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(54) **POOL CLEANER**

(57) A pool cleaner that may include a removable floatation and skimmer device (85), a submerged unit (10), a controller and a mechanism; wherein the submerged unit (10) comprises a propulsion module and a filter. The controller may be configured to receive or generate a connection indication that indicates whether the removable floatation and skimmer device (85) is connected to the submerged unit (10); operate the pool cleaner in an operational mode selected out of a skimmer mode and a submerged cleaning mode, based, at least, on the connection indication; and change the operational mode of the pool cleaner.

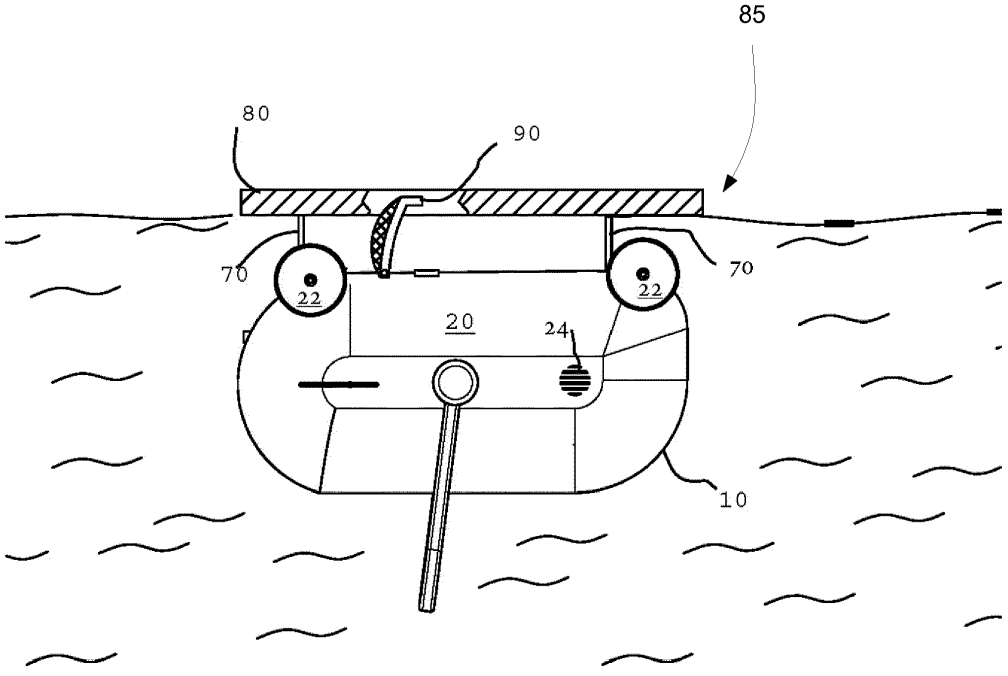

FIG. 1

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Description

CROSS REFERENCE

[0001] This application claims priority from US provisional patent 62/568,894 filing date October 6, 2017.

BACKGROUND

[0002] Debris may be accumulated within a pool and may also be accumulated at the waterline.

[0003] There is a growing need to provide efficient pool cleaners and methods for cleaning both the waterline and the submerged parts of the pool.

SUMMARY

[0004] There may be provided a pool cleaner that may include a removable floatation and skimmer device, a submerged unit, a controller and a mechanism; wherein the submerged unit may include a propulsion module and a filter. The controller may be configured to: receive or generate a connection indication that indicates whether the removable floatation and skimmer device may be connected to the submerged unit; operate the pool cleaner in an operational mode selected out of a skimmer mode and a submerged cleaning mode, based, at least, on the connection indication; and change the operational mode of the pool cleaner.

[0005] The controller may be configured to (a) control the mechanism to connect the removable floatation and skimmer device to the submerged unit, during the skimmer mode; and (b) control the mechanism to disconnect the removable floatation and skimmer device from the submerged unit, following the skimmer mode.

[0006] The removable floatation and skimmer device may be without a propulsion module

[0007] The mechanism may be configured to rigidly connect the removable floatation and skimmer device to the submerged unit, during the skimmer mode.

[0008] The mechanism may include at least one structural element and at least one holding mechanism that may be configured to hold, under the control of the controller, the at least one structural element.

[0009] The mechanism may include multiple structural elements and multiple holding mechanisms that may be configured to hold, under the control of the controller, the multiple structural elements, wherein a first structural element belongs to the submerged unit and a second structural element belongs to the removable floatation and skimmer device.

[0010] The pool cleaner may include at least one sensor for aligning the submerged unit and the removable floatation and skimmer device before connecting the submerged unit to the removable floatation and skimmer device.

[0011] There may be provided a method for cleaning a pool by a pool cleaner, the method may include: operating the pool cleaner in a skimmer mode during which (a) a submerged unit of the pool cleaner may be connected to a removable floatation and skimmer device of the pool cleaner, (b) the removable floatation and skimmer device follows movements of the submerged unit, and (c) the removable floatation and skimmer device collects debris from a waterline; disconnecting the removable floatation and skimmer device from the submerged unit; operating the pool cleaner in a submerged cleaning mode during which the submerged unit may be configured to clean submerged regions of the pool.

[0012] The removable floatation and skimmer device may be idle during the submerged cleaning mode.

[0013] The removable floatation and skimmer device may be without a propulsion module.

[0014] The method may include rigidly connecting the removable floatation and skimmer device to the submerged unit, during the skimmer mode.

[0015] The method may include automatically switching from the skimmer mode to the submerged cleaning mode.

[0016] The method may include automatically switching from the skimmer mode to the submerged cleaning mode, after completing a certain movement pattern.

[0017] The method may include automatically switching from the skimmer mode to the submerged cleaning mode, after sensing that the removable floatation and skimmer device may be full.

BRIEF DESCRIPTION OF THE DRAWINGS

[0018] The subject matter regarded as the invention is particularly pointed out and distinctly claimed in the concluding portion of the specification. The invention, however, both as to organization and method of operation, together with objects, features, and advantages thereof, may best be understood by reference to the following detailed description when read with the accompanying drawings in which:

FIG. 1 illustrates a pool cleaner that includes a removable floatation and skimmer device according to an embodiment of the invention;

FIG. 2 illustrates a pool cleaner that includes a removable floatation and skimmer device according to an embodiment of the invention;

FIG. 3 illustrates some components of a detachment unit according to an embodiment of the invention;

FIG. 4 illustrates a pool cleaner after a detachment from the removable floatation and skimmer device according to an embodiment of the invention;

FIG. 5 illustrates a pool cleaner that includes a removable floatation and skimmer device according to an embodiment of the invention;

FIG. 6 illustrates various components of the pool cleaner that includes a removable floatation and skimmer device according to an embodiment of the invention;

FIG. 6 illustrates various components of the pool cleaner that includes a removable floatation and skimmer device according to an embodiment of the invention;

FIGs. 8A, 8B and 8C illustrates an exit process of the pool cleaner, a detachment of the removable flotation and skimmer device and a re-entry of the pool cleaner to the pool;

FIG. 9 illustrates a pool cleaner that includes a removable floatation and skimmer device according to an embodiment of the invention;

FIG. 10 illustrates a pool cleaner that includes a removable floatation and skimmer device according to an embodiment of the invention;

FIG. 11 illustrates a pool cleaner that includes a removable floatation and skimmer device according to an embodiment of the invention;

FIG. 12 illustrates a pool cleaner that includes a removable floatation and skimmer device according to an embodiment of the invention;

FIG. 13 illustrates a pool cleaner that includes a removable floatation and skimmer device according to an embodiment of the invention;

FIG. 14 illustrates a removable floatation and skimmer device according to an embodiment of the invention;

FIG. 15 illustrates a pool cleaner that includes a removable floatation and skimmer device according to an embodiment of the invention;

FIG. 16 illustrates a pool cleaner that includes a removable floatation and skimmer device according to an embodiment of the invention;

FIG. 17 illustrates a pool cleaner that includes a removable floatation and skimmer device according to an embodiment of the invention;

FIG. 18 illustrates a pool cleaner that includes a removable floatation and skimmer device according to an embodiment of the invention;

FIG. 19 illustrates a pool cleaner that includes a removable floatation and skimmer device according to an embodiment of the invention;

FIG. 20 illustrates a pool, a submerged unit and a removable floatation and skimmer device according to an embodiment of the invention; and

FIG. 21 illustrates a method according to an embodiment of the invention.

