



## TRANSLATION CERTIFICATION

Date: December 9, 2025

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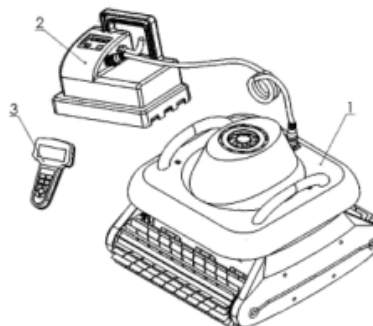
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[54] **Title of Invention**

Remote-controlled sequential swimming pool  
cleaning robot and its sequential cleaning method

[57] **Abstract**

The present invention relates to a remote-controlled sequential swimming pool cleaning robot, which comprises a cleaning robot main unit, a power control box, and a remote controller. The cleaning robot main unit comprises a filter, a housing body component, an axial-flow pump and a sealed enclosure, a housing cover component, left and right transmission systems, cleaning rollers, and a self-buoyant cable. The left and right transmission systems respectively drive the front and rear cleaning rollers to rotate, the external teeth of the timing belt contact the pool bottom or pool wall to drive the robot to crawl, the outer edge of the cleaning belt on the cleaning roller generates sliding friction with the pool bottom or pool wall to perform scrubbing; an overload sensor is provided in the control system of the cleaning robot to detect and determine touching conditions during crawling and cleaning and to issue a corresponding signal to cause the cleaning robot to enter the next step of program operation; the remote controller has a two-way communication function, and the display screen can display operating status and fault alarms. The robot plans and designs cleaning paths for swimming pools of different shapes, adopting a full-span back-and-forth path method and a half-span back-and-forth path method, thereby achieving full-coverage cleaning for swimming pools of different shapes.



1. A remote-controlled sequential swimming pool cleaning robot, comprising a cleaning robot main unit, a power control box, and a remote controller, characterized in that: the cleaning robot main unit comprises a filter, a housing body component, an axial-flow pump and a sealed enclosure, a housing cover component, left and right transmission systems, cleaning rollers, and a self-buoyant cable; the filter is at the bottom of the cleaning robot main unit, installed at an opening in a lower part of the housing body, and sealingly connected by a sealing ring; the axial-flow pump and the sealed enclosure are initially positioned on ribbed bosses on two inner sides of the housing body and fixed to the housing body, two drive motor shafts respectively extend from two sides of the sealed enclosure and are connected to toothed belt drive pulleys of the transmission systems, a motor shaft of the axial-flow pump extends from a sealed enclosure cover, on which a five-blade impeller and a flow guide cover are mounted, and a control circuit board of an underwater controller is mounted inside the sealed enclosure cover; the housing cover component is sealingly connected to the upper-end opening of the housing body by a sealing member in a sealing groove on the inner side of the housing cover, connection holes on both side edges of the housing cover are aligned with positioning holes on the sealed enclosure cover of the axial-flow pump and the sealed enclosure, and are fastened; the transmission system comprises a left transmission system and a right transmission system, the left and right transmission systems being fastened on two sides of the housing body in central symmetry; one end of a drive end cap of the front and rear cleaning rollers is connected to a corresponding toothed drive pulley on the transmission system, and one end of a transmission end cap is connected to an inner bore of a bearing of a corresponding toothed transmission pulley on the transmission system; the filter, the housing body component, the axial-flow pump and sealed enclosure, and the housing cover form the axial-flow pump with the filter; the impeller and the flow guide cover at an upper portion of the axial-flow pump and the sealed enclosure form a pump head; the filter, the housing body component, and the housing cover are sealingly connected to form an axial-flow pump housing; two check valves on a bottom plate of the filter serve as water inlets of the axial-flow pump; a space between the axial-flow pump and the sealed enclosure, the housing body, and the housing cover serves as an inlet water flow passage of the axial-flow pump; an upper portion of the housing cover serves as an outlet water flow passage of the axial-flow pump; a passage formed between a locknut and a guide vane serves as a water discharge outlet of the axial-flow pump; the cleaning robot main unit is bilaterally symmetrical, and the cable is exits from a rear end on an upper side of the housing cover along a crawling direction.

2. The remote-controlled sequential swimming pool cleaning robot according to claim 1, characterized in that: the cleaning robot main unit has one cleaning roller at each of its front and rear ends, and a diameter of the outer edge of a cleaning belt on a cleaning roller is greater than a pitch-circle diameter of a toothed end pulley on the transmission system.

3. The remote-controlled sequential swimming pool cleaning robot according to claim 1, characterized in that: a buoyancy box is provided in the housing cover component, and the buoyancy box is located at a top portion of the cleaning robot main unit.

4. The remote-controlled sequential swimming pool cleaning robot according to claim 1, characterized in that: the power control box comprises a low-power-consumption switching power supply and a waterproof cable receptacle; the cleaning robot cable is a self-buoyant cable, and is connected to the cleaning robot main unit by a waterproof connector.

5. The remote-controlled sequential swimming pool cleaning robot according to claim 1, characterized in that: an accelerometer is provided on the circuit board of the underwater controller.

6. The remote-controlled sequential swimming pool cleaning robot according to claim 1, characterized in that: the remote controller provides two-way communication, a display screen displays an operating status of the cleaning robot main unit and receives alarm signals, and membrane keys are configured to set an automatic work mode and manual operations, communication circuit board 34.

7. The remote-controlled sequential swimming pool cleaning robot according to claim 1, characterized in that: outer toothed surfaces of timing belts of the left transmission system and the right transmission system contact a pool bottom or pool wall, and maintain a bottom surface of the housing body of the cleaning robot main unit at a distance of 15 mm from the pool bottom or pool wall.

8. A sequential cleaning method of a remote-controlled sequential swimming pool cleaning robot, characterized in that: a cleaning route sequence is planned and designed, and accelerometer and wall-climbing height control signals are used to control a cleaning robot main unit to crawl along a planned route, thereby performing sequential full-coverage cleaning of the pool.

9. The sequential cleaning method of the remote-controlled sequential swimming pool cleaning robot according to claim 8, characterized in that: different path cleaning methods are adopted for cleaning pool bottoms of different shapes:

for a rectangular pool, a full-span back-and-forth path cleaning method is adopted, wherein after the cleaning robot main unit touches a pool wall it automatically adjusts its direction with the cleaning roller departing perpendicularly from the pool wall, crawls 0.5 m and stops, then turns left or right 90° and then crawls forward 0.35 m and stops, then turns back 90°, returns to the direction at the moment of departing from the pool wall and crawls toward the pool wall, and after touching the wall again retreats and crawls to an opposite pool wall; the above actions are repeated, and when the cleaning robot main unit moves from one end of the pool to the other end, full-coverage sequential cleaning of the rectangular pool bottom is completed;

for a non-rectangular pool, a half-span back-and-forth path cleaning method is adopted; after the cleaning robot main unit touches a pool wall, it automatically adjusts its direction with the cleaning roller departing perpendicularly from the pool wall, crawls 0.5 m and stops, turns left or right 90° and crawls forward 0.35 m and stops, then turns back 90°, returns to the direction at the moment of departing from the pool wall and crawls toward the pool wall, after touching the wall again, retreats and crawls toward the opposite pool wall and stops halfway, turn left or right 90, crawls forward 0.35 m and stops, then turns back 90° and crawl toward the initial pool wall to touch the wall,

the above actions are repeated; when the cleaning robot main unit moves along the pool wall for one complete circuit, full-coverage sequential cleaning of the non-rectangular pool bottom is completed.

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**Remote-Controlled Sequential Swimming Pool Cleaning Robot and its Sequential Cleaning Method****Technical Field**

The present invention relates to a cleaning device, and particularly relates to a remote-controlled sequential cleaning robot for cleaning swimming pools and a sequential cleaning method.

**Background Art**

Swimming pools provided for people's swimming activities must be kept clean and sanitary. Usually, the pool water is replaced regularly, and manual methods are adopted to clean the pool. In recent years, some developed countries and regions have adopted automated mechanical equipment, such as automatic pool cleaners, which can automatically clean pools without draining the pool water. This not only saves precious water resources, but also replaces the heavy labor of manually cleaning the pool. Among these cleaners are suction cleaners that only clean the pool bottom, wall-climbing nonsequential cleaners that can automatically clean the pool bottom and walls, and more advanced controllable cleaners capable of crawling and turning left and right, but they have not yet achieved sequential and full-coverage cleaning.

The cleaning strength of existing pool cleaners is relatively weak, and strong scrubbing has not been achieved for the cleaned pool bottom, pool walls, and scale lines; A typical pool cleaner generally has an internal-filter type filter component, the connection between this component and the housing is often not tight, and pool water containing washed-off dirt easily flows directly into the housing and mixes with the filtered water to cause secondary pollution; In the prior art, cleaning rollers are generally used as the cleaning components, and commonly, both the front and rear cleaning rollers are split into left and right parts at the middle, so that they can be driven by left and right transmission components to achieve maneuvering turns to the left and right, but when the cleaning roller is split at the middle, the section between the left and right parts cannot be cleaned, which is not conducive to full-coverage cleaning.

### Summary of the Invention

The objective of the present invention is to provide a remote-controlled sequential swimming pool cleaning robot, capable of automatically performing sequential full-coverage cleaning of a swimming pool.

Another objective of the present invention is to design a path for sequential cleaning, and, for swimming pools of different shapes, to adopt two types of path planning, namely a full-span back-and-forth cleaning path and a half-span reciprocating cleaning path.

The present invention adopts the following technical solution: a remote-controlled sequential swimming pool cleaning robot, comprising a cleaning robot main unit, a power control box, and a remote controller, characterized in that: the cleaning robot main unit comprises a filter, a housing body component, an axial-flow pump and a sealed enclosure, a housing cover component, left and right transmission systems, cleaning rollers, and a self-buoyant cable; the filter is at the bottom of the cleaning robot main unit, installed at an opening in the lower part of the housing body, and sealingly connected by a sealing ring; the axial-flow pump and sealed enclosure is initially positioned on a ribbed boss on the inner side of the housing body and fixed to the housing body, two drive motor shafts respectively extend out from the two sides of the sealed enclosure and are connected to toothed-belt drive pulleys of the transmission system, the axial-flow pump motor shaft extends out from the sealed enclosure cover, with a five-blade impeller and a flow guide cover mounted thereon, and the control circuit board of an underwater controller is installed inside the sealed enclosure cover; the housing cover component is sealingly connected to an upper-end opening of the housing body through a sealing member in a sealing groove on the inner side of the housing cover, connection holes on both sides of the housing cover are aligned with positioning holes on the sealed enclosure cover of the axial-flow pump and sealed enclosure, and are fastened; the transmission systems are a left transmission system and a right transmission system, and the left and right transmission systems are fastened on two sides of the housing body in symmetry about the center; the driving end cap of the front and rear cleaning rollers has one end connected to a corresponding toothed driving pulley on the transmission system, and one end of the transmission end cap is connected to a bearing inner bore of a corresponding toothed transmission pulley on the transmission system; the filter, the housing body component, the axial-flow pump and sealed enclosure, and the housing cover form an axial-flow pump with a filter; an impeller and a flow guide cover at the upper end of the axial-flow pump and the sealed enclosure forms a pump head; the filter, the housing body component, and the housing cover are a sealingly connected to form an axial-flow pump housing; two check valves on a bottom plate of the filter are water inlets of the axial-flow pump; the space between the axial-flow pump and the sealed enclosure and between the housing body and the housing cover is the inlet flow passage of the axial-flow pump;

the upper end of the housing cover is the outlet flow passage of the axial-flow pump; the intermediate passage between the locknut and the guide vanes is the discharge outlet of the axial-flow pump; the cleaning robot main unit is left-right symmetrical, and the cable is led out from the rear end on the housing cover along the crawling direction.

The cleaning robot main unit has one cleaning roller at each of its front and rear ends, and the diameter of the outer edge of the cleaning belt on the cleaning roller is greater than the pitch-circle diameter of the toothed belt pulley on the transmission system.

The housing cover component has a buoyancy box, and the buoyancy box is at the top of the cleaning robot main unit.

The power control box is equipped with a low-power switch-mode power supply and a waterproof cable socket; the cleaning robot cable is a self-buoyant cable and is connected to the cleaning robot main unit with a waterproof connector.

An accelerometer is provided on the circuit board of the underwater controller.

The cleaning crawl path of the swimming pool cleaning robot main unit is related to the shape, size, and depth of the swimming pool being cleaned. When cleaning the pool bottom or performing a comprehensive cleaning of pools, the present invention adopts two different path control methods for pools of different shapes: for rectangular pools, a full-span back-and-forth path control method is used, whereas for non-rectangular pools, a half-span back-and-forth path control method is used. The “full-span” refers to the distance between opposite faces of the pool walls, and the “half-span” refers to one half of the distance between opposite faces of the pool walls. Below, taking the pool bottom cleaning mode as an example, these two control methods are described:

The full-span back-and-forth path control method is a control program for the cleaning robot to clean the bottom of a rectangular swimming pool: when the sensor detects wall contact, the microcontroller determines that the cleaning robot main unit has touched the wall and issues a command; after the robot automatically adjusts its direction, it stops crawling, then reverses crawling 0.5 m perpendicular to the wall at that location and stops; the timing belts on both sides of the robot main unit run in reverse, and it rotates in place about its central axis clockwise by 90° and stops; the two drive motors are started, the timing belts on both sides of the robot main unit run synchronously in the same direction, and the robot main unit crawls forward 0.35 m and stops; next, the timing belts on both sides of the robot main unit run in reverse at equal speed, and it rotates back counterclockwise by 90° about its central axis and stops; at this time the direction of the robot main unit is the same as that when it backed off upon touching the wall, except that it has shifted 0.35 m to the right. Immediately thereafter, the robot main unit crawls toward the pool wall and soon touches the wall; the sensor detects it, the microcontroller determines wall contact, and at this moment the robot automatically adjusts its direction and then stops crawling. The microcontroller issues a crawling command,

the timing belts on both sides of the robot main unit crawl backward in the same direction at equal speed along a straight line, the robot main unit departs perpendicularly from the pool wall until its rear-end cleaning roller touches the wall; at this moment the sensor detects it, the microcontroller determines that the cleaning robot main unit has touched the wall and issues a command to stop reverse crawling; the robot main unit turns back 0.5 m perpendicular to the pool wall and stops, then turns 90° clockwise and advances 0.35 m, then turns 90° counterclockwise, whereupon the direction of the robot main unit is consistent with the direction when it touches the wall and it has shifted 0.35 m to the right. The microcontroller issues a command to crawl backward, the rear end of the robot main unit crawls toward the pool wall; when the sensor detects it and the microcontroller determines wall contact, the robot stops crawling; the microcontroller issues a command to crawl forward, the robot main unit departs perpendicularly from the pool wall and crawls in a straight line toward the pool wall at the front end of the robot main unit, returning to the same side of the pool wall as at the start. This is repeated back and forth, and the crawling path of the robot is a reciprocating serpentine route shifting toward the right side. When the starting point is at one end of the pool and the end point is at the other end of the pool, the cleaning robot performs sequential full-coverage cleaning of the pool. The starting point and end point of cleaning can be realized by the cleaning robot first performing preparatory cleaning measurements and determinations.

The half-span back-and-forth path-control method is the mode for the robot main unit to clean the bottom of a non-rectangular swimming pool. The automatic crawling cleaning path of the cleaning robot main unit is carried out according to the control program of the selected working mode: when the sensor detects and the microcontroller determines that the cleaning robot has contacted the wall, the momentum when the robot main unit crawls and touches the wall allows its cleaning roller to automatically become parallel to the pool wall, and then it stops crawling; the microcontroller issues a reverse command, the front end of the robot main unit may depart perpendicularly from the pool wall and crawl backward 0.5 meters and stop; after turning clockwise 90°, it advances 0.35 meters and stops; then it turns counterclockwise 90°, the front end of the robot main unit turns toward the pool wall and crawls toward the pool wall; when the sensor detects and the microcontroller determines that the cleaning robot main unit touches the wall, the microcontroller issues a command to reverse, the front end of the robot main unit departs perpendicularly from the pool wall, crawls backward in a straight line to the middle of the pool or stops under timing-program control after reversing approximately half of the distance relative to the pool wall, the microcontroller issues a command to advance, the robot main unit, under timing-program control, returns along the reverse route and advances a certain distance and stops crawling, the microcontroller issues a command to turn clockwise 90° and then advance 0.35 meters and stop, the robot main unit shifts 0.35 meters to the right of the forward route, then after turning counterclockwise 90° it crawls forward, and after the robot main unit crawls in a straight line and touches the wall, under the effect of the momentum of touching the wall by crawling, it automatically adjusts its direction so that the cleaning roller is parallel to the pool wall, and the robot main unit returns to the starting pool wall. The sensor detects it, the

microcontroller determines wall contact, the microcontroller issues a command to crawl backward a half-span distance, the robot main unit departs perpendicularly from the pool wall and crawls backward a half-span distance, and its crawling path may intersect with the path previously traveled. By repeating the actions in this way, the robot main unit may clean the pool bottom along a clockwise half-span back-and-forth path along the pool wall, and when it has moved along the pool wall one lap, it may have performed full-coverage sequential cleaning of the bottom of the non-rectangular swimming pool.

**Beneficial Effects of the Present Invention:**

1. The turning mechanism of the cleaning robot main unit enables the cleaning robot main unit to turn during a crawling cleaning process and to automatically crawl to all areas of the swimming pool.
2. An overload sensor is provided on the drive control circuit board to detect and determine wall contact status of the cleaning robot and issue a corresponding signal, thereby controlling the cleaning robot main unit to perform sequential cleaning.
3. The swimming pool cleaning robot of the present invention can perform sequential full-coverage cleaning of pools of different shapes.
4. The swimming pool cleaning robot of the present invention has functions including automatic crawling, wall climbing, automatic cleaning, automatic filtration, and centralized collection of scrubbed-off dirt to avoid secondary pollution during the cleaning process.
5. Sealed connections are adopted for the connection among the filter, the housing body, and the housing cover of the cleaning robot main unit to ensure that the filtered pool water is not contaminated.
6. The outer toothed surfaces of the timing belt of the cleaning robot of the present invention contact the pool bottom or pool wall, and it is the running of the timing belt that drives the cleaning robot main unit to crawl.
7. The diameter of the outer edge of the cleaning belt on the cleaning roller of the present invention is greater than the pitch-circle diameter of the timing-belt pulley of the cleaning roller; the linear speed at the outer edge of the cleaning belt is greater than the running speed of the timing belt, i.e., greater than the crawling speed of the cleaning robot main unit; when the outer edge of the cleaning belt contacts the pool bottom or wall during a crawling process of the cleaning robot main unit, sliding friction with the pool bottom or wall produces powerful scrubbing.
8. In the present invention, a buoyancy box is provided at a top portion of the cleaning robot main unit to provide buoyancy for the robot and to provide stabilizing torque.

