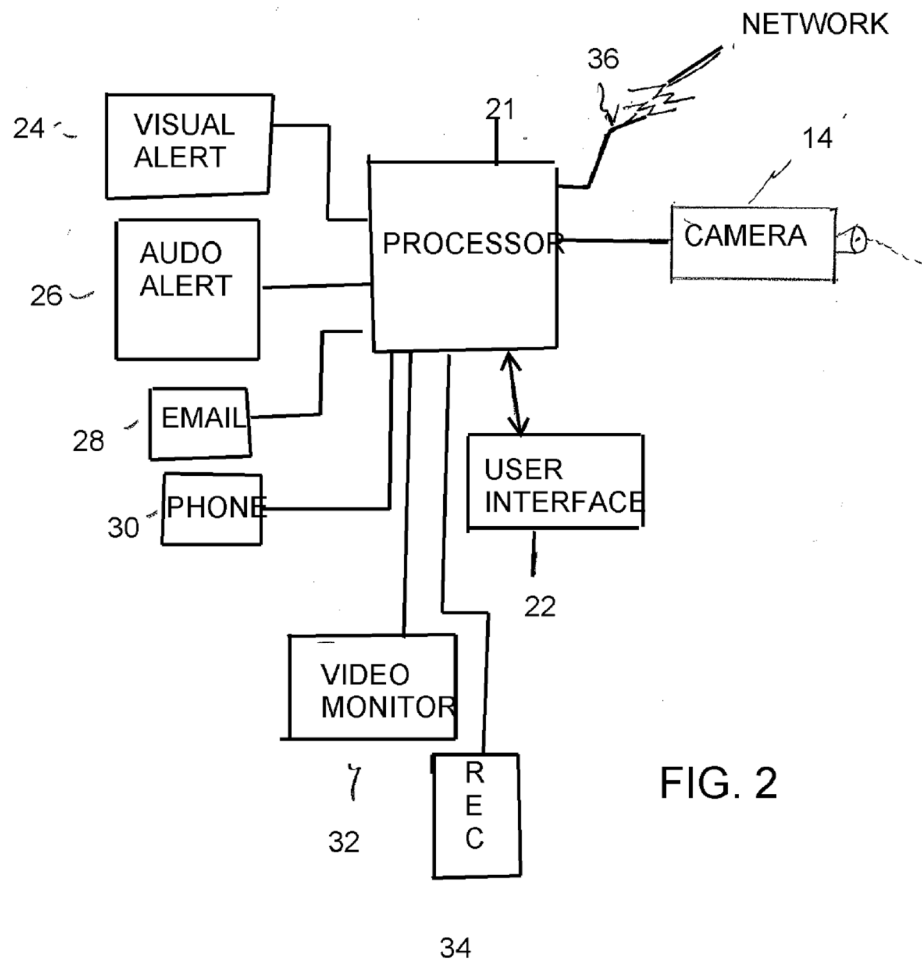


FIG. 1

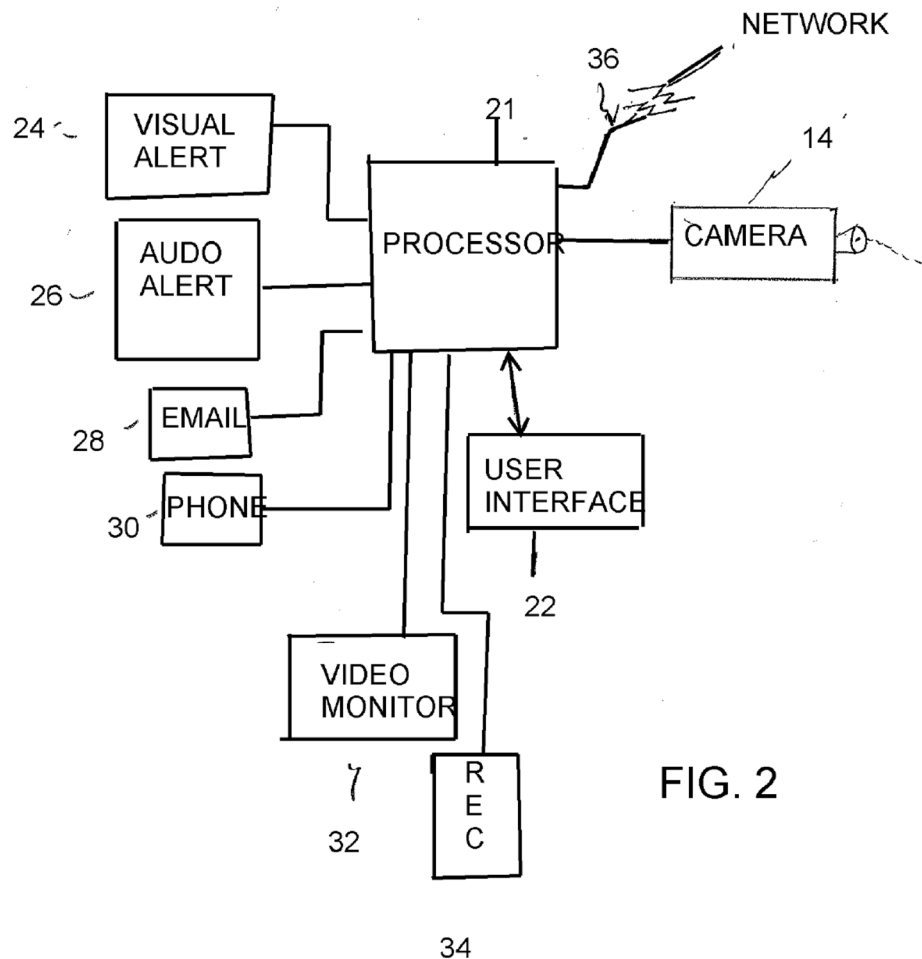
Laitta describes sending “an email with attached images selected from **the images from the camera**,” “a video monitor 32...enabl[ing] viewing of the **image being supplied by the camera**,” and “a recorder 34...record[ing] **the images supplied by the camera 14**.” *Id.*, [0018]-[0019], FIG. 2 (below). A POSITA would have understood that Laitta’s camera captures those images. Janét, ¶400.



d. 2[c][i]

Laitta discloses or suggests 2[c][i]. Janét, ¶¶401-404.

Laitta's system includes a processor 21 (controller) wired to camera 14 and to visual alert 24, audio alert 26, email alert 28, and/or telephone alert 30. *See* Laitta, FIG. 2 (below).



Laitta describes that “[t]he output of the camera is supplied to a processor 21,” which “interfaces with a visual alert 24, an audio alert 26, an email...alert 28 and a telephone alert 30.” *Id.*, [0017]. Laitta further explains that “[o]n detection of an alert condition as viewed by camera 14 and interpreted by processor 21, an alarm may be sounded,” including the visual, audio, email, and telephone alerts. *Id.*, [0018]. Because processor 21 receives image data from camera 14 and drives the alert devices, it is a controller in communication with both the camera(s) and the equipment.

e. 2[c][ii]

Laitta discloses or suggests 2[c][ii]. Janét, ¶¶405-406.

Laitta's processor (controller) receives visual/image data from camera 14. *See* §IV.G.2.d (2[c][i]). Laitta's processor 21 also determines a control action for alert devices (equipment) based on the received visual data, because alerts are triggered "as viewed by camera 14 and interpreted by processor 21," after which "an alarm may be sounded," with the processor interfacing with "a visual alert..., an audio alert..., an email...alert...and a telephone alert." Laitta, [0017]-[0018]. Laitta further explains the processor uses decision criteria—"motion," "size of object," and "speed"—to "determine whether an alarm event has taken place." Laitta, [0020]. Laitta's processor's determining (and generating) alert signals constitutes "determine[ing] a control action" for alert devices (equipment) based on the received visual data, because Laitta's processor analyzes images to decide whether an event occurred and then activates the visual/audio/email/telephone alert devices, based on the received visual/image data. *Id.*; Janét, ¶406.

3. Claim 7

Laitta discloses or suggests claim 7. Janét, ¶¶411-414.