It will be appreciated that for simplicity and clarity of illustration, elements shown in the figures have not necessarily been drawn to scale. For example, the dimensions of some of the elements may be exaggerated relative to other elements for clarity. Further, where considered appropriate, reference numerals may be repeated among the figures to indicate corresponding or analogous elements.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0019] In the following detailed description, numerous specific details are set forth in order to provide a thorough understanding of the invention. However, it will be understood by those skilled in the art that the present invention may be practiced without these specific details. In other instances, well-known methods, procedures, and components have not been described in detail so as not to obscure the present invention.

[0020] The subject matter regarded as the invention is particularly pointed out and distinctly claimed in the concluding portion of the specification. The invention, however, both as to organization and method of operation, together with objects, features, and advantages thereof, may best be understood by reference to the following detailed description when read with the accompanying drawings.

[0021] It will be appreciated that for simplicity and clarity of illustration, elements shown in the figures have not necessarily been drawn to scale. For example, the dimensions of some of the elements may be exaggerated relative to other elements for clarity. Further, where considered appropriate, reference numerals may be repeated among the figures to indicate corresponding or analogous elements.

[0022] Any reference in the specification to a system should be applied mutatis mutandis to a method that can be executed by the system.

[0023] Because the illustrated embodiments of the present invention may for the most part, be implemented using electronic components and circuits known to those skilled in the art, details will not be explained in any greater extent than that considered necessary as illustrated above, for the understanding and appreciation of the underlying concepts of the present invention and in order not to obfuscate or distract from the teachings of the present invention.

[0024] Any reference in the specification to a method should be applied mutatis mutandis to a system capable of executing the method and should be applied mutatis mutandis to a non-transitory computer readable medium that stores instructions that once executed by a computer result in the execution of the method.

[0025] Any reference in the specification to a system should be applied mutatis mutandis to a method that can be executed by the system and should be applied mutatis mutandis to a non-transitory computer readable medium that stores instructions that once executed by a computer result in the execution of the method.

[0026] There is provided a pool cleaner that includes a removable floatation and skimmer device. The pool cleaner also a submerged unit that may include:

a. a housing,
b. a filtering unit,
c. an inlet for allowing un-filtered fluid to enter the housing and be filtered by the filtering unit;
d. an outlet for allowing filtered fluid to exit the pool cleaner;
e. an electrical drive and propulsion mechanism;

f. One or more sensor for sensing the vicinity of the pool cleaner;
g. a controller for controlling the operation of the pool cleaner.

[0027] The pool cleaner may have any other component that allows the pool cleaner to clean submerged parts of the pool. For example- the pool cleaner may include one or more brush wheels for scrubbing submerged parts of the pool, a communication module, a power supply module, and the like.

[0028] The submerged unit is a part of the pool cleaner that may perform submerged cleaning. It may also be referred to as "main body".

[0029] The removable floatation and skimmer device include a float or any other floating means as well as components for skimming, filtering and holding debris such as a net or any other debris net and reservoir configuration, components for directing the debris towards the debris reservoir, and the like.

[0030] The pool cleaner may operate in two operational modes:

a. A skimmer mode.
b. A submerged cleaning mode.

[0031] During the skimmer mode, the removable floatation and skimmer device is coupled to the submerged unit of the pool cleaner and the submerged unit of the pool cleaner may propagate within the water of the pool thereby moving the removable floatation and skimmer device and assisting the removable floatation and skimmer device in aggregating waterline floating debris. The submerged unit of the pool cleaner may perform any movement patters, may respond to events (such as reaching a sidewall, reaching a certain level of fullness of the removable floatation and skimmer device, and the like). The submerged unit of the pool cleaner is expected to move in close proximity to the waterline while maintaining the removable floatation and skimmer device at the waterline.

[0032] During the submerged cleaning mode, the removable floatation and skimmer device is detached from the submerged unit of the pool cleaner and the pool cleaner may sink to the bottom and start a new cycle to perform any underwater cleaning session.

[0033] It should be noted that the pool cleaner may also attempt to perform waterline cleaning even when the removable floatation and skimmer device is detached.

[0034] The pool cleaner may automatically switch from the skimmer mode to the submerged cleaning mode. The pool cleaner may use its one or more sensors (for example a camera) to navigate towards the removable floatation and skimmer device.

[0035] For example- the pool cleaner may ,without human intervention, detach its submerged unit from the removable floatation and skimmer device after completing a certain movement pattern, and/or after sensing that the removable floatation and skimmer device net or reservoir is full, and/or after receiving a command from another device or from a user, and/or after spending a predetermined time in the skimmer mode, after reaching a predefined location, and the like.

[0036] After detachment, the removable floatation and skimmer device may be taken out of the pool by a user, by a station, and the like. The pool cleaner may exit the pool prior the detachment of the removable floatation and skimmer device. The station may remove the removable flotation and skimmer device and/or may receive the removable flotation and skimmer device and/or may detach the removable flotation and skimmer device to the pool cleaner, and the like. In figures 8A, 8B and 8C the removable flotation and skimmer device is removed from the pool cleaner, received by the station 100, and the pool cleaner may re-enter the pool without the removable flotation and skimmer device. Station 100 included a frame 101 for receiving the removable flotation and skimmer device and also a mechanism 102 for assisting the pool cleaner 10 to exit the pool. It should be noted that the order of operations illustrated in figures 8A, 8B and 8C may be reversed - and that the pool cleaner may be attached to the removable flotation and skimmer device (held by the station) before entering the pool. Pool cleaner 10 in figures 8A, 8B and 8C is depiced as including an electrical power cord attached to an external power supply source (not shown) connected to 102 that is located in station 100.

[0037] The station may be at least partially submerged - and may receive and/or provide the removable flotation and skimmer device while the reminder of the pool cleaner (or at least a part of it) is submerged.

[0038] The pool cleaner may automatically switch from the submerged cleaning mode to the skimmer mode.

[0039] For example- the pool cleaner may connect its submerged unit to the removable floatation and skimmer device after completing a certain movement pattern, and/or after sensing that the removable floatation and skimmer device is located at the waterline, and/or after receiving a command from another device or from a user, and/or after spending a predetermined time in the submerged mode, after reaching a predefined location, and the like.

[0040] Any detachment mechanism may be used to detachably connect the removable floatation and skimmer device to the pool cleaner. The detachment mechanism may be a mechanical mechanism, may use magnetic forces, may be hydraulic, and the like.

[0041] Figure 1 illustrates a pool cleaner that includes a submerged unit 10 and removable floatation and skimmer device 85 according to an embodiment of the invention.

[0042] Removable floatation and skimmer device 85 includes one or more floating elements 80 and a net 90 for collecting, filtering and holding debris.

[0043] The submerged unit 10 is illustrated as including

outlet 24, housing 20 and wheels 22.