9. The cleaning robot main unit of the present invention is generally bilaterally symmetrical, and the cable is led out along the crawling direction, providing favorable conditions for maintaining the crawling direction.

10. The power control box in the present invention is provided with a low-power-consumption switching power supply and a waterproof cable socket.

11. Effective measures are adopted in the present invention to reduce energy consumption, such as selecting an axial-flow pump with a high-efficiency impeller and using rolling bearings instead of sliding friction in the transmission system.

12. In the present invention, the cleaning robot main unit adopts a self-buoyant cable, and uses a waterproof cable connector for connection, making operation more convenient.

13. The remote controller in the present invention provides two-way communication, and its display can show the operating status of the cleaning robot main unit and receive alarm signals; by using membrane keys to set the automatic working mode and manual operation, the cleaning robot main unit works according to the operator's intention.

14. The cleaning robot of the present invention has automatic shutdown protection and alarm when the main unit emerges from water, jam alarm and protection when the main unit is stuck during cleaning, and a filter-pocket pore clogging alarm, and other functions.

15. The cleaning robot of the present invention crawls in a sequential manner according to a set program and does not have cable entanglement problems during a cleaning process.

16. The present invention provides two effective sequential cleaning methods for the cleaning robot. Different cleaning-path methods are adopted for pool bottoms of different shapes: the full-span back-and-forth path cleaning method is adopted for rectangular pools, and the half-span back-and-forth path cleaning method is adopted for non-rectangular pools.

### **Brief Description of the Drawings**

Figure 1, a perspective view of the composition of the remote-controlled sequential swimming pool cleaning robot;

Figure 2, the cleaning robot main unit in the present invention;

Figure 3, showing the power control box in the present invention;

Figure 4, the remote controller in the present invention;

Figure 5, the filter component of the cleaning robot main unit of the present invention;

Figure 6, the housing body component of the cleaning robot main unit of the present invention;

Figure 7, the axial-flow pump and the sealed enclosure of the cleaning robot main unit of the present invention;

Figure 8, the housing cover component of the cleaning robot main unit of the present invention;

Figure 9, the transmission system of the cleaning robot main unit of the present invention;

Figure 10, the cleaning roller of the cleaning robot main unit of the present invention;

Figure 11, the self-buoyant cable component of the cleaning robot main unit of the present invention;

Figure 12, the key function diagram of the remote controller of the present invention;

Figure 13, the schematic diagram of the power, control, and communication circuits of the present invention;

Figure 14, a schematic diagram of three alarm-protection circuits of the present invention;

Figure 15, a workflow diagram of the robot of the present invention cleaning the bottom of a rectangular swimming pool;

Figure 16, a workflow diagram for the robot cleaning the bottom of a non-rectangular swimming pool;

In the figures, 1. Cleaning robot main unit with cable; 2. Power control box; 3. Remote controller; 11. Filter; 12. Housing body component; 13. Axial-flow pump and sealed enclosure; 14. Housing cover component; 15. Transmission system; 16. Cleaning roller; 17. Self-buoyant cable; 21. Cabinet body; 22. Switch-mode power supply; 23. Power control circuit board; 24. Membrane keys; 25. Connecting plate; 26. Connecting angle piece; 27. Base plate; 28. Cable gland with input power cord; 29. Waterproof cable socket; 31. Front housing; 32. Rear housing; 33. Display screen; 34. Communication circuit board; 35. Battery box with battery; 36. Housing sealing ring; 37. Battery box cover; 38. Battery box cover sealing pad; 39. Membrane keys; 111. Filter bottom plate; 112. Sealing ring; 113. Frame; 114. Filter pocket; 115. Rotating carry handle; 116. Silicone cover plate; 117. Pressure plate; 121. Housing body; 122. Discharge port cover plate; 123. Pressure plate; 131. Impeller; 132. Flow guide cover; 133. Coupling shaft with bearing and oil seal; 134. Brushless motor; 135. Sealed enclosure cover with two sealing rings; 136. Heat-conducting plate; 137. Pump motor control board; 138. Underwater controller circuit board;

139. Sealed enclosure body; 139A. Drive motor with connection end plate; 139B. Coupling shaft with oil seal; 139C. Locknut; 140. Waterproof cable gland and cable; 141. Housing cover; 142. Guide vanes; 143. Locknut; 144. Buoyancy box; 145. Handle; 146. Waterproof cable connector socket; 147. Sealing ring; 151. Bracket base; 152. Hexagonal coupling shaft; 153. Toothed-belt driving pulley; 154. Transmission pulley; 155. Double-sided staggered-tooth timing belt; 156. Toothed driving end pulley; 157. Toothed transmission end pulley; 161. Cleaning belt; 162. Drum; 163. Driving end cap; 164. Transmission end cap; 171. Buoyancy cable; 172. Trailing waterproof male plug; 173. Trailing waterproof female plug.

### Specific Embodiments

A cabled remote-controlled sequential swimming pool cleaning robot (see Figure 1) includes a cleaning robot main unit and a cable, a power control box, and a remote controller; the cleaning robot main unit comprises a filter 11, a housing body component 12, an axial-flow pump and a sealed enclosure 13, a housing cover component 14, a transmission system 15, a cleaning roller 16, and a self-buoyant cable 17.

The filter 11 is sealingly connected to a lower-end opening of the housing body 121 via a sealing ring 112 on a flange of the filter bottom plate 111, and a rotating carry handle 115 locks the filter bottom plate 111 at the lower-end opening of the housing body 121; on the filter bottom plate 111 there is also a frame 113 supporting a filter pocket 114, and the pocket mouth drawstring of the filter pocket is tightly tied to the filter bottom plate 111 with a spring buckle.

The housing body component 12 comprises the housing body 121, the discharge port cover plate 122, and the pressure plate 123. The axial-flow pump and the sealed enclosure 13 are installed inside the housing body 121 and are fastened by screws on both sides. The top of the housing body 121 is open, its periphery is sealingly connected with the housing cover component 14, its bottom face has a large opening sealingly connected with the filter 11, three discharge ports are opened respectively at the front and rear underneath, and on the outside of each discharge port, the discharge port cover plate is fixed to the housing body 121 through the pressure plate 123 with pull rivets to form a one-way discharge valve. On the outer sides of both sides of the housing body, there are six guide positioning posts and four positioning connection nuts respectively for connection with the transmission system 15.

The axial-flow pump and sealed enclosure 13 comprises three parts, namely an axial-flow pump head,

a sealed enclosure cover, and a sealed enclosure body. Inside the sealed enclosure, a heat-conducting plate 136 is installed, on which the pump control circuit board and the underwater controller circuit board are fixedly mounted. The axial-flow pump brushless motor 134 is mounted at the center of the sealed enclosure cover 135, its bearing projects outside the cover and is connected to the coupling shaft 133 on which a bearing and a double-lip skeleton oil seal are mounted; the flow guide cover 132 is supported on the coupling shaft by a bearing, its upper end has a double-lip skeleton oil seal to seal with the coupling shaft, and its lower end is sealingly connected to the sealed enclosure cover 135 with a sealing ring; drive motors 139A with connection end plates are mounted at both side ends of the sealed enclosure body 139, the connection end plates are sealingly fitted to holes of the sealed enclosure body by sealing rings and locked with locknuts 139C, and coupling shafts with double-lip skeleton oil seals are plugged onto the shafts of the drive motors 139A and sealingly connected to inner bores of the connection end plates by the double-lip skeleton oil seals. The cable sealing gland 140 with a cable is installed at the center of the bottom surface of the sealed enclosure body 139, and the cable is sealed and led out from inside the sealed enclosure body 139. The sealed enclosure cover 135 and the sealed enclosure body 139 are connected through a cylindrical-surface sealing connection with a sealing ring and are locked with screws. The axial-flow pump and sealed enclosure 13 are initially positioned by ribbed bosses on the two inner sides of the housing body 121 and are fastened at both ends of the sealed enclosure body 139 to the two sides of the housing body 121 with screws. Discharge port cover plates 122 are mounted at the lower ends of the front and rear faces of the housing body 121.

The sealing ring 147 is provided in an inner-side sealing groove of the housing cover component 14 and is sealingly connected to an upper-end opening of the housing body 121. Four connection holes on the housing cover 141 are aligned with corresponding positioning connection holes on the sealed enclosure cover 135 and fixedly connected with screws; at the middle on the top of the housing cover 141, the guide vane 142 and the buoyancy box 144 are locked with the locknut 143 and fixed onto the housing cover 141; handles 145 are mounted on both sides on the top of the housing cover; a waterproof cable-socket female plug 146 is provided at the rear end on the top of the housing cover 141. Thus the filter 11, the housing body component 12, and the housing cover component 14 form the housing of the axial-flow pump; the opening under the silicone cover plate on the filter bottom plate 111 is the pump inlet; formed between the pump head 131, 132 and the housing body 121 and the housing cover 141 is the inlet flow passage of the axial-flow pump, and formed between it and the upper part of the housing cover component is the outlet flow passage of the axial-flow pump.

The transmission system 15 comprises a bracket base 151, a hexagonal coupling shaft 152, a toothed-belt driving pulley 153, six transmission pulleys 154, a toothed driving end pulley 156, a toothed transmission end pulley 157, and a timing belt 155. The timing belt 155 is driven by the toothed-belt driving pulley 153 and runs around between the toothed driving end pulley 156, the transmission pulleys 154, and the toothed transmission

end pulley 157. The transmission system 15 is fixedly connected by screws through locating post holes to both sides of the housing body 121; the lower outer teeth of the timing belt 155 on the transmission system 15 contact the pool bottom or wall; the bottom face of the housing body 121 is 15 mm from the pool bottom; when the timing belt runs, it drives the cleaning robot to move, i.e., to crawl.

The pin of the driving end cap 163 of the cleaning roller 16 is inserted into the hole of the toothed driving end pulley 156 of the transmission system 15; the cylindrical pin of the transmission end cap 164 at the other end of the cleaning roller 16 is inserted into the hole in the inner ring of the bearing bore of the toothed transmission end pulley 157 of the transmission system 15; thus the front and rear cleaning rollers are supported by the left and right transmission systems and are respectively driven to operate by the left and right transmission systems; the cleaning belt of the cleaning roller 16 contacts the pool bottom or wall and, during operation, generates sliding friction with the pool bottom or wall to form a scrubbing function.

The cable used on the cleaning robot is the self-buoyant cable 17, and the waterproof plug 172 at one end is connected to the waterproof socket 173 on the housing cover.

The power control box comprises a cabinet body 21, a switch-mode power supply 22, a power control circuit board 23, membrane keys 24, a connecting plate 25, connecting angle pieces 26, a base plate 27, an input power cord 28, and a waterproof cable socket 29. The switch-mode power supply 22 and the power control circuit board 23 are fixed by screws to the connecting plate 25 via the connecting angle pieces 26; the connecting plate 25 is fastened to the cabinet body 21 with screws, and the base plate 27 is connected to the cabinet body 21 and the connecting plate 25 with screws. The membrane keys 24, which have waterproof capability, are adhesively attached on top of the cabinet body 21. At a stepped shoulder on the top of the cabinet body 21 are installed a waterproof cable gland 28 for the power input cord and a waterproof cable socket male plug 29.

The remote controller comprises a front housing 31, a rear housing 32, a display 33, a communication circuit board 34, a battery box 35, a housing sealing ring 36, a battery box cover 37, a battery box cover sealing pad 38, and membrane keys 39. The display 33, the communication circuit board 34, and the battery box 35 are fixed by screws inside the front housing 31; the membrane keys 39 are bonded to the outer surface of the front housing 31; the sealing ring 36 provides a sealed connection between the front housing 31 and the rear housing 32, which are tightened with screws. The sealing pad 38 is provided under the battery box cover 37 and is fixed through a snap-on slot onto the outside of the rear housing 32.

As shown in Figure 14, a sampling resistor is connected in series in the brushless-motor control circuit to convert the current signal of the pump motor into a voltage signal; this voltage signal is connected to the AD sampling pin of the microcontroller, thereby converting the voltage signal into a digital signal that the

microcontroller can process and recognize. When the water pump operates in different states, its electric current level differs, thereby causing the AD sampling value on the microcontroller to change; corresponding processing is performed according to the change in the AD sampling value, thereby realizing the above three protection functions. When the robot is out of the water, because the load on the water pump decreases, the pump's output power drops and the electric current flowing through the pump in turn decreases; the AD sampling value on the microcontroller decreases, and when the sampling value is lower than a certain value, the microcontroller determines that the machine is already out of the water, performs shutdown protection after a delay of a few seconds, and makes the alarm lamp blink to give a corresponding indication; when the filter screen is clogged, the output power of the water pump rises, thereby causing the AD sampling value of the microcontroller to increase; when the AD sampling value increases to a certain value, the microcontroller determines that the filter screen is clogged, and the alarm lamp blinks as an indication; when the water pump stalls for some reason, the electric current passing through it increases significantly; when the microcontroller's AD sampling value greatly exceeds the normal operating value, the microcontroller determines that the motor is stalled, immediately cuts off the power supply to the pump motor, and makes the alarm lamp blink to give a corresponding indication.

Below, the features and advantages of the present invention are further described through the working process and principles of the remote-controlled sequential swimming pool cleaning robot:

When the swimming pool cleaning robot main unit is operating in the pool, the axial-flow pump motor runs, the impeller of the axial-flow pump rotates to draw the pool water trapped under the housing of the cleaning robot main unit into the housing via the check valves and the filter pocket, and subsequently discharges pressurized clean water to the outside of the housing through the inlet water flow passage and the outlet water flow passage. At the same time, because the axial-flow pump is operating, the pool water under the housing and the clean water inside the housing flow, forming a low-pressure region at the bottom surface of the housing and thus generating suction force, while pressurized clean water is discharged from the outlet water flow passage, generating a reaction pressure on the housing; these two forces provide the robot with a positive pressure for crawling on the pool bottom and climbing walls, which is thereby converted into suction force.

The cleaning robot main unit operates with two travel motors driving its transmission system's timing belts. Because some of the outer teeth of the timing belts contact the pool bottom, when the timing belts are operating, they cause the entire robot to crawl. Climbing on the pool wall is achieved because the friction force generated by the suction provided by the axial-flow pump is greater than the weight of the cleaning robot in water.

When the cleaning robot main unit crawls in the pool, the timing belts drive the cleaning rollers to rotate; because the linear speed at the outer edge of the cleaning belt on the cleaning roller is greater than the linear speed of the timing belts, i.e., greater than the crawling speed of the cleaning robot main unit, sliding friction is generated at the contact between the outer edge of the cleaning belt and the pool bottom or pool wall, producing a scrubbing action. The intensity of its scrubbing action is related to the degree of sliding friction, namely the faster the sliding-friction speed, the stronger the scrubbing action and the greater the scrubbing force. Therefore, the ratio of the difference between the linear speed of the cleaning belt and the crawling speed to the crawling speed is one of the indicators representing scrubbing force, abbreviated as the speed-difference ratio.

As a result of the scrubbing action of the cleaning belt, the cleaning robot main unit automatically cleans the pool while it crawls; the scrubbed-off dirt is confined in the pool water under the robot housing; under the suction action of the axial-flow pump, large amounts of the water under the housing are drawn into the filter, forming a low-pressure region beneath the bottom surface of the housing; the pool water around the bottom of the cleaning robot continuously flows from the gap between the lower part of the cleaning robot main unit and the pool bottom or pool wall into the area under the housing bottom surface, preventing the outward spread of pool water containing scrubbed-off dirt and preventing pollution. The pool water drawn into the filter, after filtration, enters the housing, passes through the inlet flow passage and the outlet flow passage, and the clean water is discharged from the discharge port. In this process, under the action of the axial-flow pump, the scrubbed-off dirt is filtered out by the filter and collected centrally inside the filter, effectively avoiding secondary pollution during cleaning.

Because the transmission systems are arranged in central symmetry on both sides of the cleaning robot main unit, the toothed driving end pulley of the left transmission system is connected at the front end with the driving end cap of the front cleaning roller and drives only the front cleaning roller to operate, while the toothed driving end pulley of the right transmission system is connected at the rear end with the driving end pulley of the rear cleaning roller and drives only the rear cleaning roller to operate. As such, the two drive motors of the cleaning robot respectively drive the left and right transmission systems, and the left and right transmission systems respectively drive the front and rear cleaning rollers to operate. When the left and right timing belts run in the same direction forward (or backward), the front and rear cleaning rollers also run in the same direction accordingly, and the cleaning robot main unit crawls forward or backward. When the left and right timing belts run in opposite directions at equal speed, such as the left side moving forward and the right side moving backward, then the front and rear cleaning rollers rotate in opposite directions; at this time the timing belts on both sides, in running, produce friction forces with the pool bottom in opposite directions, forming a clockwise torque about the central axis of the cleaning robot main unit, whereas the front and rear

cleaning rollers, when rotating oppositely, also produce opposite friction forces with the pool bottom, and they are front-rear symmetric, so they do not produce torque on the central axis of the cleaning robot main unit; at this time the cleaning robot main unit may rotate in place clockwise under the moment of the friction between the timing belts and the pool bottom, and the degree of the rotation angle is determined by the duration of the opposite running of the timing belts on both sides; if the left timing belt runs backward and the right timing belt runs forward, then the cleaning robot main unit may rotate in place counterclockwise. Similarly, when the left and right timing belts on both sides run in the same direction or in opposite directions at different speeds, the cleaning robot may change its crawling direction according to the corresponding rule. The crawling turning mechanism of the transmission system is the technical foundation for the robot to achieve sequential cleaning.

The sequential cleaning workflow diagrams of the cleaning robot of the present invention are as shown in Figures 15–16.