Laitta's processor (controller) analyzes the visual data from camera 14 to detect a person being present or an "alarm event." Laitta, [0017]-[0018], [0020]; §§IV.G.2.d-e (2[c][i]-[ii]). A POSITA would have understood that a person being

present or an alarm event constitutes a “characteristic of the location,” because it describes the state of the monitored area. Janét, ¶412.

Laitta’s processor then controls the alert devices (equipment) to output alerts based on the detected characteristics (e.g., presence of a person). *See* §IV.G.2.e (2[c][ii]); Janét, ¶413.

4. Claim 12

Laitta discloses or suggests Claim 12. Janét, ¶¶415-422.

a. 12[pre]

Laitta discloses or suggests 12[pre], because it discloses “a pool video safety...system” that monitors “pool areas” using cameras and processor to detect conditions and generate responses. Laitta, Title, Abstract, [0016]-[0018], FIGS 1-2; Janét, ¶416; §IV.G.1.

b. 12[a]

Laitta discloses or suggests 12[a], because Laitta’s processor (controller) receives images from camera 14, and a POSITA would have understood that these are “images of at least a portion of a location including a swimming pool,” as Laitta explains that “pool 12 is observed by...cameras 14 which observe the pool area” (FIG. 1, observation perimeter 16). Laitta, [0017]-[0019], FIG. 1; Janét, ¶417; §§IV.D.3.d-e (2[c][i]-2[c][ii]).

c. 12[b]

Laitta discloses or suggests 12[b]. Janét, ¶¶418-420.

Laitta discloses determining monitoring/monitored zones or sensing area (target area). Laitta, [0016]-[0018], [0022], FIG. 1; Janét, ¶419. Specifically, Laitta teaches that “observation perimeter 16...is defined around the pool” and **“monitoring zones may be set...which define monitored zones...used when determining alarm conditions,”** while “areas in the field of view can be masked off or...be ignored or specifically observed.” Laitta, [0016]-[0018], [0022], FIG. 1. Thus, Laitta’s system determines the target area by defining observation perimeter 16 (or monitoring/monitored/sensing zones) and applying masking/foreground-background separation. Laitta, [0016]-[0018], [0020], FIG. 1 (below); Janét, ¶419.

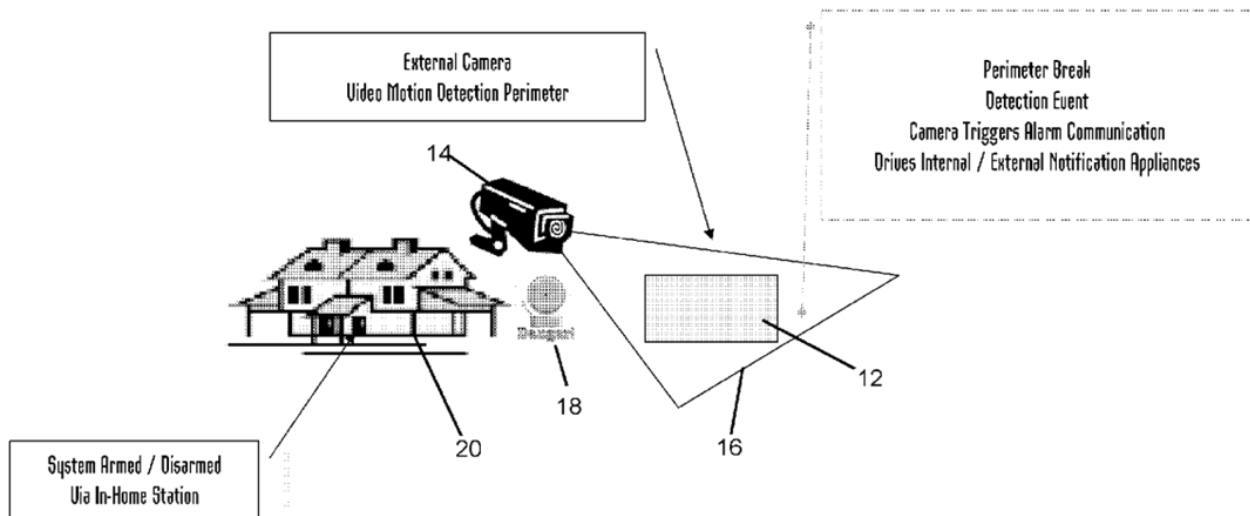


FIG. 1

Laitta also discloses detecting a characteristic of the target area based on the images, because its processor (controller) analyzes visual data to detect presence of