[0044] Rods 70 extend from removable floatation and skimmer device 85 and are detachably connected to the submerged unit 10.

[0045] Figures 2 and 3A illustrates that rod 70 has an opening (not shown) through which curved holding element 72 may enter (thereby holding rods 70). Curved holding element 72 rotates about an axis of rotation 74 - and the rotation may cause curved holding element 72 to exit the opening of rod 70 and to release rod 70 - thereby detaching the removable floatation and skimmer device 85 from the submerged unit 10.

[0046] A spring 76 be forced against curved holding element 72 and may force it to maintain in a locked position. When the spring is forced to move away from curved holding element 72 - the curved holding element may release rod 70.

[0047] It should be noted that any other means for selectively detaching the removable floatation and skimmer device 85 from the submerged unit may be used.

[0048] Figure 3B illustrates a piston or servo motor 77 that is connected to a rod 78 that may enter the opening in rod 70 - the piston may be used to connect or allow detachment of the removable floatation and skimmer device 85 to the submerged unit of the pool cleaner.

[0049] Figure 4 illustrates the submerged unit when the pool cleaner operates in the submerged mode- after detaching from the removable floatation and skimmer device.

[0050] In figure 4 the submerged unit is detached from the removable flotation and skimmer device and perform an upside-down movement in order to land on the bottom of the pool with its wheels (or other movement mechanism interfaces downwards).

[0051] In figure 5 the submerged unit is detached from the removable flotation and skimmer device and lands on the bottom of the pool with its wheels and tracks (or other movement mechanism interfaces downwards) without needing to perform the upside-down movement.

[0052] Thus, in figure 4 the submerged unit (when moving along the bottom of the pool) faces the removable flotation and skimmer device. On the other hand, the submerged unit (when moving along the bottom of the pool) faced an opposite direction that the removable flotation and skimmer device - in figure 5.

[0053] Figure 6 illustrates the submerged unit as including a jet propulsion movement system 60 that includes fluid inlet 61, fluid control element 62 and fluid outlets 65, 64, 63, 65, 66 and 67. The fluid control element 62 is fluidly coupled to fluid inlet 61 and to fluid outlets 65, 64, 63, 65, 66 and 67 - and may selectively distribute the fluid between the fluid outlets. The fluid outlets may include panes or other direction control elements. Fluid also enters the pool cleaner via bottom inlet 68 and may be filtered and then ejected from the pool cleaner.

[0054] The submerged unit 10 is also illustrated as including a controller 69, sensor 691 (such as but not limited a gyroscope), pump motor 696, impeller 695, filtering unit 694, drive motor 693, and generator 692.

[0055] Figure 9 illustrates the submerged unit 10 of the pool cleaner (especially a battery 116) as being electrically fed by an interface (such as inductance-based interface 112 and 114) from electricity generated by a power source (such as a solar panel 88 connected to cable 89) of the removable floatation and skimmer device 80. It should be noted that the submerged unit may feed the removable floatation and skimmer device by power generated or received by a power source within the submerged unit.

[0056] Figures 10-14 illustrates various sensors that may belong to the submerged unit and/or may belong to the removable floatation and skimmer device 80 - and are used for aligning the submerged unit with the removable floatation and skimmer device during an attachment process. Any sensors may be provided, and any alignment process may be applied. For example - the sensors may be image sensors, cameras, acoustic sensors, magnetic sensor and the like. The removable floatation and skimmer device may transmit beacons that mat be sensed by non-visual sensors of the submerged unit. In figure 11 sensor 121 has a field of view 121'- that may be of any shape and size. In figure 12 sensor 89 has a field of view 89' - that may be of any shape and size.

[0057] The submerged unit may have a controller 69 that may receive signals from one or more sensors (121) of the submerged unit and/or from one or more sensors of the removable floatation and skimmer device. Signals from sensors (such as 87) of the removable floatation and skimmer device may be sent to a communication module 89 of the removable floatation and skimmer device, then sent to communication module 122 of submerged unit 10 and then sent to controller 69 of submerged unit.

[0058] Figure 14 illustrates that rod 70 may be flexible, semi-rigid (for example can be made of relatively rigid rubber), and the like. It should be noted that any amount of movement and/or deformation in relation to a certain position and/or shape of the rod may be provided.

[0059] There may be any number of rods- especially more than 2 or 3 rods- and may be arrange din any manner- preferably not all rods are located along a same linear line.

[0060] In any of the figures and examples - rod 70 may be replaced by any structural element (for example a string) that can be selectively held by a holding mechanism.

[0061] The rods may belong to the submerged unit and not to the removable floatation and skimmer device.

[0062] One or more holding element may belong to the submerged unit while one or more holding elements may belong to the detachably held by a holding mechanism. The same applies to the holding mechanisms.

[0063] A holding mechanism for selectively holding the rod may be positioned in the removable floatation and skimmer device. This is illustrated in figure 15 - see holding mechanism 71 inside removable floatation and skim-

mer device.

[0064] The rod may be movable in and/or outside the submerged unit, may be movable between various positions, may be telescopic, and the like.

[0065] Figure 16 illustrates a manipulator 75 for moving the rod between various positions. The manipulator may be any type of motor, gear, combination of motor and gear, and the like.

[0066] Figure 17 illustrates a magnetic force-based attachment - in which at least one of the interfacing elements (for example at least one of rod 79 and 79') include magnets 79" for holding each other. The magnets may be included in both submerged unit and removable floatation and skimmer device or in only one of them.

[0067] Figure 18 illustrates a sensor 123 for sensing when the submerged unit is connected to the removable floatation and skimmer device. The sensing may assist a controller of the robot to determine how to operate the pool cleaner. The determination may also be based on a policy for operating the pool cleaning robot, commands received from a user and the like.

[0068] For example - assuming that the policy mandates that the pool cleaner should start, after being power up to operate in a skimmer mode only when the submerged unit is connected to the removable floatation and skimmer device.

a. Under this assumption - if after power up the sensor senses that the submerged unit is not connected to the removable floatation and skimmer device then the pool cleaner may start operating in the submerged cleaning mode.

b. Under this assumption - if after power up the sensor senses that the submerged unit is connected to the removable floatation and skimmer device the the pool cleaner may start operating in the skimmer mode.

[0069] For example - assuming that the policy mandates that the pool cleaner should start, after being power up to operate in a skimmer mode - then, under this assumption, if the sensor senses that the submerged unit is not connected to the removable floatation and skimmer device - then the pool cleaner should attempt to connect the submerged unit to the removable floatation and skimmer device.

[0070] Sensor 123 may be any type of sensors including but not limited to an image sensor, a gyroscope, a proximity sensor, a contact sensor, a motion sensor, a float sensor, a tilt sensor and the like. The sensor may determine, directly or indirectly, that the the submerged unit is connected to the removable floatation and skimmer device.

[0071] The submerged unit, when idle (not use any propulsion system), may tend to sink in the water (or may not stay upside down for more than a certain period) unless it is connected to the removable floatation and skimmer device. Accordingly - sensing the orientation of the submerged unit and/or the movement of the submerged unit provide an indirect indication about whether the submerged unit is connected to the removable floatation and skimmer device or not. Yet for another example of indirect sensing - the relationship between the movement of the submerged unit and the manner in which the propulsion system operates (for example- torque, speed) may differ when the submerged unit is disconnected or connected to the removable floatation and skimmer device. When disconnected the submerged unit is heavier, may easily sink, and the like.