When the remote controller of the present invention is switched on, the display shows the operating state of the cleaning robot, and the function keys on the membrane keypad can be used to select the working mode:

When “A, Clean Pool Bottom” is selected, after the cleaning robot main unit goes into water, when the sensor detects and the microcontroller (MCU) determines that the cleaning robot main unit has touched a pool wall and issues a command, the robot main unit automatically adjusts its orientation so that the cleaning roller is parallel to the pool wall and immediately stops; next it departs perpendicularly from the pool wall and crawls 0.5 meters and stops; it turns clockwise  $90^\circ$  and crawls forward 0.35 meters and stops; then it turns counterclockwise  $90^\circ$  and stops; next it crawls toward a pool wall until it touches the wall, and after touching the wall, it automatically adjusts its orientation and stops; when the sensor detects and the microcontroller (MCU) determines that the wall is touched and issues a command, the robot main unit departs perpendicularly from the pool wall and crawls backward toward the opposite pool wall until touch it or returns at halfway until touching the pool wall again. By repeating the actions in this way, the cleaning of the pool bottom can be completed.

When “B, Clean Pool Wall” is selected, after the cleaning robot main unit goes into water, when the sensor detects and the microcontroller (MCU) determines that the robot has touched a pool wall and issues a command, it continues to crawl up the pool wall; when it reaches the water surface (under time control), the robot main unit reverses to the pool bottom; when the sensor detects and the microcontroller determines that the bottom has been reached and issues a command, the robot main unit continues crawling perpendicularly away from the pool wall for 0.5 m and stops, turns  $90^\circ$  clockwise and then crawls forward 0.35 m and stops, then turns  $90^\circ$  counterclockwise and crawls toward a pool wall, and, after touching the pool wall, continues to climb up the wall; by repeating the actions in this way, cleaning of the pool wall alone can be completed.

When “C, Full Pool Cleaning” is selected, after the cleaning robot main unit goes into the pool, when the sensor detects and the microcontroller determines that the robot main unit has touched a pool wall, it issues a command to continue crawling up the pool wall; when the water surface is reached, under time control, the microcontroller issues a command for the robot main unit to crawl backward to the pool bottom; at this time when the sensor detects and the microcontroller determines the bottom is reached and issues a command, the robot departs perpendicularly from the pool wall and continues crawling until touching the opposite pool wall or returns a half-span until touching a pool wall; after automatically adjusting its orientation, it continues to climb the pool wall; when it reaches the water surface, under time control, the robot main unit crawls backward to the pool bottom; when the sensor detects and the microcontroller determines the bottom is reached and issues a command, the robot main unit departs perpendicularly from the pool wall and continues crawling 0.5 m and stops, turns 90° clockwise and then crawls forward 0.35 m and stops, then turns 90° counterclockwise and crawls toward a pool wall until it touches the wall; when the sensor detects and the microcontroller determines the wall is touched and issues a command, the robot main unit continues to climb the pool wall. By repeating the actions in this way, full cleaning of the entire pool including pool bottom and pool walls can be performed.

When “D, Clean Waterline Scale” is selected, after the cleaning robot main unit goes into water, when the sensor detects and the microcontroller determines that the robot main unit has touched a pool wall and issues a command, it is to continue crawling up the pool wall; when the water surface is reached, under time control, the microcontroller issues a command to control the rotational speeds of the two drive motors to achieve a certain speed difference, enabling the cleaning robot main unit to crawl in an inclined balanced posture on the pool wall and move horizontally along the waterline scale, thereby completing the cleaning of the waterline scale.

When the manual keys for moving forward, backward, and for turning left or right are pressed manually, the cleaning robot main unit may crawl and clean along the path controlled by the operator’s intention.