a person or an “alarm event” within the monitored zones (target area). *See* §IV.G.3 (Claim 7). A POSITA would have understood that this presence of a person constitutes a characteristic of the target area (i.e., its occupancy or security status), which is detected based on the processor’s analysis of visual parameters like motion, size, and speed in the images. Janét, ¶420.

d. 12[c]

Laitta discloses or suggests 12[c], because its system generates a control response—actuating alert devices (e.g., visual alert 24, audio alert 26)—based on the detected occupancy or security status (characteristic) of monitoring/monitored/sensing zones (target area). Laitta, [0016]-[0018], [0020], FIGS. 1-2; Janét, ¶421; §IV.G.2.e (2[c][ii]).

5. Claim 14

Laitta discloses or suggests claim 14, because Laitta’s processor generates the control response by controlling the operation of pool equipment (alert device)—visual alert 24, audio alert 26, and/or email alert 28—to produce an alert upon a detected occupancy or security status (characteristic) of monitoring/monitored/sensing zones (target area). Laitta [0016]-[0018], [0020], FIG. 2 (below); Janét, ¶423; §IV.G.2.b (2[a]) and §IV.G.4.d (12[c]).

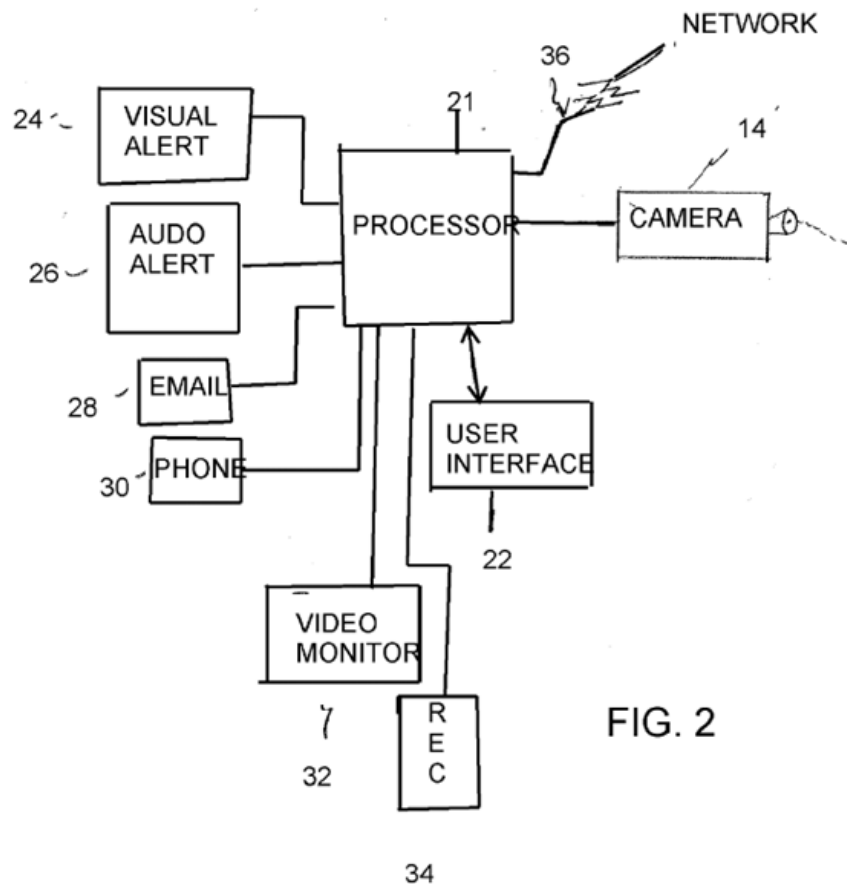
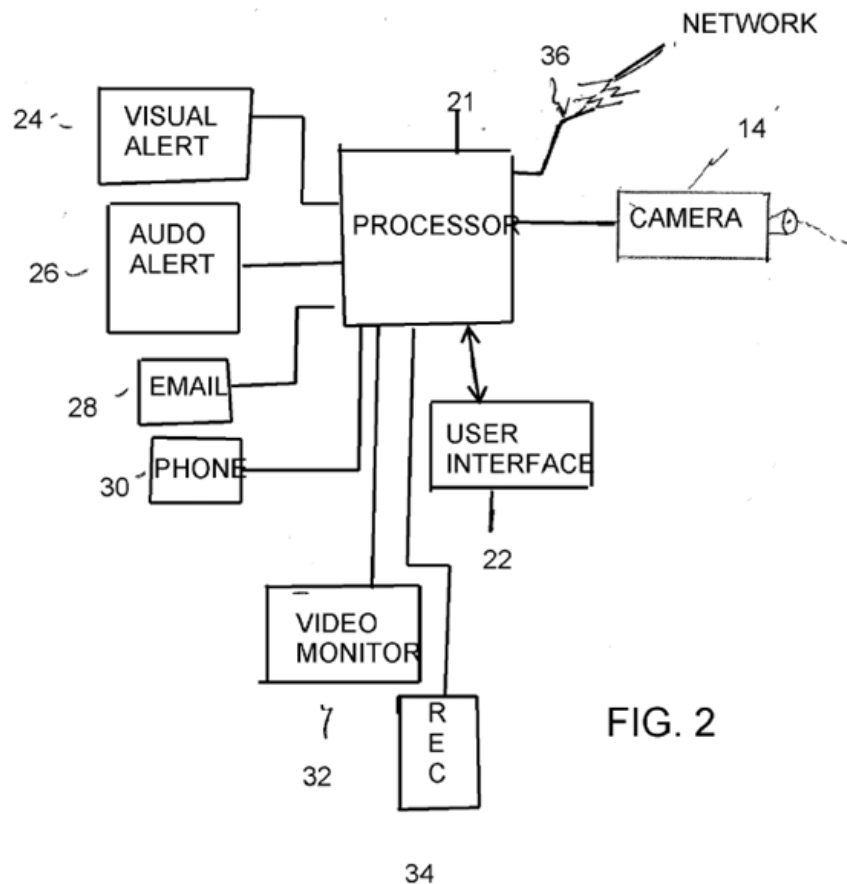