[0072] An example of direct sensing may include sensing that the holding mechanism holds a structural element. This may include contact sensing, image sensing, proximity sensing, and the like. Figure 19 illustrates sensor 123 as sensing (for example image sensing) that the rod is locked by piston 77 or by curved holding element 72.

[0073] The state (tilt, orientation, position) of any holding element may indicate whether contact was made or not.

[0074] It should be noted that while the connection of the submerged unit to the removable floatation and skimmer device may be done automatically (for example under the control of a controller of the pool cleaner) or manually. When the connection is done manually the controller may control the pool cleaner based, at least in part, on the sensing of whether the submerged unit is connected to the removable floatation and skimmer device.

[0075] It should be noted that the pool cleaner may be manually inserted into the pool while being in a connected configuration (submerged unit is connected to the removable floatation and skimmer device) or while being in a disconnected format (submerged unit is not connected to the removable floatation and skimmer device).

[0076] It should also be noted that the pool cleaner may be manually removed from the pool when in connected configuration (submerged unit is connected to the removable floatation and skimmer device) and that either one of the submerged unit and the removable floatation and skimmer device may be manually extracted from the pool.

[0077] The submerged unit may be configured to detach from the removable floatation and skimmer device in predefined locations - such as near (for example- up to 50 centimetres) to the edge of the pool - in order to enable an easy extraction of the removable floatation and skimmer device from the pool. See, for example figure 20 in which the submerged unit 10 cleans the pool while the removable floatation and skimmer device 80 is left near the edge of pool 199.

[0078] The submerged unit may automatically exit the pool while the removable floatation and skimmer device is maintained in the pool. The removable floatation and skimmer device may be removed from the pool while the submerged unit maintains in the pool - and even continues to clean the pool.

[0079] The removable floatation and skimmer device

may or may not include any propulsion means.

[0080] The submerged unit may be rigidly connected to the removable floatation and skimmer device and thus may accurately control the movement of the removable floatation and skimmer device - especially may control the movement with an accuracy that does not exist when the submerged unit is connected to the removable floatation and skimmer device via long cables. This accurate control may allow the pool cleaner to force the removable floatation and skimmer device to exactly follow a desired movement pattern - thus cleaning desired areas of the waterline at a highly efficient manner.

[0081] When the submerged unit is connected to the removable floatation and skimmer device while maintaining a close distance (for example between 1 and 25 centimetres) between said elements - then accuracy of controlling the movement of removable floatation and skimmer device may improve - and the the mechanical load imposed on the submerged unit and/or the removable floatation and skimmer device, due to directional changes of the submerged unit, may be reduced (lower momentum).

[0082] There may be provided a method for cleaning a pool using a pool cleaner that has a removable floatation and skimmer device. The method may involve operating the pool cleaner in a skimmer mode, detaching the removable floatation and skimmer device from the submerged unit of the pool cleaner and then operating the pool cleaner in a submerged cleaning mode.

[0083] Figure 21 illustrates method 400.

[0084] Method 400 may include step 410 of operating the pool cleaner in a skimmer mode during which (a) a submerged unit of the pool cleaner may be connected to a removable floatation and skimmer device of the pool cleaner, (b) the removable floatation and skimmer device follows movements of the submerged unit, and (c) the removable floatation and skimmer device collects debris from a waterline.

[0085] Step 410 may be followed by step 420 of disconnecting the removable floatation and skimmer device from the submerged unit.

[0086] Step 420 may be followed by step 430 of operating the pool cleaner in a submerged cleaning mode during which the submerged unit may be configured to clean submerged regions of the pool.

[0087] The removable floatation and skimmer device may be idle during the submerged cleaning mode.

[0088] The removable floatation and skimmer device may be without a propulsion module.

[0089] Step 410 may include rigidly connecting the removable floatation and skimmer device to the submerged unit, during the skimmer mode.

[0090] Step 420 may include automatically switching from the skimmer mode to the submerged cleaning mode.

[0091] The switching may be executed following a command send to the pool cleaner by a remote control.

[0092] Step 420 may include switching from the skimmer mode to the submerged cleaning mode, after completing a certain movement pattern.

[0093] Step 420 may include automatically switching from the skimmer mode to the submerged cleaning mode, after sensing that the removable floatation and skimmer device may be full.

[0094] Method 400 may also include determining automatically to exit the pool.

[0095] There may be provided a method that may include (a) sensing the status of the pool cleaner (in connected format or disconnected format) or receiving information about the status of the pool cleaner, (b) and based on the status of the pool cleaner and a policy determining in which mode out of skimmer mode and submerged mode to operate, and (c) operating in the selected mode. Step (c) may be followed by automatically changing the operational mode.

[0096] Additionally or alternatively, the method may include operating the pool cleaner in a submerged cleaning mode, connecting the removable floatation and skimmer device to the submerged unit of the pool cleaner and then operating the pool cleaner in the skimmer mode.

[0097] The controller of the pool cleaner may store instructions that once executed by the pool cleaner causes the pool cleaner to execute any of the mentioned above methods. The controller may include one or more integrated circuits.

[0098] In the foregoing specification, the invention has been described with reference to specific examples of embodiments of the invention. It will, however, be evident that various modifications and changes may be made therein without departing from the broader spirit and scope of the invention as set forth in the appended claims.

[0099] Moreover, the terms "front", "back", "top", "bottom", "over", "under " and the like in the description and in the claims, if any, are used for descriptive purposes and not necessarily for describing permanent relative positions. It is understood that the terms so used are interchangeable under appropriate circumstances such that the embodiments of the invention described herein are, for example, capable of operation in other orientations than those illustrated or otherwise described herein.

[0100] Those skilled in the art will recognize that the boundaries between logic blocks are merely illustrative and that alternative embodiments may merge logic blocks or circuit elements or impose an alternate decomposition of functionality upon various logic blocks or circuit elements. Thus, it is to be understood that the architectures depicted herein are merely exemplary, and that in fact many other architectures can be implemented which achieve the same functionality.

[0101] Any arrangement of components to achieve the same functionality is effectively "associated" such that the desired functionality is achieved. Hence, any two components herein combined to achieve a particular functionality can be seen as "associated with" each other such that the desired functionality is achieved, irrespective of architectures or intermedial components. Like-

wise, any two components so associated can also be viewed as being "operably connected" or "operably coupled" to each other to achieve the desired functionality.

[0102] Furthermore, those skilled in the art will recognize that boundaries between the above described operations merely illustrative. The multiple operations may be combined into a single operation, a single operation may be distributed in additional operations and operations may be executed at least partially overlapping in time. Moreover, alternative embodiments may include multiple instances of a particular operation, and the order of operations may be altered in various other embodiments.

[0103] Also for example, in one embodiment, the illustrated examples may be implemented as circuitry located on a single integrated circuit or within a same device. Alternatively, the examples may be implemented as any number of separate integrated circuits or separate devices interconnected with each other in a suitable manner.

[0104] Also for example, the examples, or portions thereof, may implemented as soft or code representations of physical circuitry or of logical representations convertible into physical circuitry, such as in a hardware description language of any appropriate type.

[0105] Also, the invention is not limited to physical devices or units implemented in non-programmable hardware but can also be applied in programmable devices or units able to perform the desired device functions by operating in accordance with suitable program code, such as mainframes, minicomputers, servers, workstations, personal computers, notepads, personal digital assistants, electronic games, automotive and other embedded systems, cell phones and various other wireless devices, commonly denoted in this application as 'computer systems' .

[0106] However, other modifications, variations and alternatives are also possible. The specifications and drawings are, accordingly, to be regarded in an illustrative rather than in a restrictive sense.