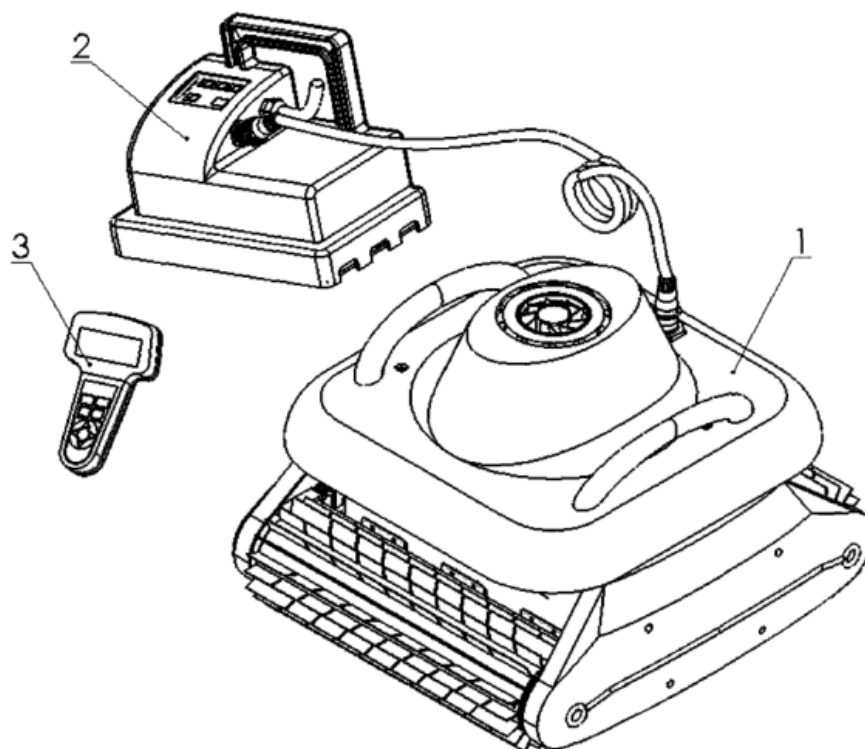


Figure 1

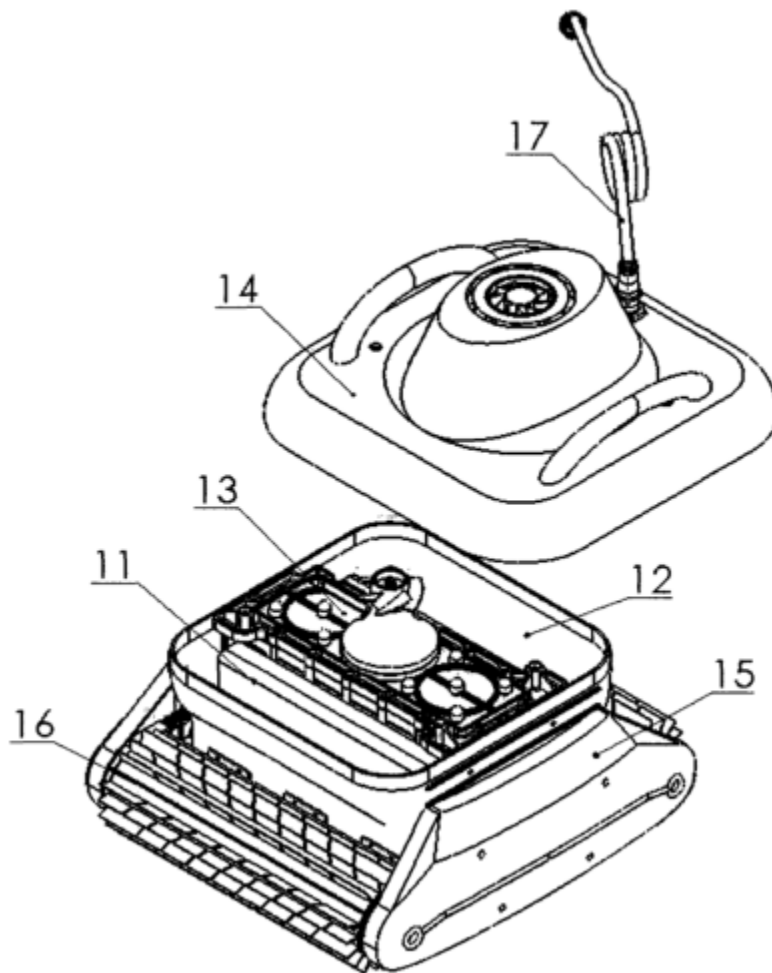


Figure 2

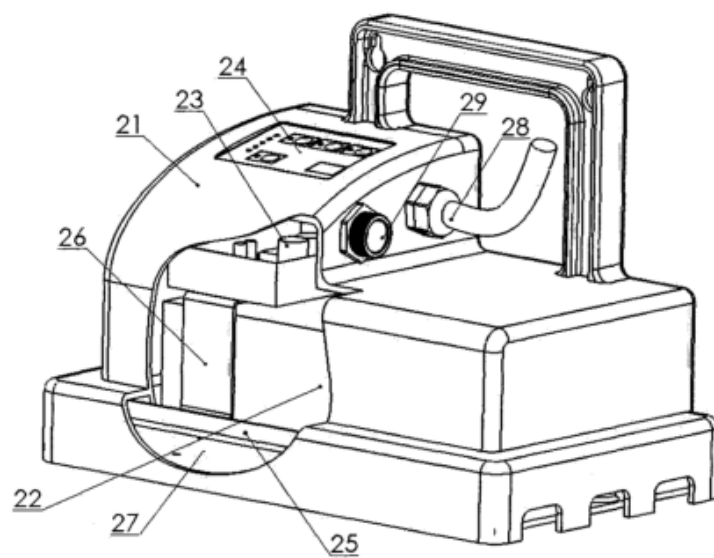


Figure 3

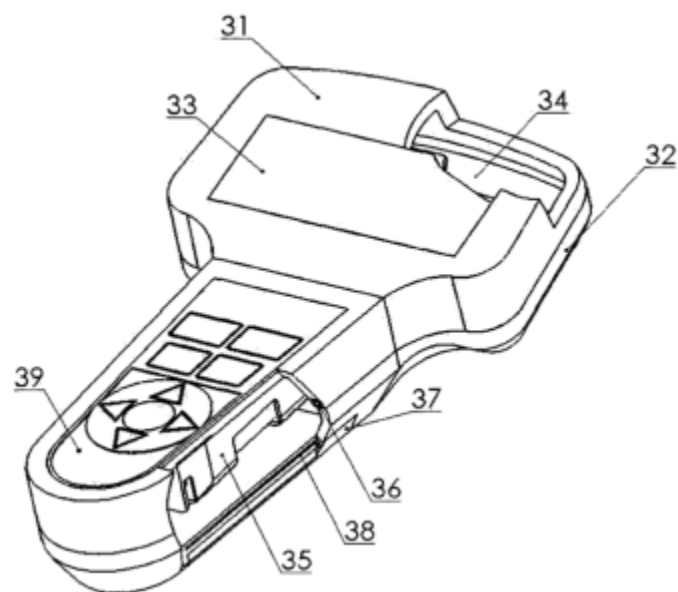


Figure 4

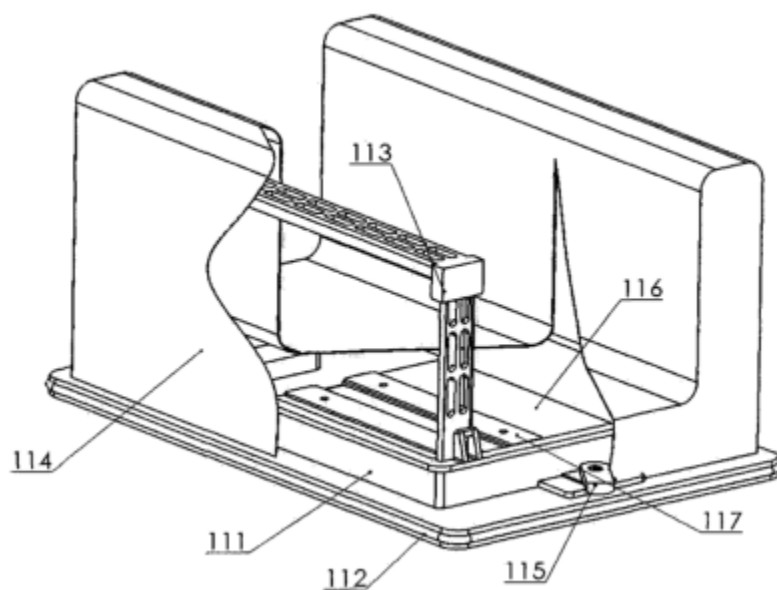


Figure 5

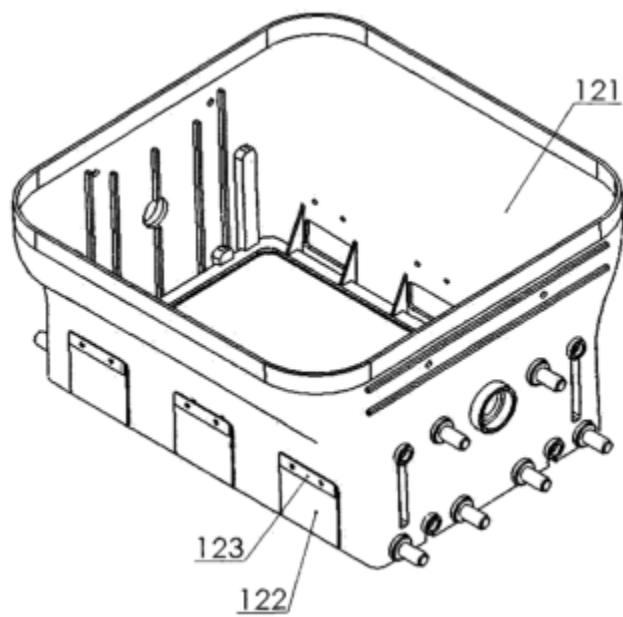


Figure 6

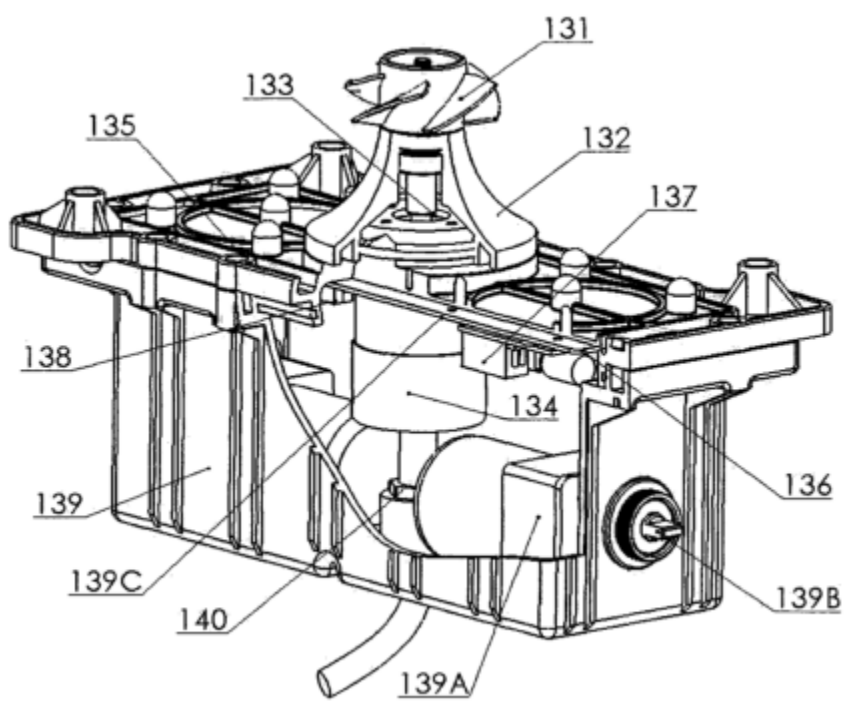


Figure 7

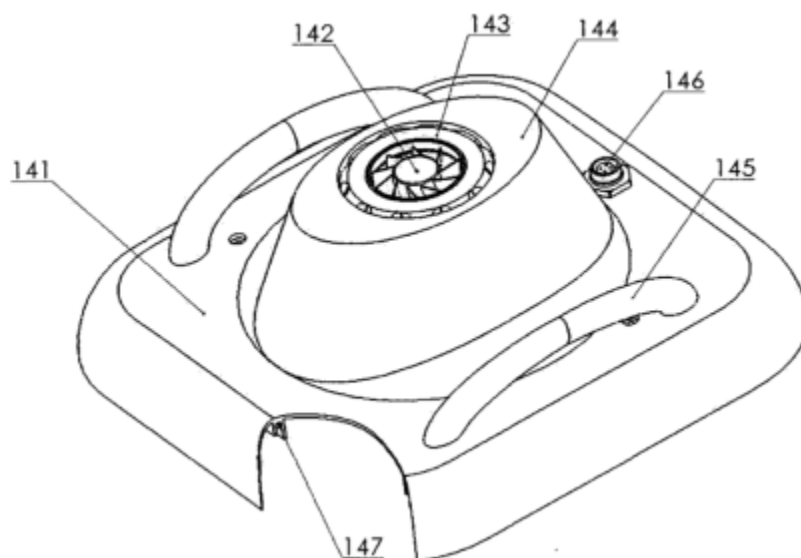


Figure 8

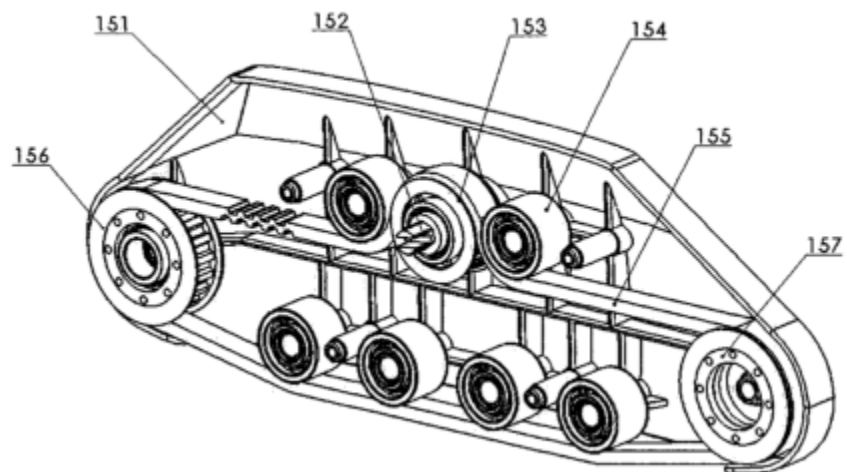


Figure 9

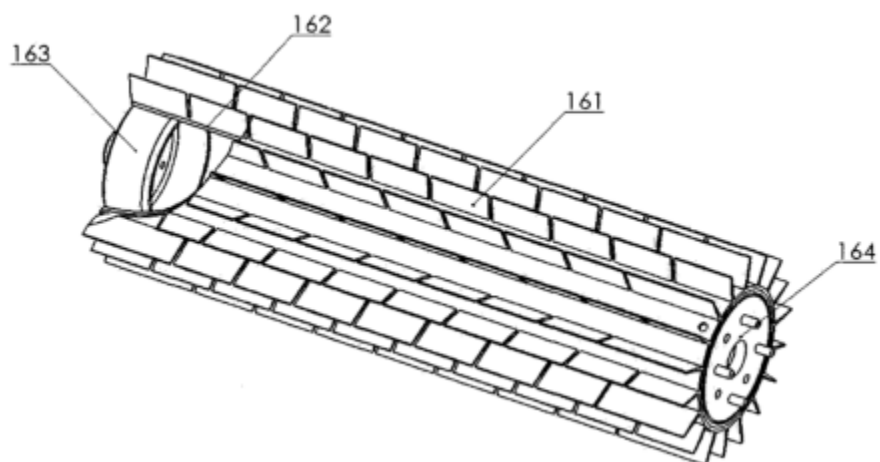


Figure 10

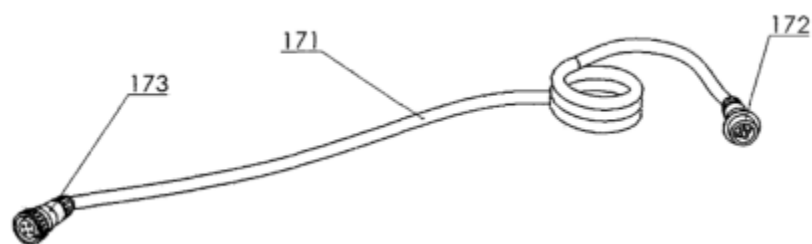


Figure 11

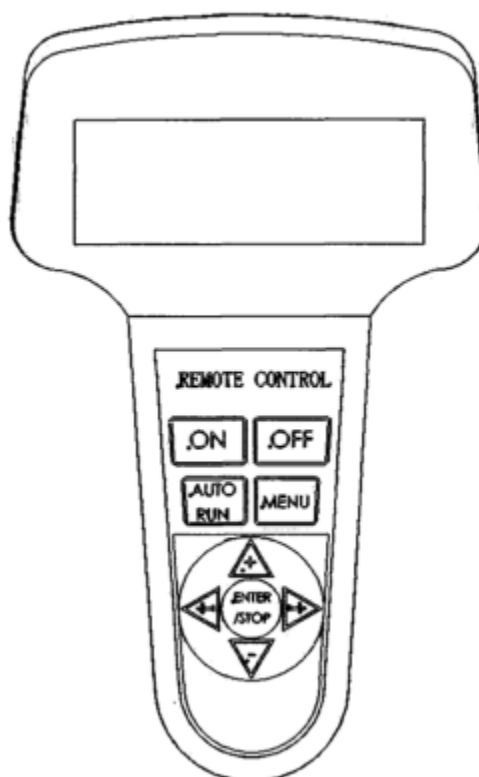


Figure 12

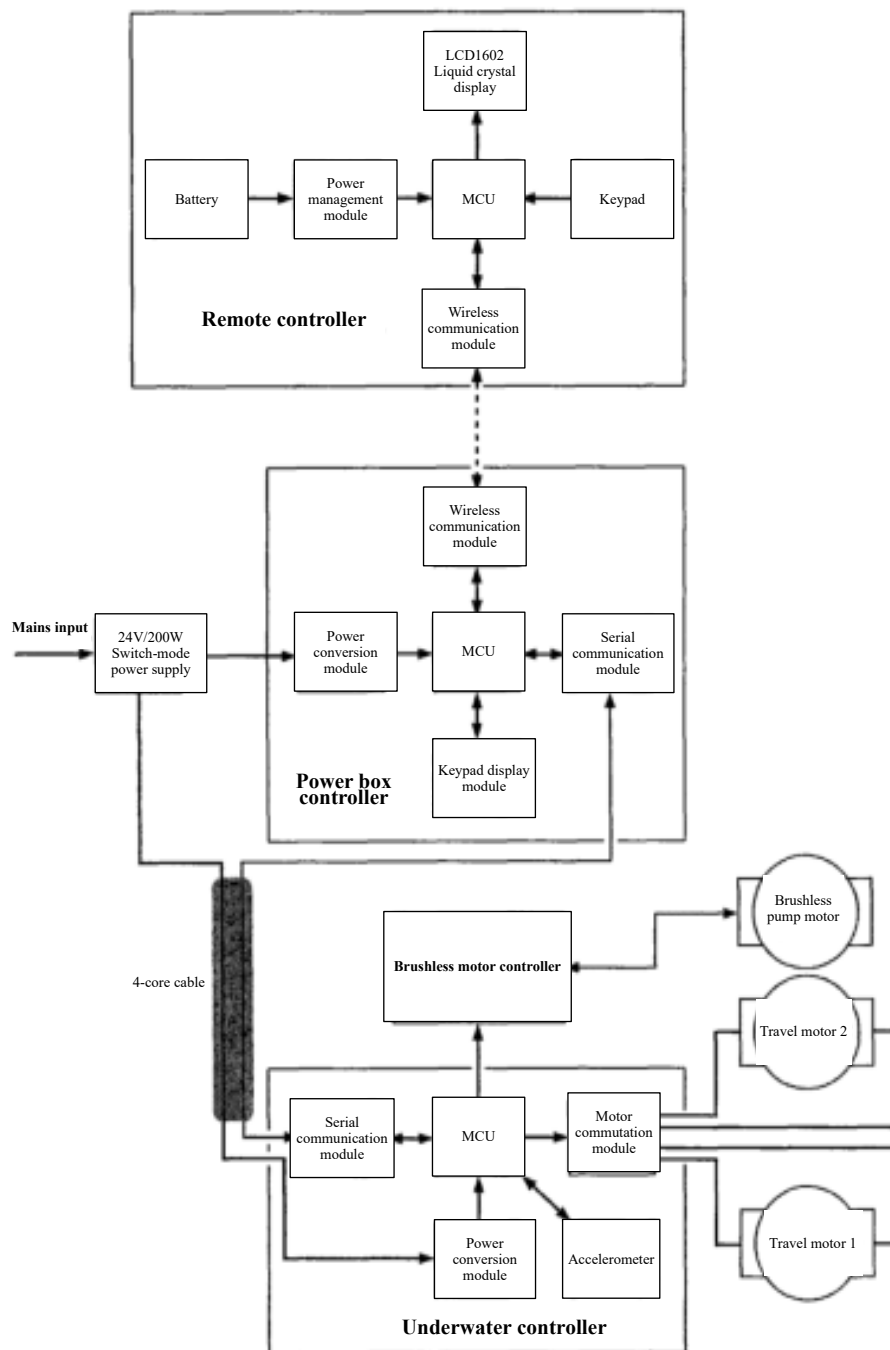


Figure 13

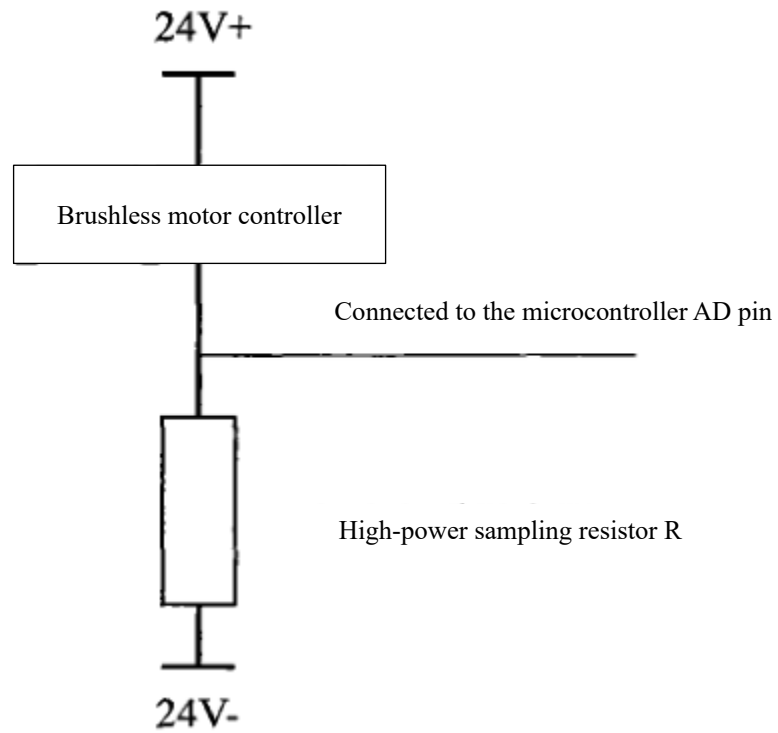


Figure 14

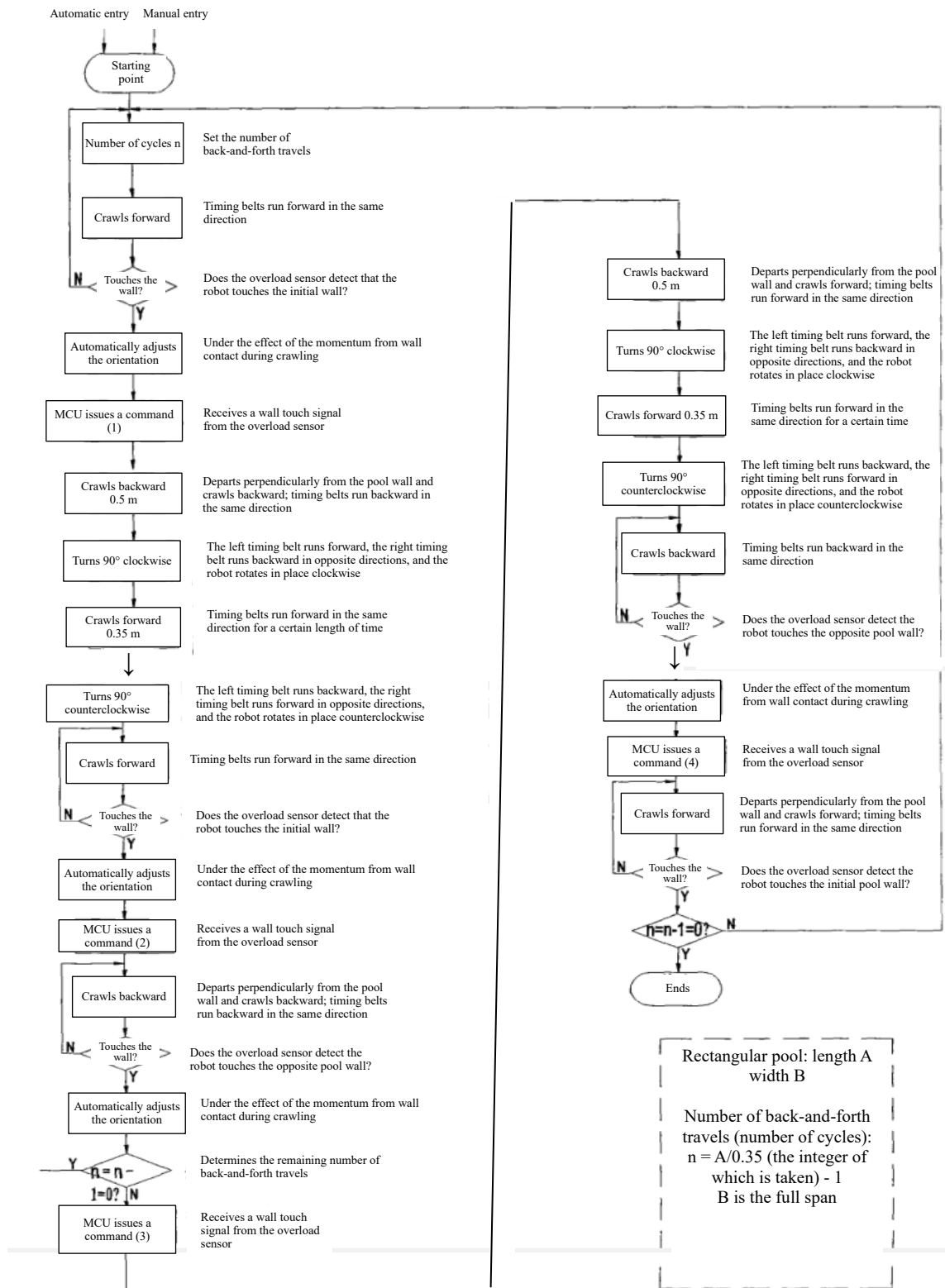


Figure 15

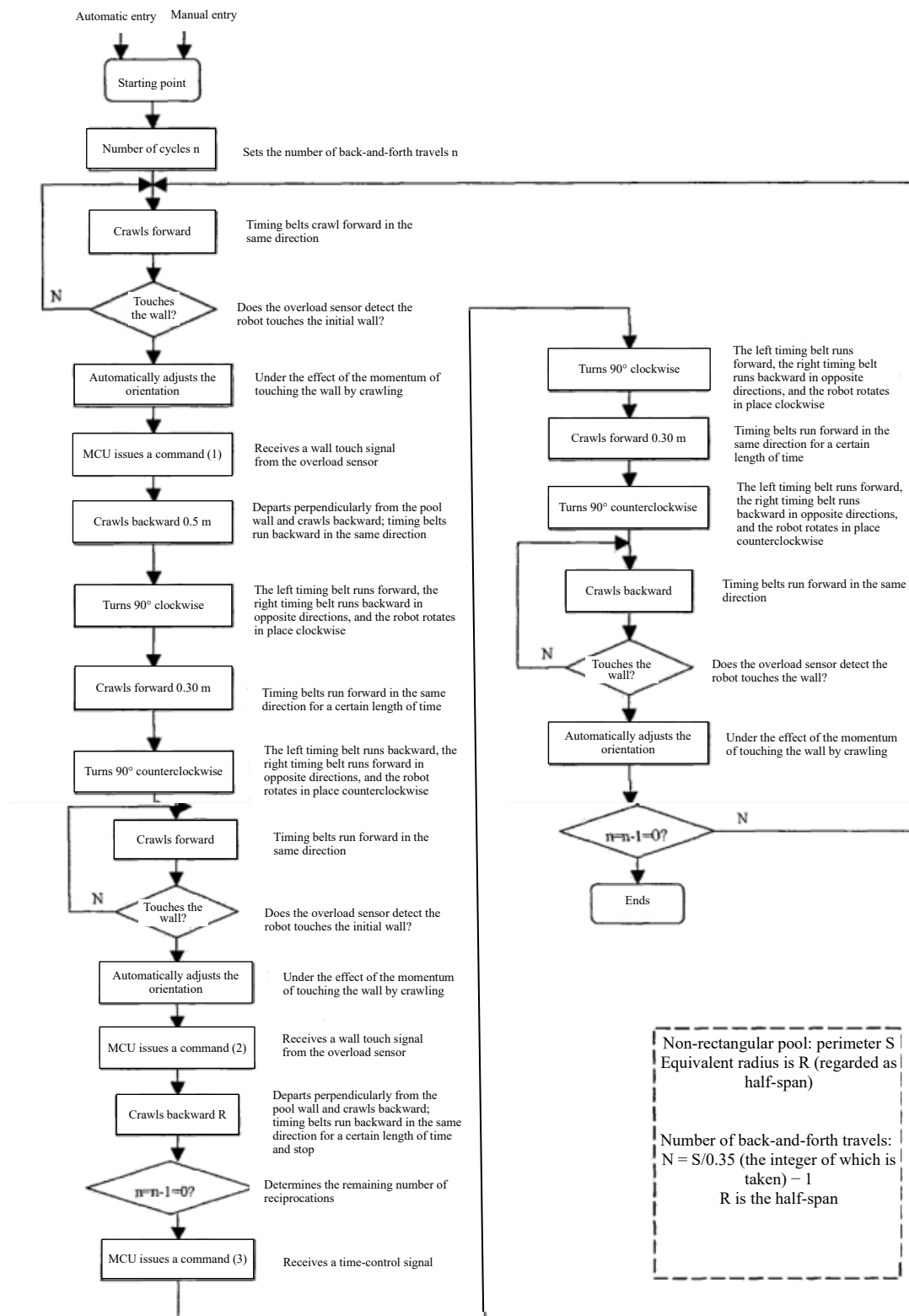


Figure 16

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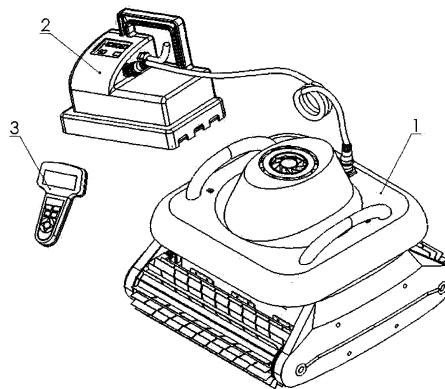
权利要求书3页 说明书14页 附图11页

### [54] 发明名称

遥控有序泳池清洁机器人及其有序清洗方法

### [57] 摘要

本发明涉及一种遥控有序泳池清洁机器人，其包括清洁机器人主机、电源控制箱和遥控器。清洁机器人主机包括过滤器、机壳体部件、轴流泵和密封盒、机壳盖部件、左右传动系统、清洁辊和自浮电缆。左右传动系统分别驱动前后清洁辊转动，同步带外齿接触池底或池壁驱动机器人爬行，清洁辊上的清洁皮带外缘与池底或池壁产生滑动摩擦，进行刷洗；清洁机器人的控制系统中设置有过载传感器，检测判断在爬行清洗中触壁状况，发出相应信号使清洁机器人转入下一步程序工作；遥控器具有双向通讯功能，显示屏能显示工作状况和故障报警。该机器人对不同形状泳池进行路径规划设计，采用全程折返路径法和半程折返路径法，实现了对不同形状泳池进行有序全覆盖清洗。