FIG. 2

6. Claim 15

Laitta discloses or suggests claim 15. Janét, ¶¶425-427.

Laitta discloses generating an alert as the control response. *See* §IV.G.5 (claim 14). Laitta also discloses that the alert is on a remote device, because it teaches an **email alert** “with attached images” and a **telephone alert** that “might call...phone numbers (**cell phone**...),” and provides “video monitor 32...to enable viewing of the image...**from a location remote** from the pool.” Laitta, [0018]-[0019], [0021], FIG. 2 (below); Janét, ¶426.



7. Claim 16

Laitta discloses or suggests claim 16, because Laitta's alert (control response) includes a telephone alert calling (wireless communicating) a "cell phone" (remote device). Laitta, [0018]; Janét, ¶428; §IV.G.4.d (12[c]). Laitta also discloses an email alert (control response) "with attached images," sent via interface 36 "adapted to connect to a network," which a POSITA would have understood or found obvious to be delivered wirelessly (cellular/Wi-Fi) to, e.g., a cellphone. Laitta, [0018], [0021]; Janét, ¶428.

V. CONCLUSION

The Board should institute IPR and cancel the Challenged Claims.

VI. MANDATORY NOTICES

A. Real Party in Interest

Petitioner identifies itself as a real party in interest. The following are identified as additional real parties in interest: Deepwater Innovation Technology (Hong Kong) Limited and Xingmai Innovation Technology (Suzhou) Co., Ltd.