[0107] In the claims, any reference signs placed between parentheses shall not be construed as limiting the claim. The word 'comprising' does not exclude the presence of other elements or steps then those listed in a claim. Furthermore, the terms "a " or "an", as used herein, are defined as one or more than one. Also, the use of introductory phrases such as "at least one " and "one or more " in the claims should not be construed to imply that the introduction of another claim element by the indefinite articles "a " or "an " limits any particular claim containing such introduced claim element to inventions containing only one such element, even when the same claim includes the introductory phrases "one or more " or "at least one " and indefinite articles such as "a " or "an. " The same holds true for the use of definite articles. Unless stated otherwise, terms such as "first " and "second " are used to arbitrarily distinguish between the elements such terms describe. Thus, these terms are not necessarily intended to indicate temporal or other prioritization of such elements The mere fact that certain measures are recited in mutually different claims does not indicate that a combination of these measures cannot be used to advantage.

[0108] Any system, apparatus or device referred to this patent application includes at least one hardware component.

[0109] Any reference to "comprising" should be applied mutatis mutandis to "consisting" and/or to "consisting essentially of'.

[0110] While certain features of the invention have been illustrated and described herein, many modifications, substitutions, changes, and equivalents will now occur to those of ordinary skill in the art. It is, therefore, to be understood that the appended claims are intended to cover all such modifications and changes as fall within the true spirit of the invention.

Claims

1. A pool cleaner, comprising a removable floatation and skimmer device, a submerged unit, a controller and a mechanism; wherein the submerged unit comprises a propulsion module and a filter,
   wherein the controller is configured to:

   receive or generate a connection indication that indicates whether the removable floatation and skimmer device is connected to the submerged unit;
   operate the pool cleaner in an operational mode selected out of a skimmer mode and a submerged cleaning mode, based, at least, on the connection indication; and
   change the operational mode of the pool cleaner.

2. The pool cleaner according to claim 1, wherein the controller is configured to (a) control the mechanism to connect the removable floatation and skimmer device to the submerged unit, during the skimmer mode; and (b) control the mechanism to disconnect the removable floatation and skimmer device from the submerged unit, following the skimmer mode.

3. The pool cleaner according to claim 1 or 2, wherein the removable floatation and skimmer device is without a propulsion module

4. The pool cleaner according to claim 1, 2 or 3, wherein the mechanism is configured to rigidly connect the removable floatation and skimmer device to the submerged unit, during the skimmer mode.

5. The pool cleaner according to any one of the preceding claims, wherein the mechanism comprises

at least one structural element and at least one holding mechanism that is configured to hold, under the control of the controller, the at least one structural element.

6. The pool cleaner according to any one of the preceding claims, wherein the mechanism comprises multiple structural elements and multiple holding mechanisms that are configured to hold, under the control of the controller, the multiple structural elements, wherein a first structural element belongs to the submerged unit and a second structural element belongs to the removable floatation and skimmer device.

7. The pool cleaner according to any one of the preceding claims, comprising at least one sensor for aligning the submerged unit and the removable floatation and skimmer device before connecting the submerged unit to the removable floatation and skimmer device.

8. A method for cleaning a pool by a pool cleaner, the method comprising:

operating the pool cleaner in a skimmer mode during which (a) a submerged unit of the pool cleaner is connected to a removable floatation and skimmer device of the pool cleaner, (b) the removable floatation and skimmer device follows movements of the submerged unit, and (c) the removable floatation and skimmer device collects debris from a waterline;
disconnecting the removable floatation and skimmer device from the submerged unit;
operating the pool cleaner in a submerged cleaning mode during which the submerged unit is configured to clean submerged regions of the pool.

9. The method according to claim 8, wherein the removable floatation and skimmer device is idle during the submerged cleaning mode.

10. The method according to claim 8 or 9, wherein the removable floatation and skimmer device is without a propulsion module.

11. The method according to claim 8, 9 or 10, comprising rigidly connecting the removable floatation and skimmer device to the submerged unit, during the skimmer mode.

12. The method according to any one of claims 8 to 11, comprising automatically switching from the skimmer mode to the submerged cleaning mode.

13. The method according to any one of claims 8 to 12, comprising automatically switching from the skimmer mode to the submerged cleaning mode, after completing a certain movement pattern.

14. The method according to any one of claims 8 to 13, comprising automatically switching from the skimmer mode to the submerged cleaning mode, after sensing that the removable floatation and skimmer device is full.