1、一种遥控有序泳池清洁机器人，包括清洁机器人主机、电源控制箱和遥控器，其特征在于：清洁机器人主机由过滤器、机壳体部件、轴流泵和密封盒、机壳盖部件、左右传动系统、清洁辊和自浮电缆组成；过滤器在清洁机器人主机的底部，安装在机壳体下部的开口处，并用密封圈密封连接；轴流泵和密封盒初定位在机壳体两内侧的筋台上，并与机壳体固定，两驱动电机轴分别从密封盒两侧伸出，与传动系统的齿形带驱动轮连接，轴流泵电机轴从密封盒盖上伸出，其上装有五叶片叶轮和导流罩，水下控制器的控制电路板安装在密封盒盖内；机壳盖部件通过机壳盖内侧密封槽内的密封件与机壳体上端开口密封连接，机壳盖两侧边上的连接孔与轴流泵和密封盒的密封盒盖上的定位孔对正，并紧固；传动系统为左传动系统和右传动系统，左传动系统和右传动系统中心对称地紧固在机壳体两侧；前后清洁辊的驱动端盖一端与传动系统上对应的齿型驱动轮连接，传动端盖一端与传动系统上对应的齿型传动轮轴承内孔连接；过滤器、机壳体部件、轴流泵和密封盒及机壳盖组成带过滤器的轴流泵；轴流泵和密封盒上端的叶轮及导流罩组成泵头；过滤器、机壳体部件和机壳盖之间密封连接组成轴流泵壳体；过滤器底板上两单向活门是轴流泵的进水口；轴流泵和密封盒与机壳体、机壳盖之间的空间是轴流泵的进水流道；机壳盖上端是轴流泵的出水流道；锁母和导叶中间通道是轴流泵的排水口；清洁机器人主机左右对称，电缆从机壳盖上后端沿爬行方向引出。

2、根据权利要求1所述的遥控有序泳池清洁机器人，其特征在于：清洁机器人主机前后端各有一个清洁辊，清洁辊上的清洁皮带的外缘直径大于传动系统上齿型端轮节圆直径。

3、根据权利要求1所述的遥控有序泳池清洁机器人，其特征在于：机壳盖

部件中有一个浮力盒，浮力盒处于清洁机器人主机的顶部。

4、根据权利要求1所述的遥控有序泳池清洁机器人，其特征在于：电源控制箱配置了低功耗的开关电源和防水电缆插座；清洁机器人电缆为自浮电缆，并用防水连接器与清洁机器人主机连接。

5、根据权利要求1所述的遥控有序泳池清洁机器人，其特征在于：水下控制器电路板上设置有加速度传感器。

6、根据权利要求1所述的遥控有序泳池清洁机器人，其特征在于：遥控器双向通讯，显示屏显示清洁机器人主机工作状态和接收警报信号，贴膜按键设置自动工作模式和手动操作，使清洁机器人主机按操作者意愿工作。

7、根据权利要求1所述的遥控有序泳池清洁机器人，其特征在于：左传动系统和右传动系统的同步带外齿面与池底或池壁接触，并确保清洁机器人主机机壳体底面距池底或池壁 15mm。

8、一种遥控有序泳池清洁机器人的有序清洗方法，其特征在于：对泳池清洗路线顺序进行路径规划设计，用加速度传感器和爬壁高度控制信号控制清洁机器人主机按规划的路径爬行，对泳池进行有序全覆盖清洗。

9、根据权利要求8所述遥控有序泳池清洁机器人的有序清洗方法,其特征在于，对不同形状泳池池底采用不同路径清洗方法：对矩形泳池采用全程折返路径清洗方法，清洁机器人主机触壁后自动调整方向，清洁辊垂直离开池壁爬行 0.5M 停，向左或向右转 90° 后向前爬行 0.35M 停再回转 90°，回到离开池壁时的方向并爬向池壁，再次触壁后退行爬行到对面池壁，重复进行上述动作，清洁机器人主机从泳池一端移动到另一端就完成矩形泳池池底的全覆盖有序清洗；对非矩形泳池采用半程折返路径清洗方法；清洁机器人主机触壁后自动调整方向,清洁辊垂直离开池壁爬行 0.5M 停,向左或向右转 90° 后向前爬行 0.35M 停再转回 90°，回到离开池壁时的方向并爬向池壁,再次触壁后退行爬行到对面池壁距离一半停，向左或向右转 90° 后向前爬行 0.35M 停再转回 90° 并爬向初始

池壁触壁，重复进行上述动作，清洁机器人主机沿着池壁移动一周后就完成对非矩形泳池池底的全覆盖有序清洗。

## 遥控有序泳池清洁机器人及其有序清洗方法

### 技术领域

本发明涉及一种清洁设备，特别地涉及一种清洗泳池的遥控有序清洁机器人及有序清洗方法。

### 背景技术

为人们提供游泳活动的泳池，必须保持清洁卫生。通常是定期更换池水，采用人工方法对泳池进行清洗。近些年来，一些发达国家和地区采取用自动化机械设备——泳池自动清洁机，可在不排放池水的情况下，自动对泳池进行清洗。既节约了宝贵水资源，又代替了人工清洗泳池的繁重劳动。这些清洁机有的只清洁池底的吸污机，也有能自动清洗池底和池壁的爬墙无序清洁机，还有技术先进的可左右转弯爬行的可控制的清洁机，但还没有达到有序和全覆盖的清洗水平。

现有的泳池清洁机对泳池清洗力度较弱，对清洗的池底、池壁及水垢线没有实现强有力的刷洗；通常的泳池清洁机，一般均有一个内滤式的过滤器部件，该部件与机壳的连接处往往接触不严，含有被清洗下来污物的池水极易直接进入机壳内，与经过过滤的水混合产生二次污染；现有技术中，普遍采用清洁辊来作为清洁部件，常用的是前后清洁辊均从中间分开成左右两部分，这样可由左右传动部件带动运转，实现左右转弯机动，但清洁辊从中间分开，左右两部分之间这一段不能清洗，不利于全覆盖清洗。

## 发明内容

本发明的目的是提供一个遥控有序泳池清洁机器人，对泳池能自动进行有序地全覆盖清洗。

本发明的另一个目的是设计有序清洗的路径，针对不同形状的泳池，采取两种路径规划，即全程折反清洗路径和半程折反清洗路径。

本发明采用以下技术方案来实现：一种遥控有序泳池清洁机器人，包括清洁机器人主机、电源控制箱和遥控器，其特征在于：清洁机器人主机由过滤器、机壳体部件、轴流泵和密封盒、机壳盖部件、左右传动系统、清洁辊和自浮电缆组成；过滤器在清洁机器人主机的底部，安装在机壳体下部的开口处，并用密封圈密封连接；轴流泵和密封盒初定位在机壳体两内侧的筋台上，并与机壳体固定，两驱动电机轴分别从密封盒两侧伸出，与传动系统的齿形带驱动轮连接，轴流泵电机轴从密封盒盖上伸出，其上装有五叶片叶轮和导流罩，水下控制器的控制电路板安装在密封盒盖内；机壳盖部件通过机壳盖内侧密封槽内的密封件与机壳体上端开口密封连接，机壳盖两侧边上的连接孔与轴流泵和密封盒的密封盒盖上的定位孔对正，并紧固；传动系统为左传动系统和右传动系统，左传动系统和右传动系统中心对称地紧固在机壳体两侧；前后清洁辊的驱动端盖一端与传动系统上对应的齿型驱动轮连接，传动端盖一端与传动系统上对应的齿型传动轮轴承内孔连接；过滤器、机壳体部件、轴流泵和密封盒及机壳盖组成带过滤器的轴流泵；轴流泵和密封盒上端的叶轮及导流罩组成泵头；过滤器、机壳体部件和机壳盖之间密封连接组成轴流泵壳体；过滤器底板上两单向活门是轴流泵的进水口；轴流泵和密封盒与机壳体、机壳盖之间的空间是轴流

泵的进水流道；机壳盖上端是轴流泵的出水流道；锁母和导叶中间通道是轴流泵的排水口；清洁机器人主机左右对称，电缆从机壳盖上后端沿爬行方向引出。

所述的清洁机器人主机前后端各有一个清洁棍，清洁辊上的清洁皮带的外缘直径大于传动系统上齿型端轮节圆直径。

所述的机壳盖部件中有一个浮力盒，浮力盒处于清洁机器人主机的顶部。

所述的电源控制箱配置了低功耗的开关电源和防水电缆插座；清洁机器人电缆为自浮电缆，并用防水连接器与清洁机器人主机连接。

所述的水下控制器电路板上设置有加速度传感器。

泳池清洁机器人主机清洗爬行的路径和被清洗泳池的形状、大小、深度有关。在清洗泳池池底或对泳池进行全面清洗时，本发明针对不同泳池形状采用两种不同的路径控制方法：对于矩形泳池采用全程折反路经控制方法，而非矩形泳池则采用半程折反路径控制方法。全程是指泳池池壁相对面之间的距离，半程就是指池壁相对面之间距离的一半。下面以清洗池底模式为例说明这两种控制方法：

全程折反路经控制方法是清洁机器人清洗矩形泳池池底的一个控制程序：当传感器检测到触壁，微控制器判别出清洁机器人主机触壁并发出指令，机器人自动调整方向后停止爬行，紧接着垂直于此处池壁退行爬行 0.5 米停，机器人主机两侧同步带反向运行，以中心轴为中心原地顺时针转 90° 后停止；启动两驱动电机，机器人主机两侧同步带同向同步运行，机器人主机向前爬行 0.35 米停止；接着机器人主机两侧同步带等速反向运行，以中心轴为中心逆时针转回 90° 后停止，此时机器人主机方向与触壁退回时的机器人主机方向一致，只是向右平移了 0.35 米。紧接着机器人主机向池壁方向爬行，并很快触壁，传感器检测到，微控制器判别出触壁，此时机器人自动调整方向后停止爬行。微控制

器发出爬行指令，机器人主机两侧同步带等速同向沿直线向后退行爬行，机器人主机垂直离开池壁直到其后端清洁辊触壁，此时传感器检测到，微控制器判别出清洁机器人主机触壁，发出停止退行爬行指令，机器人主机垂直池壁后退 0.5 米停止，顺时针转  $90^\circ$  后前进 0.35 米，再逆时针转  $90^\circ$ ，机器人主机状态是与触壁时的方向一致，且右移了 0.35 米。微控制器发出指令退行爬行，机器人主机后端爬向池壁，当传感器检测到，微控制器判别出触壁时，机器人停止爬行，微控制器发出前进指令，机器人主机垂直离开池壁，并沿直线向机器人主机前端的池壁方向爬行，返回到开始时池壁一面。这样往复继续进行，机器人的爬行路径是向右侧移动的折返式的蛇形路线。当起始点是从泳池一端开始，终点是泳池另一端时，清洁机器人对泳池就有序地进行了全覆盖清洗。清洗的起点和终点可由清洁机器人先进行清洗准备测量和判定来实现。

半程折反路经控制方法是清洁机器人主机清洗非矩形泳池池底模式。清洁机器人主机自动爬行清洗路径是按选定的工作模式的控制程序进行的：当传感器检测到，微控制器判别出清洁机器人触壁，机器人主机靠爬行触壁时的动量使其清洁辊能自动地与池壁处于平行状态后停止爬行；微控制器发出退行指令，机器人主机前端会垂直离开池壁，向后退行爬行 0.5 米停止；顺时针转  $90^\circ$  后前进 0.35 米停止；再逆时针转  $90^\circ$ ，机器人主机的前端转向池壁，并向池壁爬行；当传感器检测到，微控制器判别出清洁机器人主机触壁后，微控制器发出向后退行指令，机器人主机前端垂直离开池壁，沿直线退行至泳池中间或由时间程序控制退行大约相对池壁距离的一半停止，微控制器发出前进指令，机器人主机由时间程序控制沿退行的路线返回前进一段行程停止爬行，微控制器发出顺时针转  $90^\circ$  后前进 0.35 米停止指令，机器人主机向前进路线右侧移动 0.35 米，接着逆时针转  $90^\circ$  后向前爬行，机器人主机沿直线爬行触壁后，在爬行触

壁动量作用下，自动调整方向，使清洁辊与池壁平行，机器人主机回到开始的池壁。传感器检测到，微控制器判别出触壁，微控制器发出退行爬行半程距离指令，机器人主机垂直离开池壁退行爬行半程距离，其爬行路线会与前面走过的路线相交。这样往复继续进行，机器人主机将沿着池壁顺时针半程折返路径清洗池底，当沿池壁移动一周时，即对非矩形泳池池底有序地进行了全覆盖清洗。

本发明的有益效果：

1、清洁机器人主机的转弯结构系统，使清洁机器人主机在爬行清洗过程中具有转弯功能，能自动爬行到泳池所有地方。

2、在驱动控制电路板中设置了过载传感器，检测判断清洁机器人触壁状况并发出相应信号，控制清洁机器人主机实现有序清洗。

3、本发明泳池清洁机器人，能对不同形状泳池进行有序的全覆盖清洗。

4、本发明泳池清洁机器人具有自动爬行、爬壁、自动清洗、自动过滤、将刷洗下来的污物集中收集，避免清洗过程中的二次污染等功能。

5、清洁机器人主机的过滤器、机壳体和机壳盖之间均采用密封连接，保证被过滤的池水不被污染。

6、本发明清洁机器人的同步带外侧齿面与池底或池壁接触，是同步带运行带动清洁机器人主机爬行。

7、本发明清洁辊上的清洁皮带外缘直径大于清洁辊齿型端轮的节圆直径，清洁皮带外缘线速度大于同步带运行速度，即大于清洁机器人主机的爬行速度，清洁皮带外缘接触池底或壁，在清洁机器人主机爬行过程中，与池底或壁产生滑动摩擦形成强有力的刷洗。

8、本发明在清洁机器人主机顶部设置一个浮力盒，为机器人提供浮力，提

供稳定力矩。

9、本发明清洁机器人主机总体是左右对称的，电缆线从爬行方向上引出，为保爬行方向提供有利条件。

10、本发明中的电源控制箱，配置低功耗开关电源和防水电缆插座。

11、本发明中采取有效措施降低能耗，如选用高效叶轮的轴流泵和传动系统中采用滚动轴承代替滑动摩擦等。

12、本发明中清洁机器人主机选用自浮电缆，连接采用防水电缆连接器，使操作更方便。

13、本发明中的遥控器，是双向通讯，其显示屏可显示清洁机器人主机的工作状态和接收报警信号，运用贴膜按键设置自动工作模式和手动操作，使清洁机器人主机按操作者意愿工作。

14、本发明的清洁机器人具有主机出水自动停机保护和报警，具有主机在清洗过程中被卡住报警、保护，以及过滤口袋滤孔堵塞报警等功能。

15、本发明清洁机器人是按设定程序有序爬行，在清洗过程中，不会产生电缆缠绕问题。

16、本发明对清洁机器人制定两套有效的有序清洗方法。对不同形状的泳池池底采用不同的清洗路径方法，对矩形泳池采用全程折返路径清洗方法，对非矩形泳池采用半程折返路径清洗方法。

## 附图说明

图 1，遥控有序泳池清洁机器人组成的立体图；

图 2，本发明中的清洁机器人主机；

图 3，显示本发明中的电源控制箱；

图 4, 本发明中的遥控器;

图 5, 本发明清洁机器人主机的过滤器部件;

图 6, 本发明清洁机器人主机的机壳体部件;

图 7, 本发明清洁机器人主机的轴流泵和密封盒;

图 8, 本发明清洁机器人主机的机壳盖部件;

图 9, 本发明清洁机器人主机的传动系统;

图 10, 本发明清洁机器人主机的清洁辊;

图 11, 本发明清洁机器人主机的自浮电缆部件;

图 12, 本发明的遥控器按键功能图;

图 13, 本发明的电源、控制、通讯电路原理图;

图 14, 本发明三种报警保护电路原理图;

图 15, 本发明机器人清洗矩形泳池池底工作流程图;

图 16, 机器人清洗非矩形泳池池底工作流程图;

其中, 1. 含电缆的清洁机器人; 2. 电源控制箱; 3. 遥控器; 11. 过滤器;  
12. 机壳体部件; 13. 轴流泵和密封盒; 14. 机壳盖部件; 15. 传动系统; 16. 清洁辊; 17. 自浮电缆; 21. 机箱; 22. 开关电源; 23. 电源控制电路板; 24. 贴膜按键; 25. 连接板; 26. 连接角片; 27. 底板; 28. 带输入电源线的电缆堵头;  
29. 防水电缆插座; 31. 前机壳; 32. 后机壳; 33. 显示屏; 34. 通讯电路板; 35. 含电池的电池盒; 36. 机壳密封圈; 37. 电池盒盖; 38. 电池盒盖密封垫; 39. 贴膜按键; 111. 过滤器底板; 112. 密封圈; 113. 框架; 114. 过滤口袋; 115. 旋转搬把; 116. 硅胶盖板; 117. 压板; 121. 机壳体; 122. 排水口盖板; 123. 压板; 131. 叶轮; 132. 导流罩; 133. 带轴承和油封的接轴; 134. 无刷电机; 135. 带有两个密封圈的密封盒盖; 136. 导热板; 137. 泵电机控制板; 138. 水下控制

器电路板；139. 密封箱体；139A. 带连接端板的驱动电机；139B. 带油封的接轴；139C. 锁母；140. 防水电缆堵头和电缆；141. 机壳盖；142. 导叶；143. 锁母；144. 浮力盒；145. 提手；146. 防水电缆连接器插座；147. 密封圈；151. 支架座；152. 六方连接轴；153. 齿形带驱动轮；154. 传动轮；155. 双面错齿同步带；156. 齿形驱动端轮；157. 齿形传动端轮；161. 清洁皮带；162. 滚筒；163. 驱动端盖；164. 传动端盖；171. 浮力电缆；172. 拖线式防水公插头；173. 拖线式防水母插头。

## 具体实施方式

一种有缆遥控有序泳池清洁机器人（见图1），包括清洁机器人主机和电缆、电源控制机箱、遥控器；清洁机器人主机包括过滤器11、机壳体部件12、轴流泵和密封盒13、机壳盖部件14、传动系统15、清洁辊16、自浮电缆17。

所述的过滤器11通过过滤器底板111凸缘上的密封圈112与机壳体121下端开口密封连接，并用旋转搬把115将过滤器底板111锁紧在机壳体121下端开口处；在过滤器底板111上还有框架113支撑着过滤口袋114，过滤口袋的袋口系绳用弹簧卡扣紧紧地系在过滤器底板111上。

所述的机壳体部件12是由机壳体121、排水口盖板122和压板123组成。机壳体121内安装轴流泵和密封盒13，两侧螺钉固定。机壳体121上面是开敞的，其周边与机壳盖部件14密封连接，底面有一个大开口与过滤器11密封连接，前后面下部各开有3个排水口，在排水口外侧用拉铆钉通过压板123将排水口盖板固定在机壳体121上，形成排水单向活门。在机壳体两侧的外侧各有6个导向定位支柱和4个定位连接螺母与传动系统15连接。