B. Related Matters

To the best of Petitioner's knowledge, the '207 Patent has been involved in the following cases:

- Beatbot Technology (USA) Co. Ltd. et al v. Zodiac Pool Systems LLC, No. 3:25-cv-01946 (S.D. Cal.).
- Zodiac Pool Sys. LLC v. Wybotics, Co. Ltd., Case No. 2:25-cv-00582 (E.D. Tex).
- Wybotics Inc. et al v. Zodiac Pool Systems LLC. Case No. 2-25-cv-08526 (C.D. Cal.).
- Wybotics Inc. et al v. Zodiac Pool Systems LLC, IPR2026-00158 (PTAB).

Petitioner is also concurrently filing Petitions for *Inter Partes* Review of U.S. Patent Nos. the 11,003,191 and 11,262,766, which are related to the '201 Patent challenged herein.

C. Notice of Counsel and Service Information

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

LEAD COUNSEL	BACK-UP COUNSEL
Kyle R. Canavera Reg. No. 72,167 Perkins Coie LLP 11452 El Camino Real, Suite 300 San Diego, CA 92130-2080 Phone: 858.720.5700 Fax: 858.720.5799 canavera-ptab@perkinscoie.com	Wei Yuan Reg. No. 71,772 Perkins Coie LLP 11452 El Camino Real, Suite 300 San Diego, CA 92130-2080 Phone: 858.720.5700 Fax: 858.720.5799 yuan-ptab@perkinscoie.com
BACK-UP COUNSEL	BACK-UP COUNSEL
Bing Ai Reg. No. 43,312 Perkins Coie LLP 11452 El Camino Real, Suite 300 San Diego, CA 92130-2080 Phone: 858.720.5700 Fax: 858.720.5799 ai-ptab@perkinscoie.com	Xiaobing Zhang Reg. No. 63,929 Perkins Coie LLP 11452 El Camino Real, Suite 300 San Diego, CA 92130-2080 Phone: 858.720.5700 Fax: 858.720.5799 zhang-ptab@perkinscoie.com
BACK-UP COUNSEL	BACK-UP COUNSEL
Babak Tehrani Reg. No. 55,937 Perkins Coie LLP 11452 El Camino Real, Suite 300 San Diego, CA 92130-2080 Phone: 858.720.5700	

Fax: 858.720.5799 tehranchi-ptab@perkinscoie.com	
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D. Power of Attorney

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

Respectfully submitted,

/ Kyle R. Canavera /

Kyle R. Canavera
Reg. No. 72,167
Attorney for Petitioner

Date: January 26, 2026

PERKINS COIE LLP
11452 El Camino Real Ste 300
San Diego, CA 92130-2080

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

Pursuant to 37 C.F.R. §42.24(a), Petitioner hereby certifies that portions of the above-captioned Petition for *inter partes* review of U.S. Patent No. 11,880,207, in accordance with and reliance on the word count provided by the word-processing system used to prepare this Petition, that the number of words in this paper is 13,961. Pursuant to 37 C.F.R. §42.24(a), this word count is in compliance and excludes the table of contents, table of authorities, mandatory notices under §42.8, certificate of service, certificate of word count, appendix of exhibits, and any claim listing. This word count was prepared using Microsoft Word.

Respectfully submitted,
/ Kyle R. Canavera /

Kyle R. Canavera
Reg. No. 72,167
Attorney for Petitioner

PERKINS COIE LLP
11452 El Camino Real Ste 300
San Diego, CA 92130-2080

Date: January 26, 2026

CERTIFICATE OF SERVICE

The undersigned hereby certifies that true copies of the Petition for *inter partes* review of U.S. Patent No. 11,880,207 and supporting materials (Exhibits and Power of Attorney) were served via FedEx delivery on the Patent Owner at the correspondence address of record as listed on PAIR:

Kilpatrick Townsend & Stockton LLP - East Coast
Mailstop: IP Docketing - 22
1100 Peachtree Street
Suite 2800
Atlanta, GA 30309

A courtesy copy was also sent via electronic mail to Patent Owner's litigation counsel listed below:

Christopher Samuel Leah - cleah@kilpatricktownsend.com
Kathleen Rose Geyer - kgeyer@ktslaw.com
Steven David Moore - stevemore@velaw.com

Respectfully submitted,
/Meghan Bright/

Meghan Bright
Patent Paralegal

Date: January 26, 2026