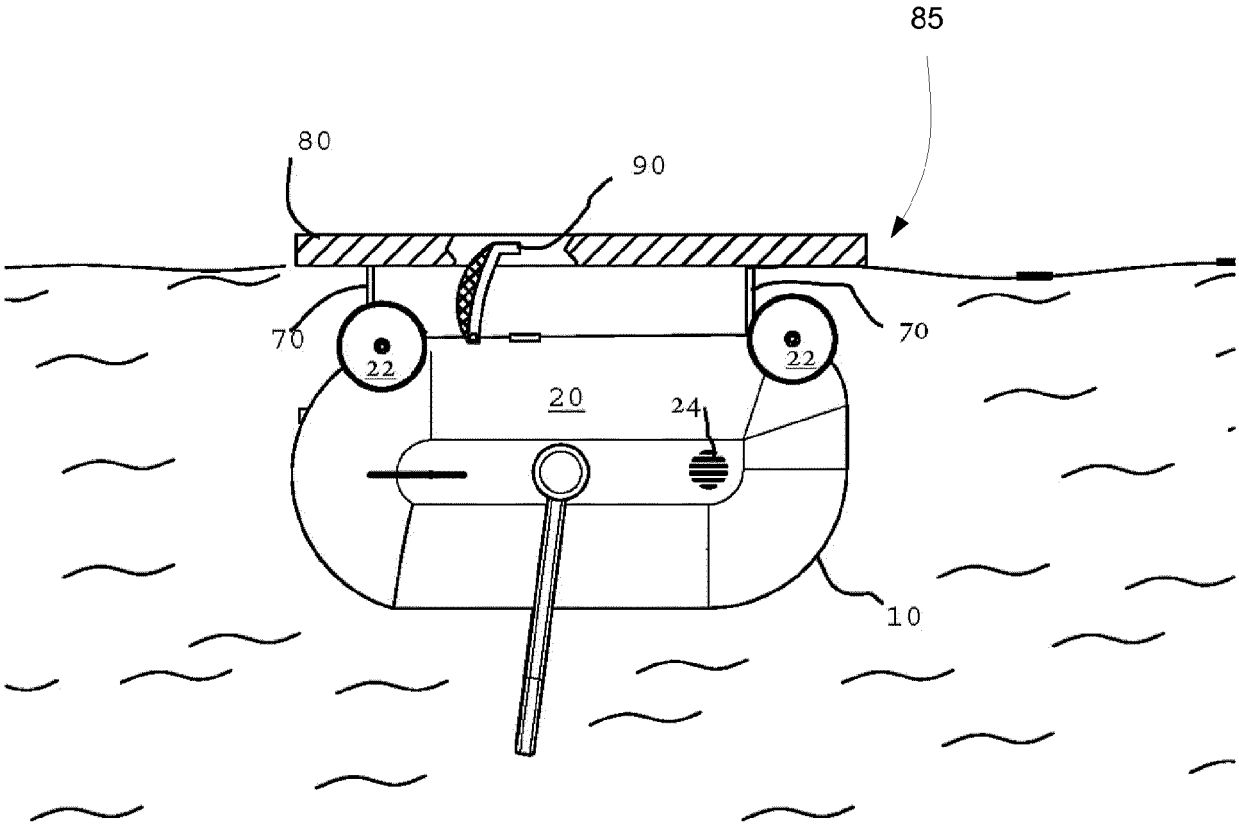

FIG. 1

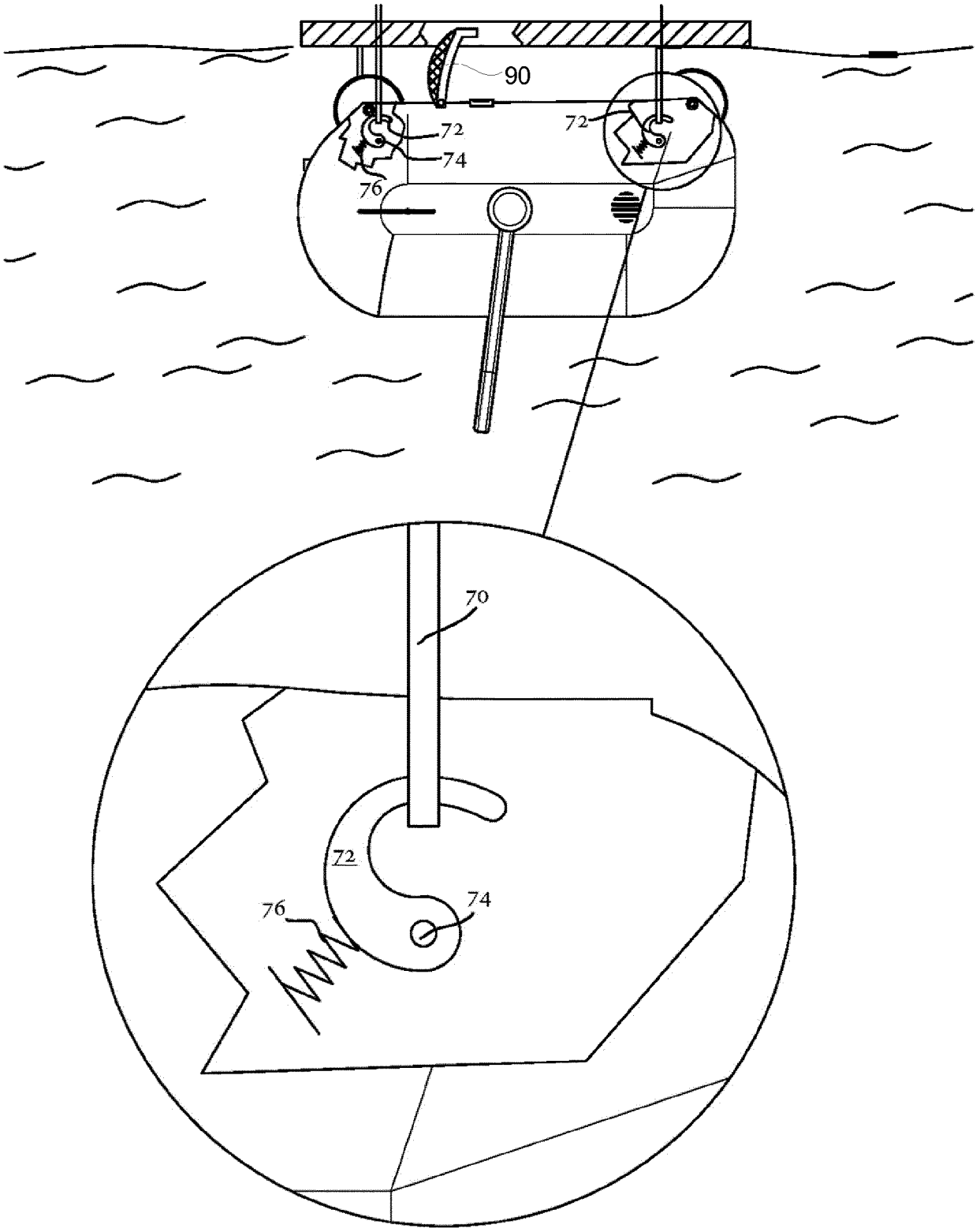

FIG. 2

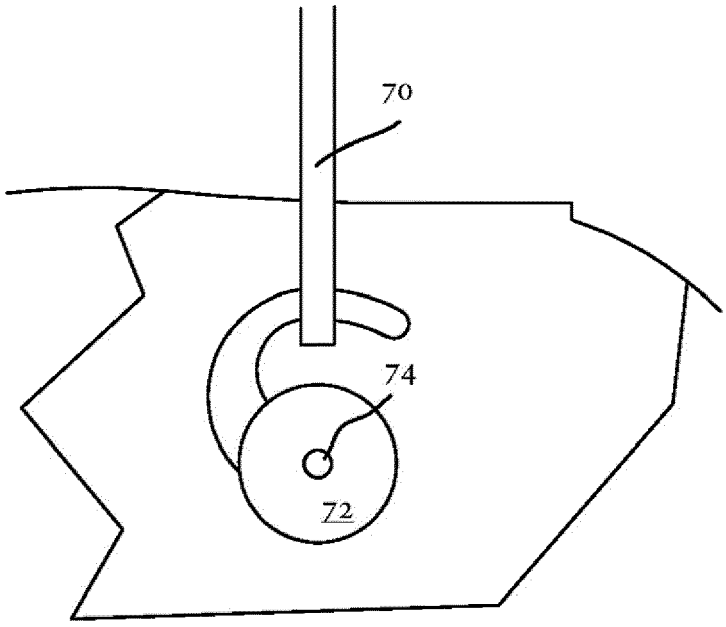

FIG. 3A

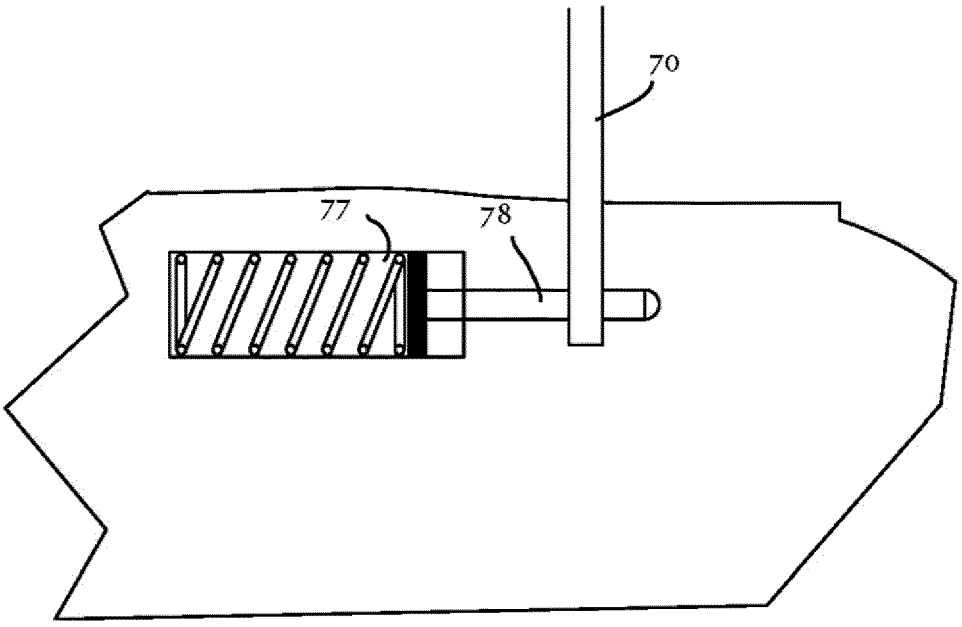

FIG. 3B

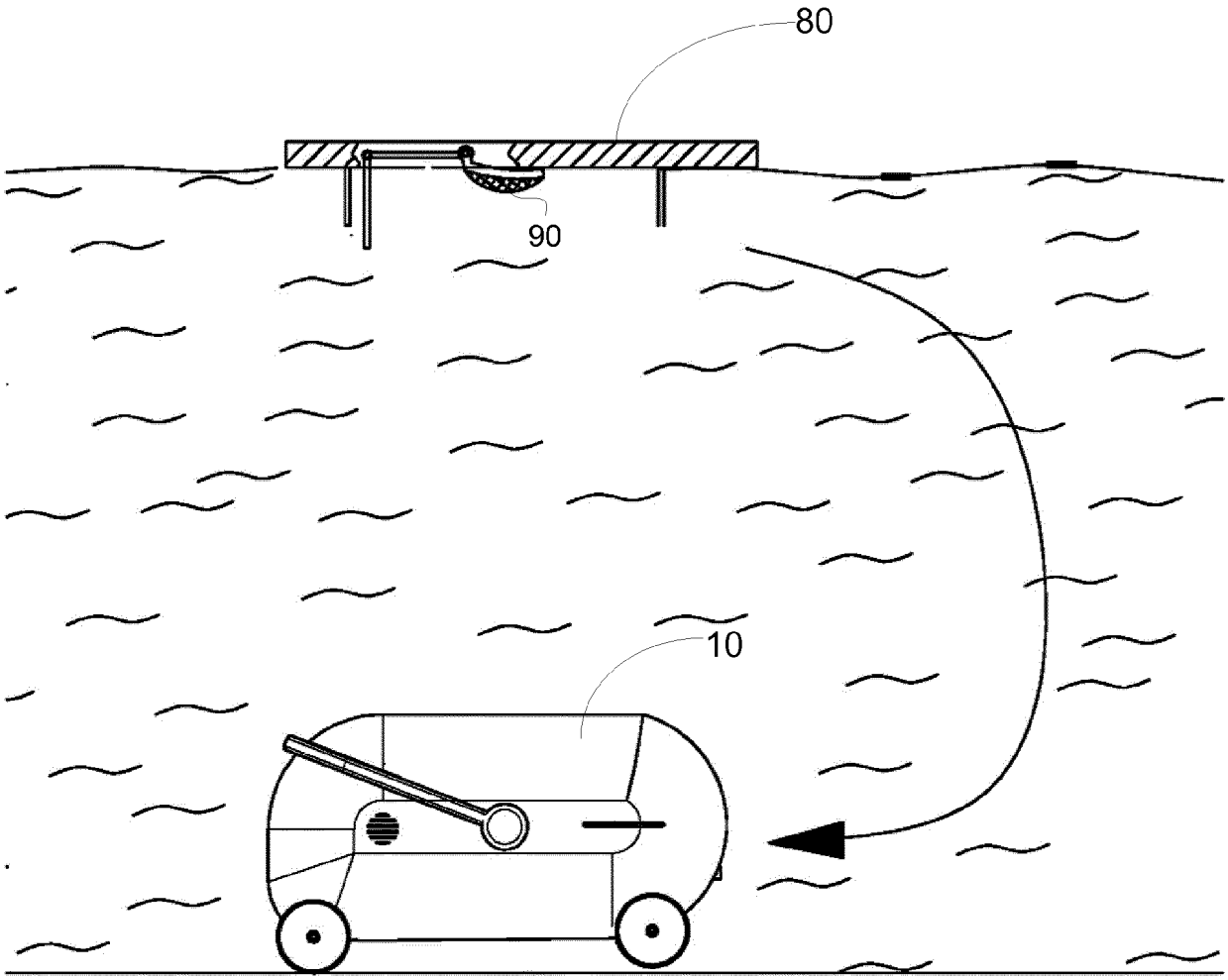