所述的轴流泵和密封盒13，由轴流泵泵头，密封盒盖和密封箱体三部分组

成。密封盒内装有导热板 136，其上固定安装轴流泵控制电路板和水下控制器电路板。轴流泵无刷电机 134 安装在密封盒盖 135 的中央，其轴承伸出盖外，并连接其上安装有轴承和双唇骨架油封的接轴 133，导流罩 132 通过轴承支撑在接轴上，其上端有双唇骨架油封与接轴密封，其下端用密封圈与密封盒盖 135 密封连接；密封箱体 139 的两侧端均安装有带连接端板的行走电机 139A，其连接端板由密封圈与密封盒体的孔台密封连接，并用锁母 139C 锁紧，带双唇骨架油封的接轴插接在行走电机 139A 轴上，并通过双唇骨架油封与连接端板内孔密封连接。在密封箱体 139 底面中央安装有带电缆的电缆密封堵头 140，将电缆从密封箱体 139 内密封引出。密封盒盖 135 与密封箱体 139 之间用密封圈柱面密封连接，并用螺钉锁紧。所述的轴流泵和密封盒 13 通过机壳体 121 两内侧的筋台初定位，在密封箱体 139 两端用螺钉与机壳体 121 两侧固定。机壳体 121 的前后面下端安装有排水口盖板 122。

所述的机壳盖部件 14 内侧密封槽内设置有密封圈 147 与机壳体 121 上端开口密封连接。机壳盖 141 上四个连接孔对正密封盒盖 135 上的对应的定位连接孔，用螺钉固定连接，机壳盖 141 上面中间处用锁母 143 将导叶 142 和浮力盒 144 锁紧，固定在机壳盖 141 上，在机壳盖上面两侧安装有提手 145，机壳盖 141 上面后端设置有防水电缆插座母插头 146。这样过滤器 11、机壳体部件 12 和机壳盖部件 14 就组成了轴流泵的外壳，过滤器底板 111 上的硅胶盖板下的开口处就是泵的进水口，机壳泵头 131，132 与机壳体 121 和机壳盖 141 之间就成轴流泵的进水流道，而其与机壳盖部件上部间就形成轴流泵的出水流道。

所述的传动系统 15 是由支架座 151、六方连接轴 152、齿形带驱动轮 153、6 个传动轮 154、齿形驱动端轮 156、齿形传动端轮 157 和同步带 155 组成。同步带 155 由齿形带驱动轮 153 驱动，并围绕在齿形驱动端轮 156、传动轮 154 和

齿形传动端轮 157 之间。所说的传动系统 15 通过定位柱孔用螺钉固定连接在机壳体 121 两侧,传动系统 15 上的同步带 155 下部外齿与池底壁接触,机壳体 121 底面距池底 15mm,同步带运行时,就带动清洁机器人移动,即爬行。

所述的清洁辊 16 的驱动端盖 163 的插销插入传动系统 15 的齿形驱动端轮 156 孔内,清洁辊 16 的另一端的传动端盖 164 的圆柱销插入传动系统 15 齿形传动端轮 157 的轴承孔内环的孔内,这样前后两清洁滚筒就由左右传动系统支撑并分别由左右传动系统带动运转,清洁辊 16 的清洁皮带与池底或壁接触,其运转时,与池底或壁之间产生滑动摩擦,形成刷洗功能。

所述的清洁机器人上所用的电缆为自浮电缆 17,其一端防水插头 172 与机壳盖上防水插座 173 连接。

所说的电源控制机箱包括机箱 21、开关电源 22、电源控制电路板 23、贴膜按键 24、连接板 25、连接角片 26、底板 27、输入电源线 28 和防水电缆插座 29。开关电源 22 和电源控制电路板 23 通过连接角片 26 用螺丝固定在连接板 25 上,连接板 25 用螺钉与机箱 21 紧固,底板 27 用螺钉与机箱 21 和连接板 25 连接。其具有防水能力的贴膜按键 24 胶粘在机箱 21 上面。在机箱 21 上面台阶处安装有电源输入线的防水电缆堵头 28 和防水电缆插座 29 公插头。

所述的遥控器包括前机壳 31、后机壳 32、显示屏 33、通讯电路板 34、电池盒 35、机壳密封圈 36、电池盒盖 37、电池盒盖密封垫 38 贴膜按键 39。显示屏 33、通讯电路板 34 和电池盒 35 用螺钉固定在前机壳 31 内,贴膜按键 39 粘接在前机壳 31 的外表面,前机壳 31 和后机壳 32 之间有密封圈 36 密封连接并用螺钉拧紧。电池盒盖 37 下垫有用密封垫 38 通过卡口紧扣在后机壳 32 的外面。

如图 14 所示,在无刷电机控制回路中串联 1 只采样电阻,用于将水泵电机的电流信号转换为电压信号;该电压信号与单片机的 AD 采样引脚相连接,从

而将电压信号转换为单片机能够处理与识别的数字信号。当水泵工作在不同状态时其电流大小是不同的，从而使单片机上 AD 采样的数值发生变化，根据 AD 采样数值的变化进行相应的处理，从而实现上述的三种保护功能。当机器人出水时由于水泵的负载减小，水泵的输出功率下降，水泵上流过的电流相应变小，单片机上 AD 采样的数值减小，当采样数值小于一定值时，单片机判断机器已经出水，延时几秒后停机保护，并使报警灯闪烁进行相应的提示；当过滤网堵塞时，水泵的输出功率会有所上升，从而引起单片机 AD 采样的数值增大，当 AD 采样数值增大到一定值时，单片机判断过滤网已经堵塞，报警灯闪烁提示；当水泵由于某种原因堵转时，其上的电流会有明显的增加，当单片机 AD 采用的数值大幅度超过正常工作值时，单片机判断电机堵转，此时立即切断水泵电机的供电，并使报警灯闪烁进行相应的提示。

下面通过遥控有序泳池清洁机器人的工作过程和原理进一步对本发明的特征和优越性进行描述：

当泳池清洁机器人主机在泳池中工作时，轴流泵电机运行，轴流泵的叶轮旋转将清洁机器人主机机壳体下面覆盖的池水经单向活门和过滤口袋吸进机壳体内，再进而经进水流道和出水流道将有压力的洁净水向机壳体外排出。在此同时，由于轴流泵工作而使机壳体下面的池水和机壳体内的洁净水流动，在机壳体底面处形成低压区，故而产生吸附力，而出水流道处排出有压力的洁净水，此处产生对壳体的反向压力，这两个力为机器人提供在池底爬行和爬壁的正压力，进而转换为吸附力。

清洁机器人主机是由两个行走电机运转带动传动系统的同步带运行。由于同步带有部分外侧齿与池底接触，因而当同步带运行时就使整个机器人爬行移动。能在池壁上爬行，是由于轴流泵提供的吸附力产生的摩擦力大于清洁机器

人在水中的重量而实现的。

清洁机器人主机在泳池中爬行时，同步带带动清洁辊转动，由于清洁辊上清洁皮带外缘线速度大于同步带的线速度，即大于清洁机器人主机的爬行速度，这样在清洁皮带外缘与池底或池壁接触处产生滑动摩擦，形成刷洗作用。其刷洗作用的强弱与滑动摩擦的程度有关，即滑动摩擦速度越快，刷洗作用越强，刷洗力度就越大。故清洁皮带的线速度与爬行速度的差，再与爬行速度的比值，是表示刷洗力度的指标之一，简称速度差比。

由于清洁皮带的刷洗作用，清洁机器人主机在爬行过程中，就自动对泳池进行了清洗，清洗下来的污物被围控在机器人机壳下的池水中，在轴流泵抽吸作用下，机壳下的池水大量地被吸进过滤器内，机壳体底面下形成低压区，清洁机器人底面周围的池水，连续地从清洁机器人主机下部与池底或池壁的间隙中流入到机壳体底面下，阻止含有清洗下来污物的池水向外扩散，防止污染。吸入过滤器的池水经过过滤后进入机壳体，经进水流道、出水流道，从排水口排出洁净水。这一过程中，在轴流泵的作用下，经过过滤器将清洗下来的污物过滤出来，并集中收集在过滤器内，有效地避免清洗过程中的二次污染。

由于传动系统是中心对称地设置在清洁机器人主机的两侧，左侧传动系统的齿形驱动端轮在前端与前清洁辊驱动端盖连接只带动前清洁辊运转，右侧传动系统齿形驱动端轮在后端与后清洁辊驱动端轮连接只带动后清洁辊运转。这样清洁机器人的两个驱动电机就分别驱动左右传动系统，左右传动系统分别带动前后清洁辊运转。当左右同步带同向运行向前（或向后），前后两清洁滚筒也随之同向运行，则清洁机器人主机向前或向后爬行。当左右同步带等速反向运行，如左侧向前右侧向后时，则前后清洁辊反向运转，此时两侧同步带运行与池底产生方向相反的摩擦力，对清洁机器人主机中心轴形成顺时针方向的扭矩，

而前后清洁辊反向运转与池底也产生反向摩擦力，而且是前后对称的，故它对清洁机器人主机中心轴不产生扭矩，此时清洁机器人主机在同步带与池底之间摩擦力的力矩作用下会产生顺时针方向原地转动，转动的角度大小由两侧同步带反向运行时间决定；如若左侧同步带向后运行，右侧同步带向前运行，此时清洁机器人主机将逆时针方向原地转动。同样道理，当左右两侧同步带以不同速度同向或反向运行时，清洁机器人将按相应规律改变爬行方向。传动系统的爬行转弯机构是机器人实现有序清洗的技术基础。

本发明的清洁机器人有序工作流程图如图 15-16 所示。

本发明的遥控器打开时，显示屏上显示清洁机器人的工作状态，可用贴膜按键上的功能键选择工作模式：

当选择 A 清洗池底时，清洁机器人主机入水后，当传感器检测到、微控制器(MCU)判别出清洁机器人主机已触壁并发出指令，机器人主机自动调整方向，使清洁辊与池壁平行后立即停止，接着垂直离开池壁爬行 0.5 米停，顺时针转 90° 向前爬行 0.35 米停，再逆时针转 90° 停，接着爬向池壁并触壁，触壁后自动调整方向后停，传感器检测到、微控制器(MCU)判别出触壁并发出指令，机器人主机垂直离开池壁退行爬行到对面池壁触壁或半程返回触壁。这样往复进行就可以完成对池底的清洗。

当选择 B 清洗池壁时，清洁机器人主机入水后，传感器检测到、微控制器(MCU)判别出机器人已触壁并发出指令，此时要继续往池壁上爬行，当达到水面时（用时间控制），机器人主机反向退行到池底，此时传感器检测到、微控制器判别出触底并发出指令，机器人主机继续爬行垂直离开池壁 0.5 米停，顺时针转 90° 后向前爬行 0.35 米停，再逆时针转 90° 后爬向池壁，触壁后继续爬上池壁，这样往复进行，就可完成单独对池壁的清洗。

当选择 C 全面清洗泳池时，清洁机器人主机入水后，传感器检测到、微控制器判别出机器人主机触壁后，发出继续往池壁上爬行指令，当达到水面时，用时间控制，微控制器发出指令机器人主机退行爬行到池底，此时传感器检测到、微控制器判别出触底并发出指令，垂直离开池壁继续爬行到对面池壁触壁或半程返回触壁，自动调整方向后继续爬上池壁，当爬到水面时，用时间控制机器人主机退行爬行到池底，传感器检测到、微控制器判别出触底并发出指令，机器人主机垂直离开池壁继续爬行 0.5 米停，顺时针转  $90^{\circ}$  后向前爬行 0.35 米停，再逆时针转  $90^{\circ}$  后爬向池壁触壁，传感器检测到、微控制器判别出触壁并发出指令，机器人主机继续爬上池壁。这样往复进行，就可以对整个泳池的底和壁进行全面清洗。

当选择 D 清洗水垢线时，清洁机器人主机入水后，传感器检测到、微控制器判别出机器人主机已触壁并发出指令，此时要继续往池壁上爬行，当达到水面时，用时间控制微控制器发出指令，控制两个驱动电机的转速达到某一个转速差，使清洁机器人主机在池壁上呈倾斜平衡姿态爬行，并沿水垢线水平移动，完成对水垢线清洗。

当按动手动按键前进后退及左右转弯时，清洁机器人主机将按操作者的意愿所控制的路径爬行清洗。

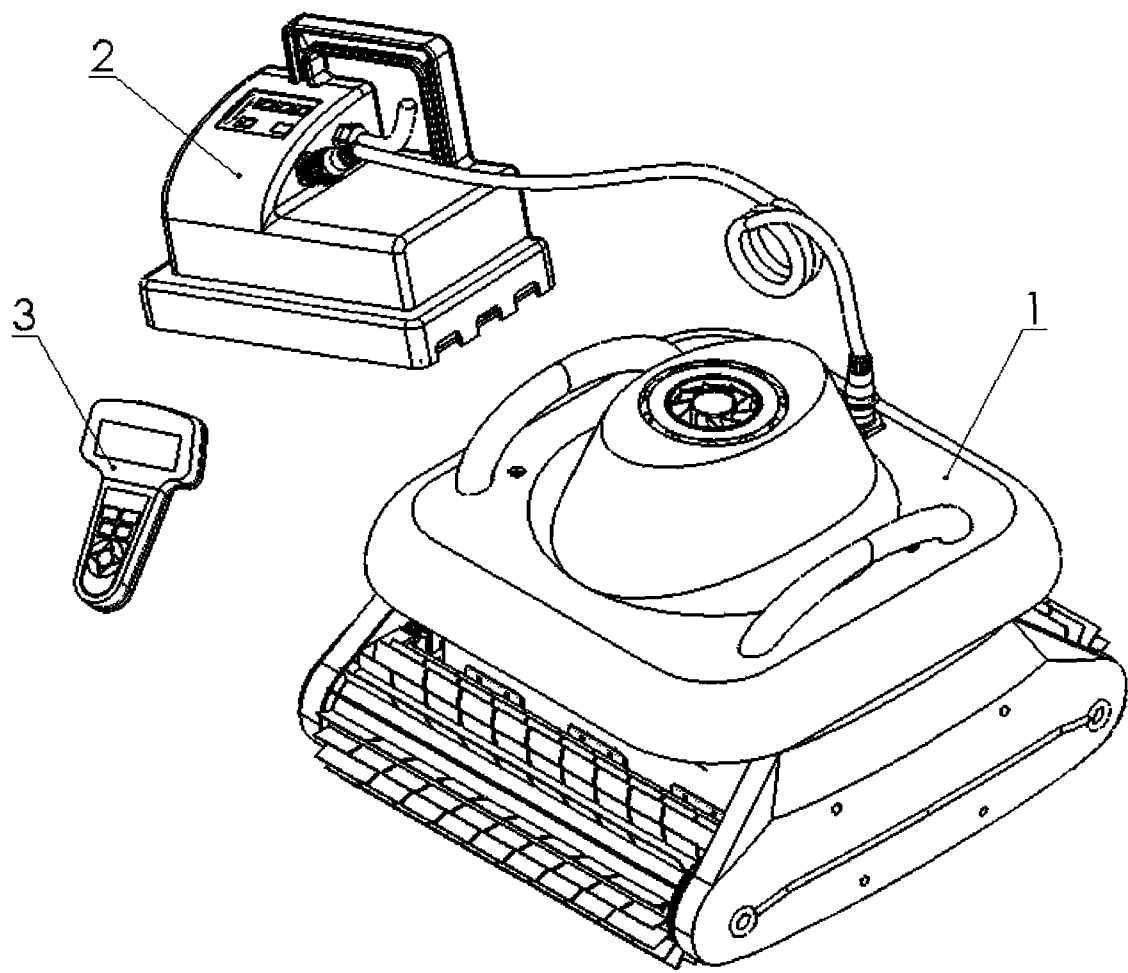


图 1

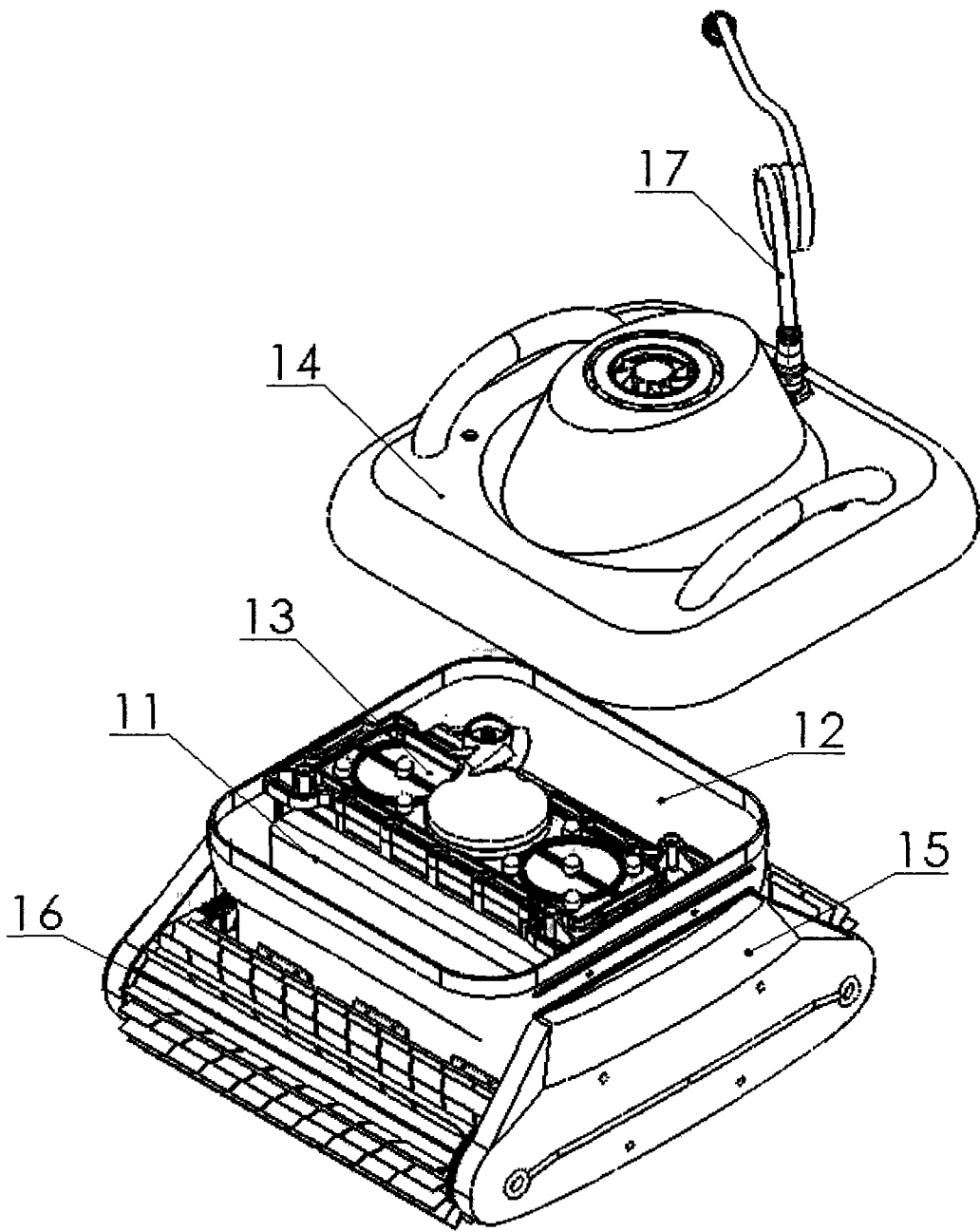


图 2

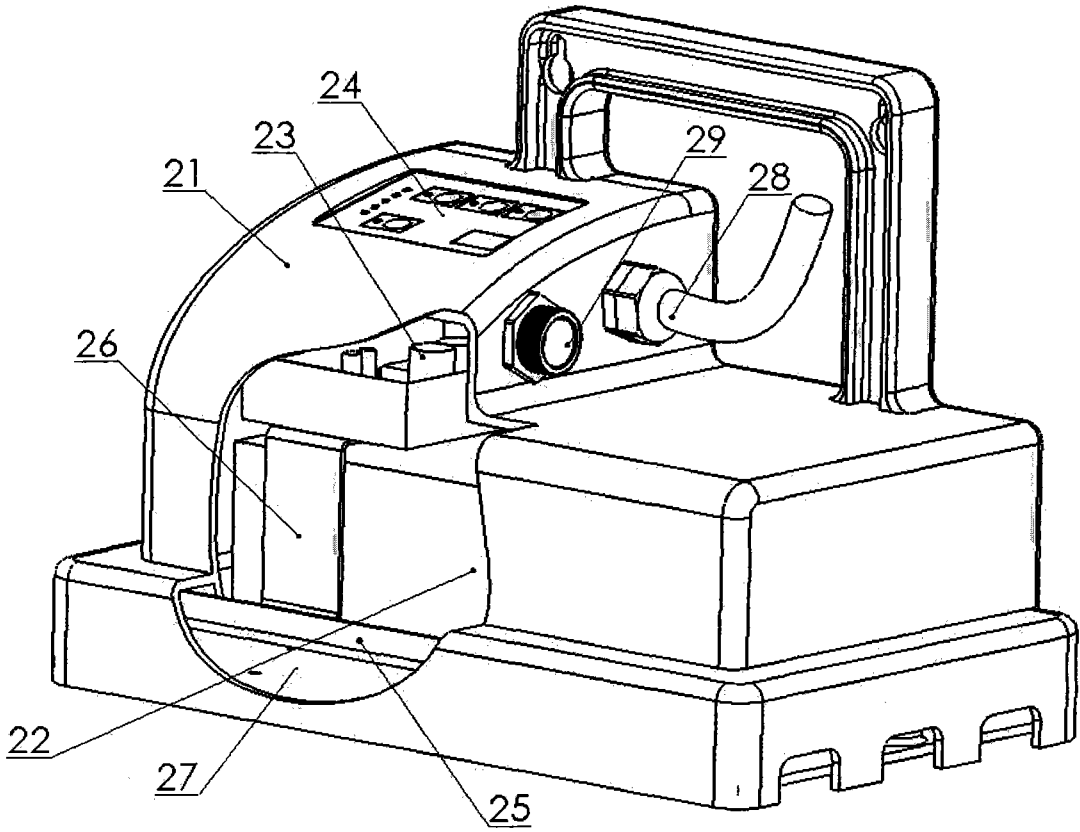


图 3

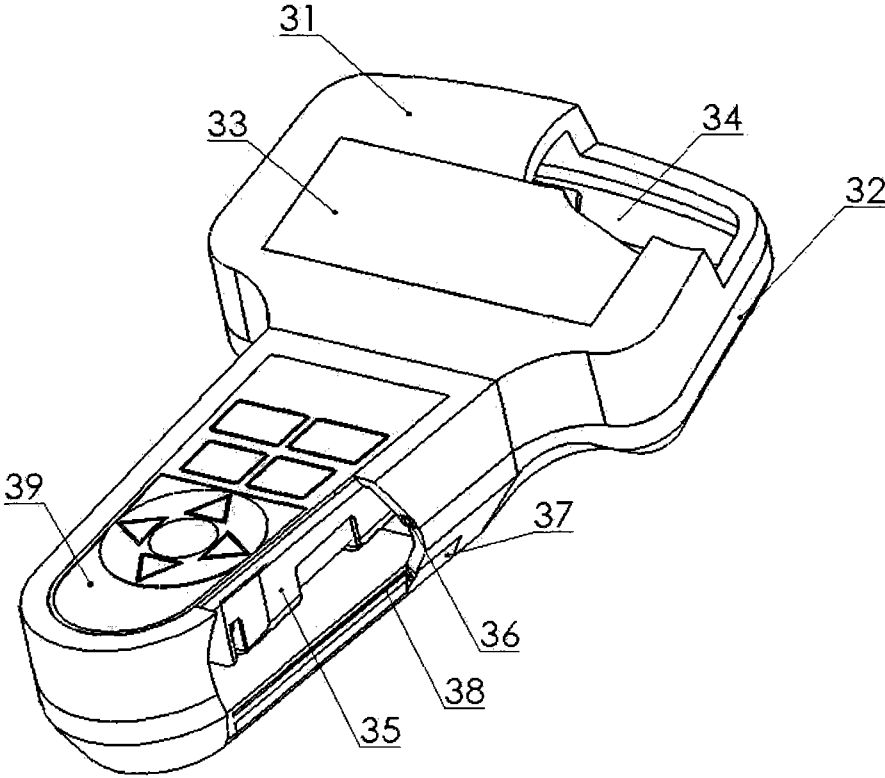


图 4

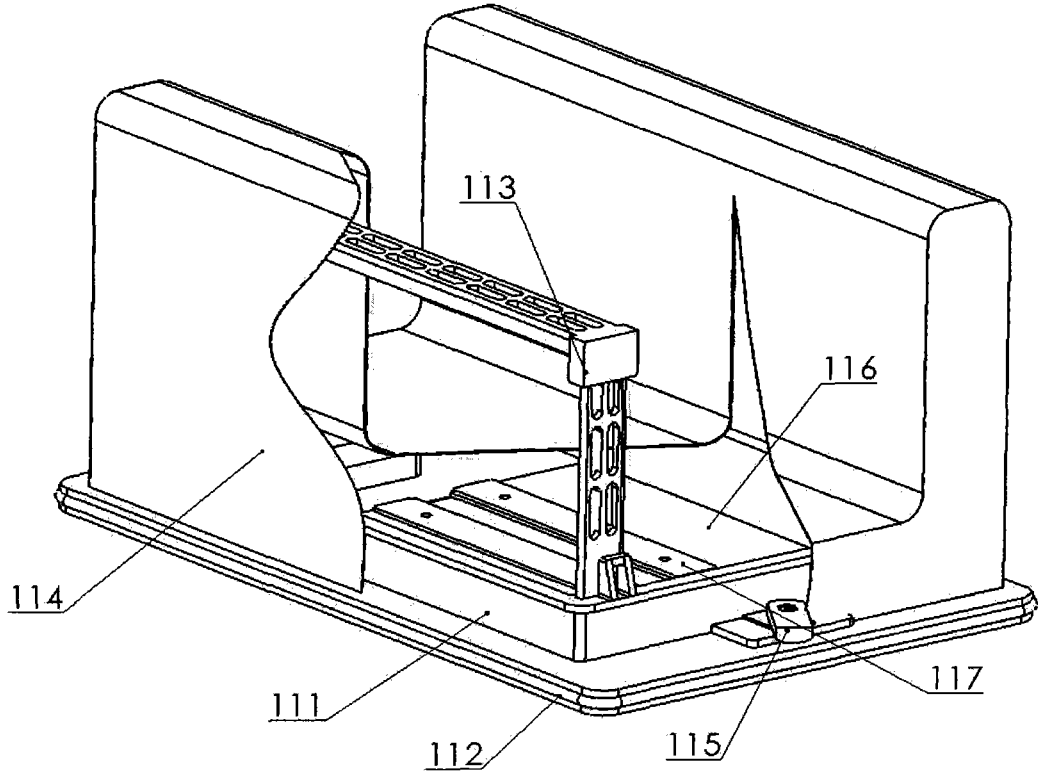


图 5

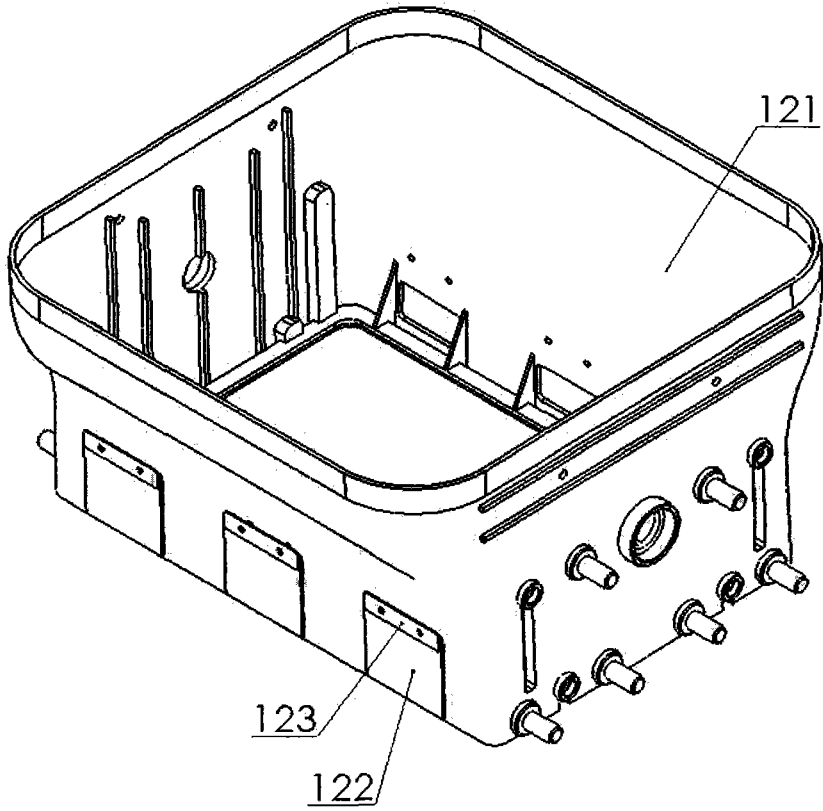


图 6

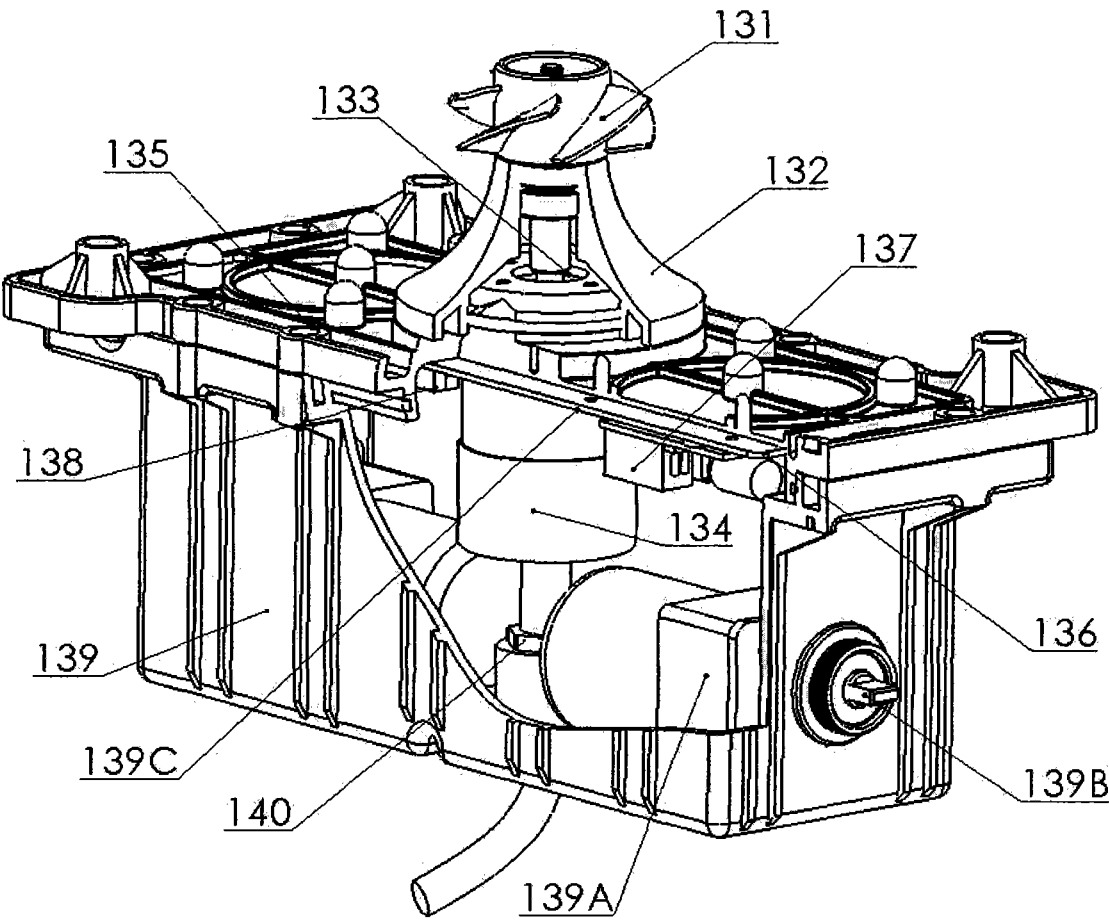


图 7

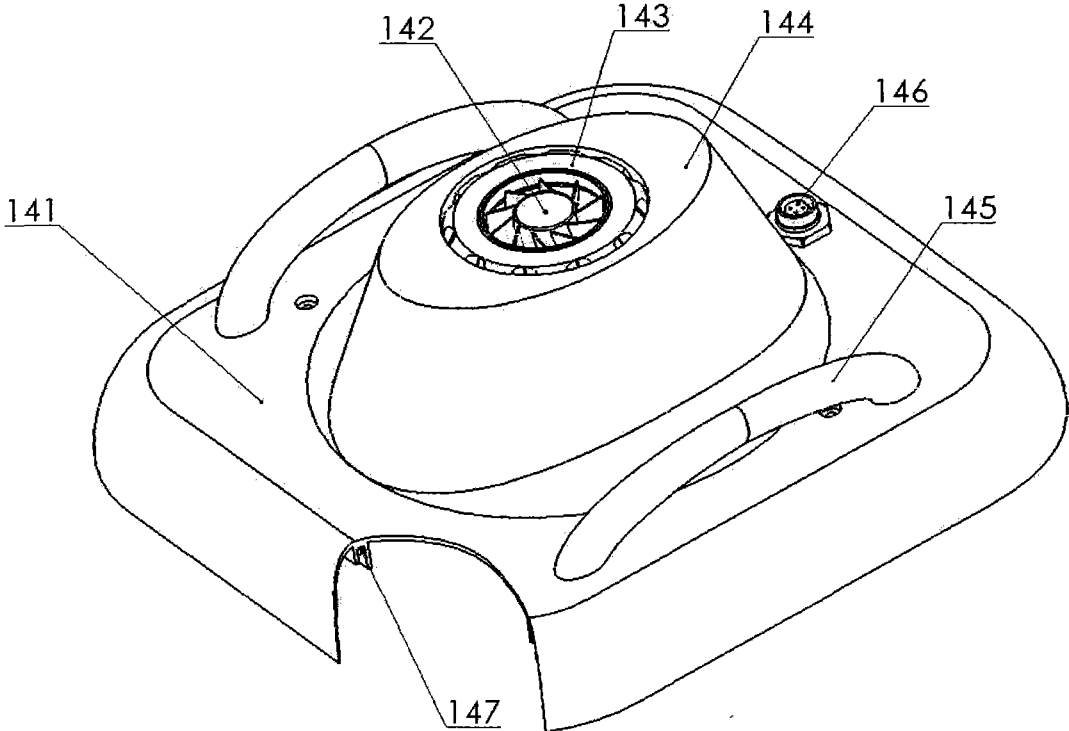