FIG. 4

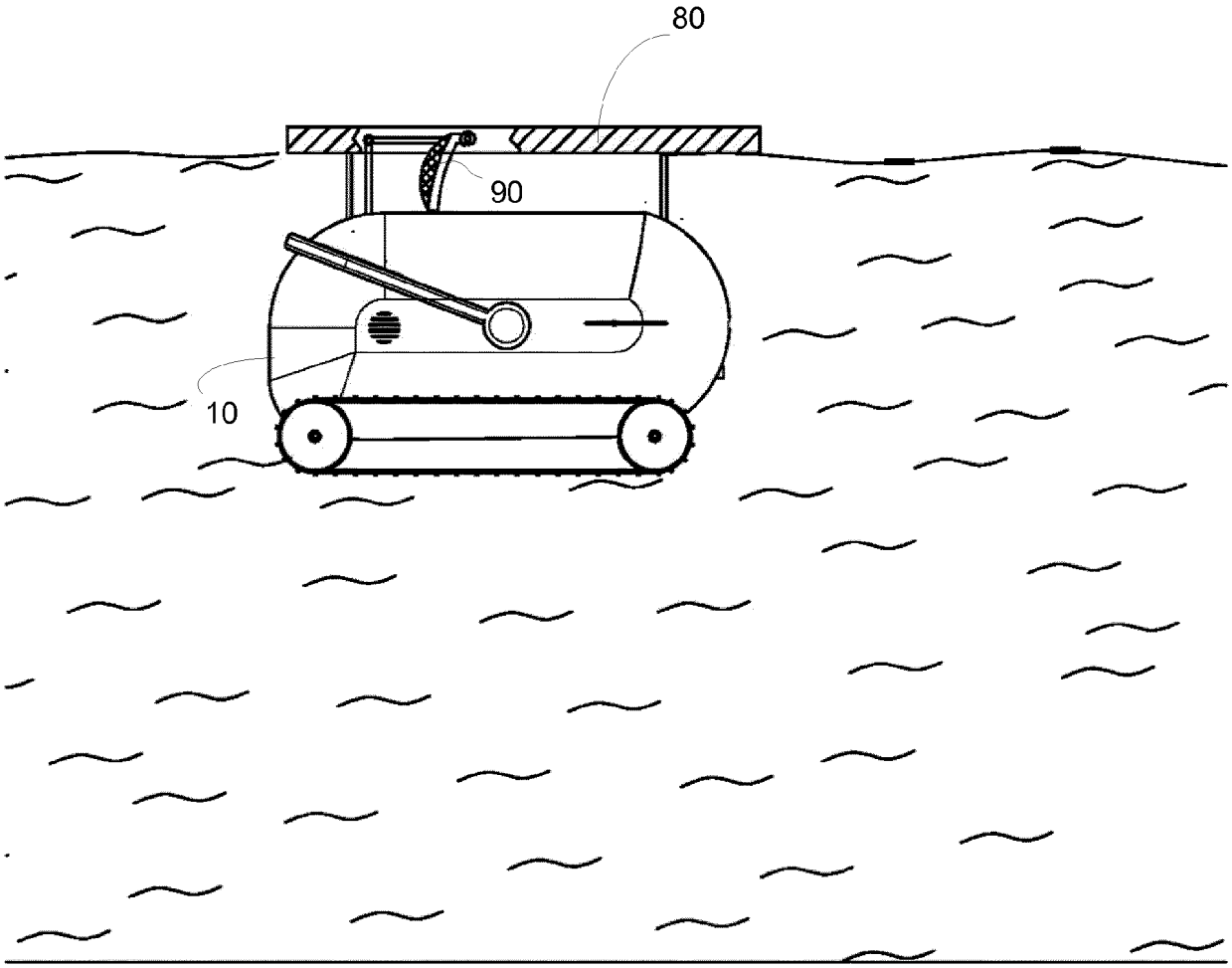

FIG. 5

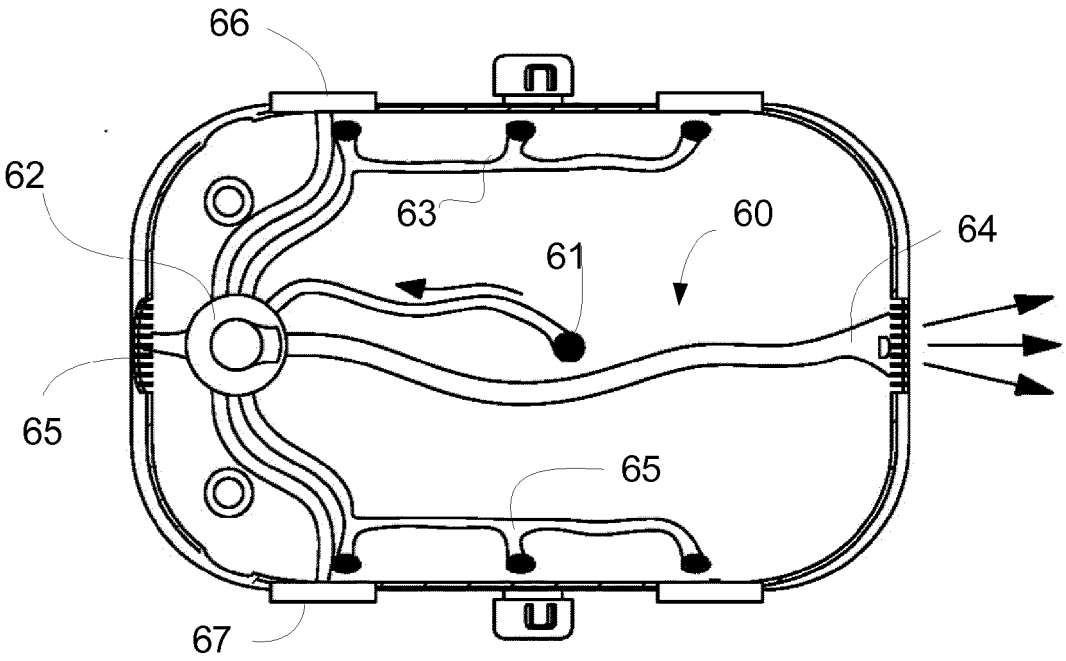
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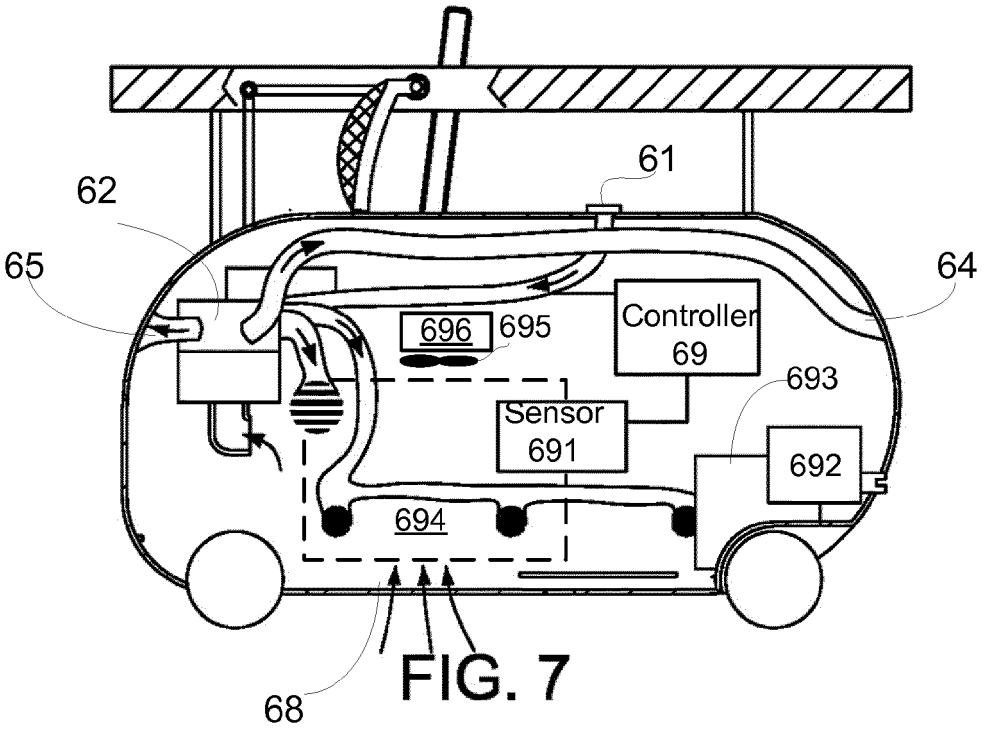