图 8

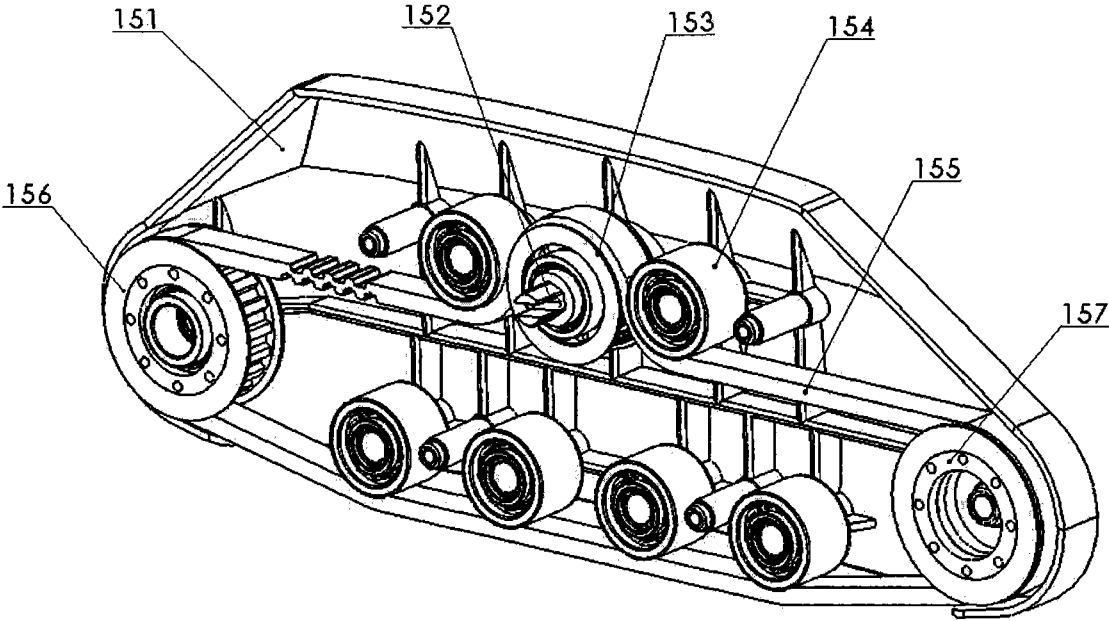


图 9

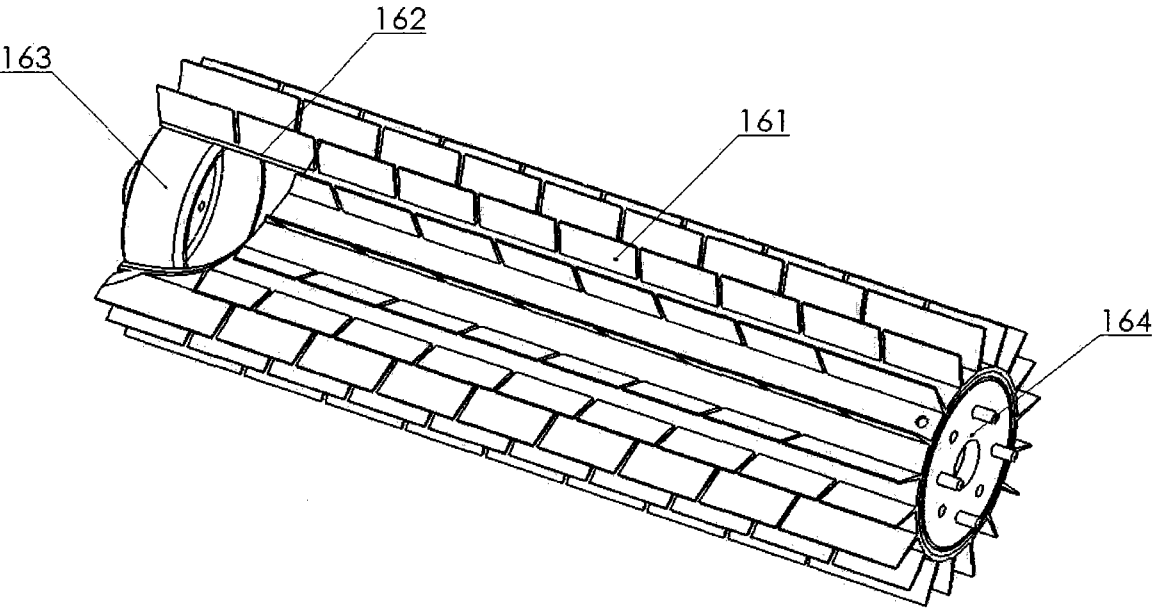


图 10

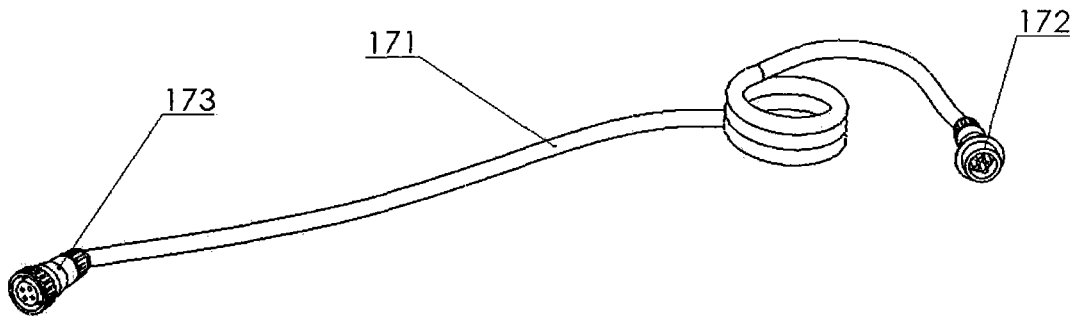


图 11

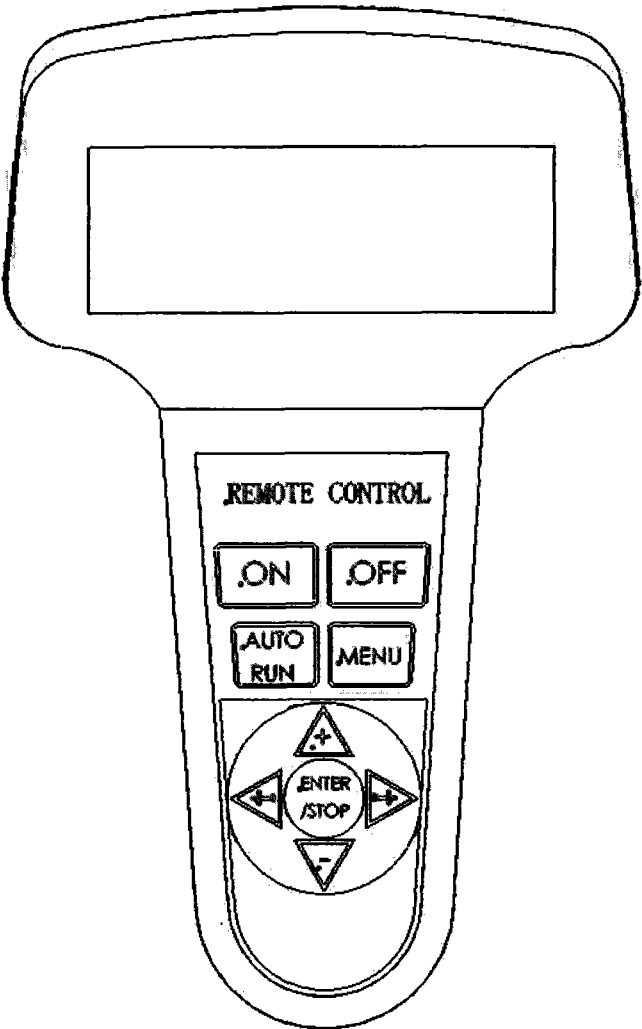


图 12

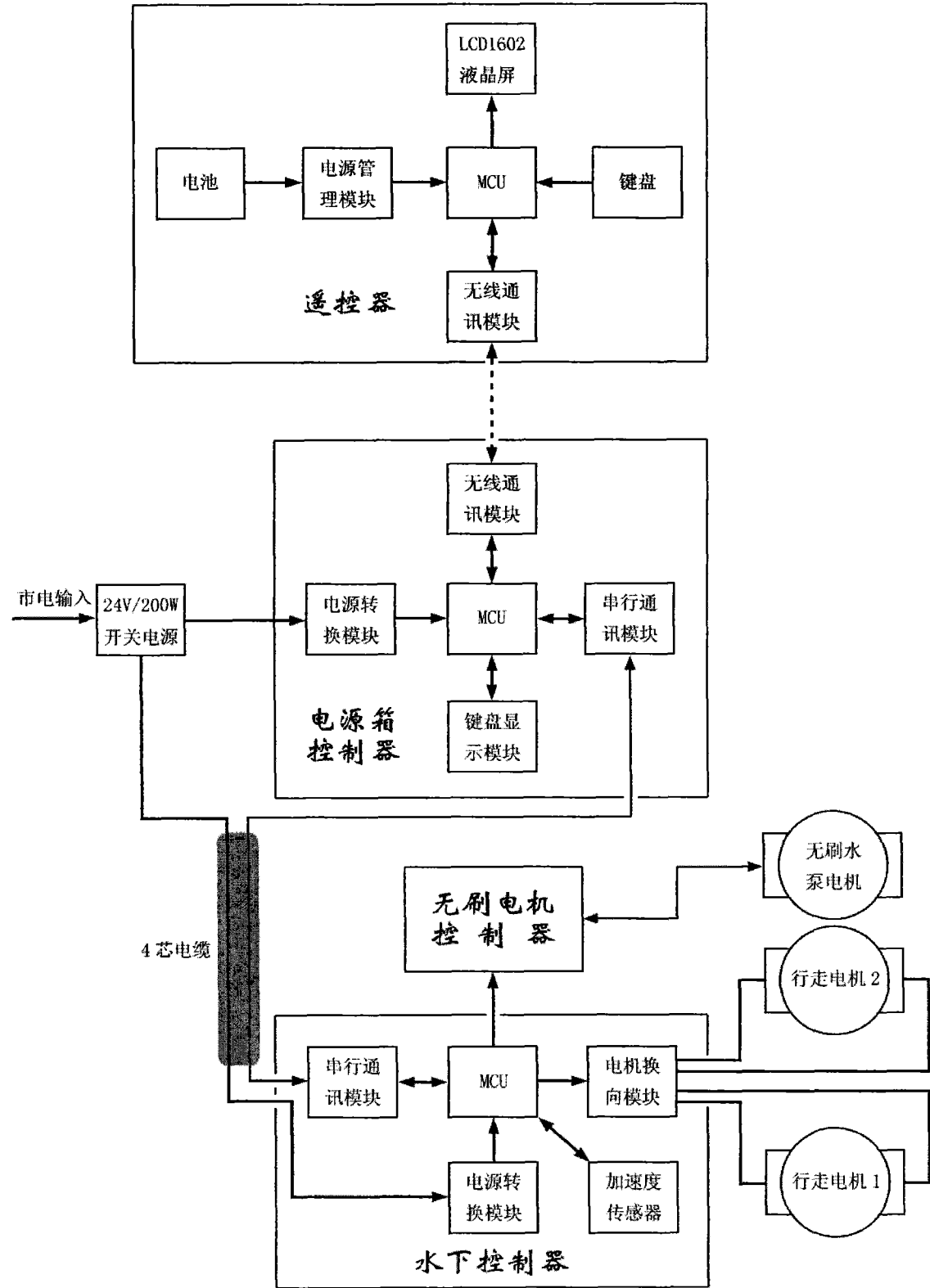


图 13

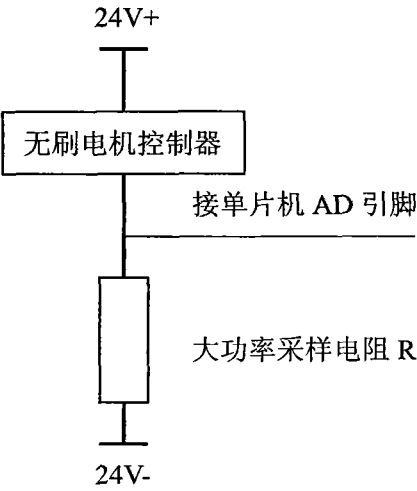


图 14

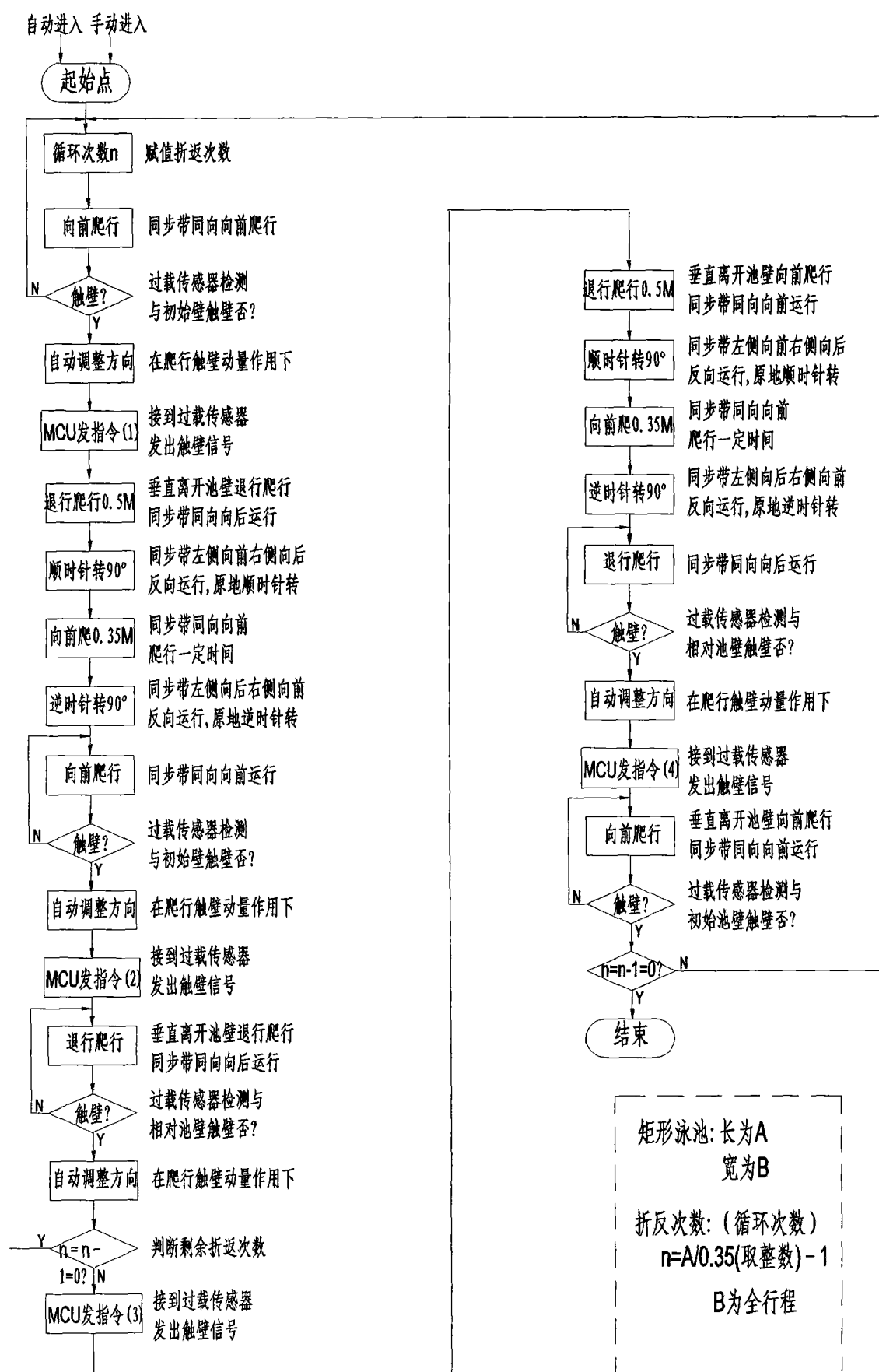


图15

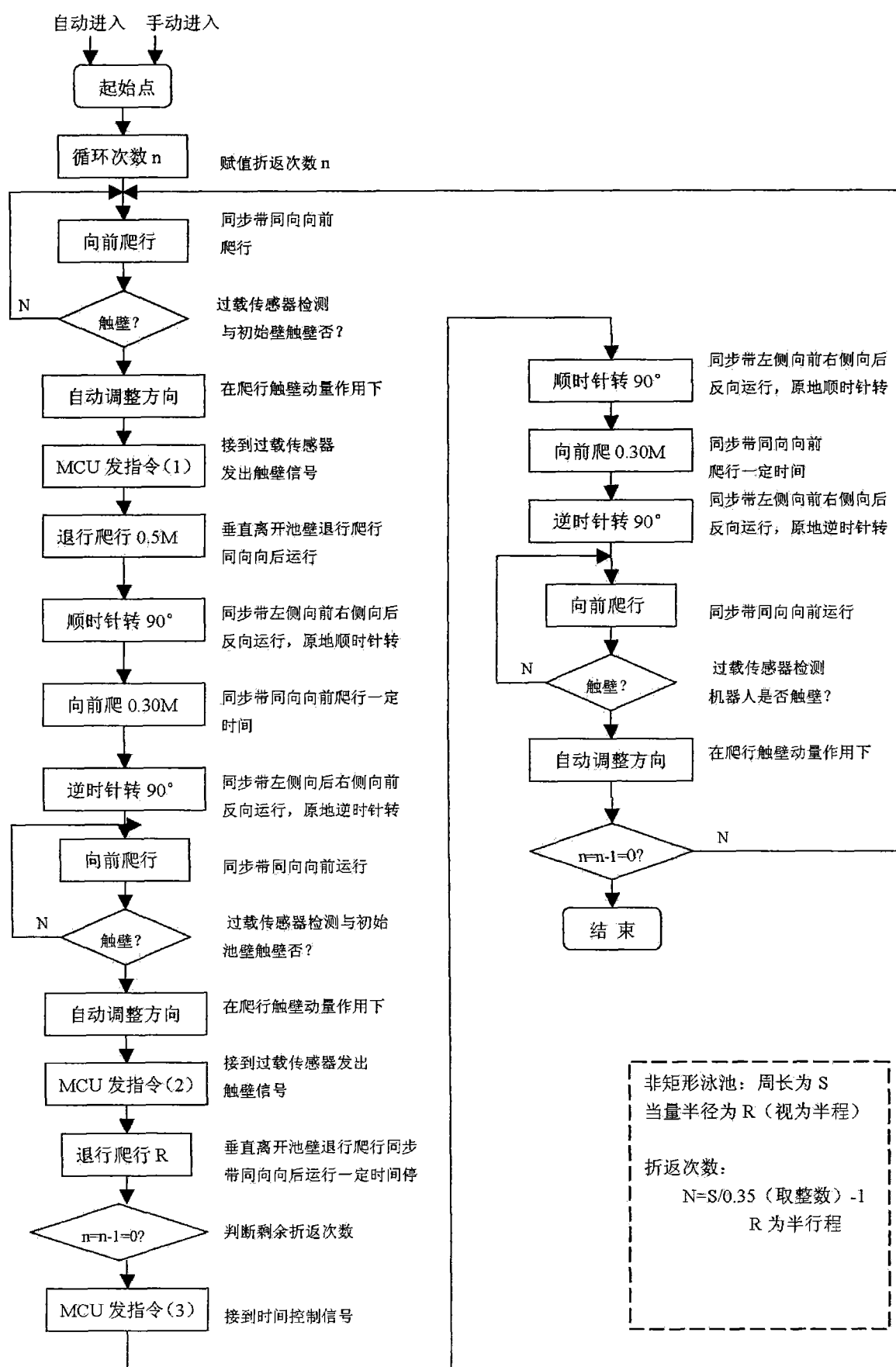


图 16