FIG. 6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Controller
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Sensor
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FIG. 7

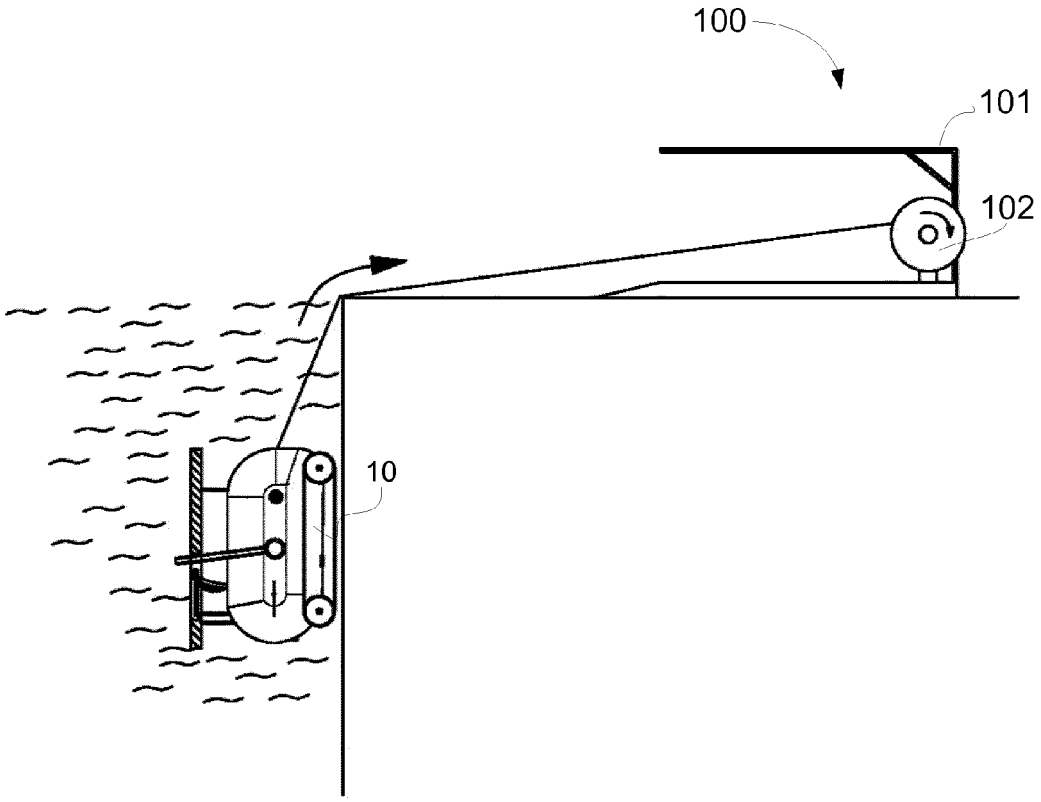


FIG. 8A

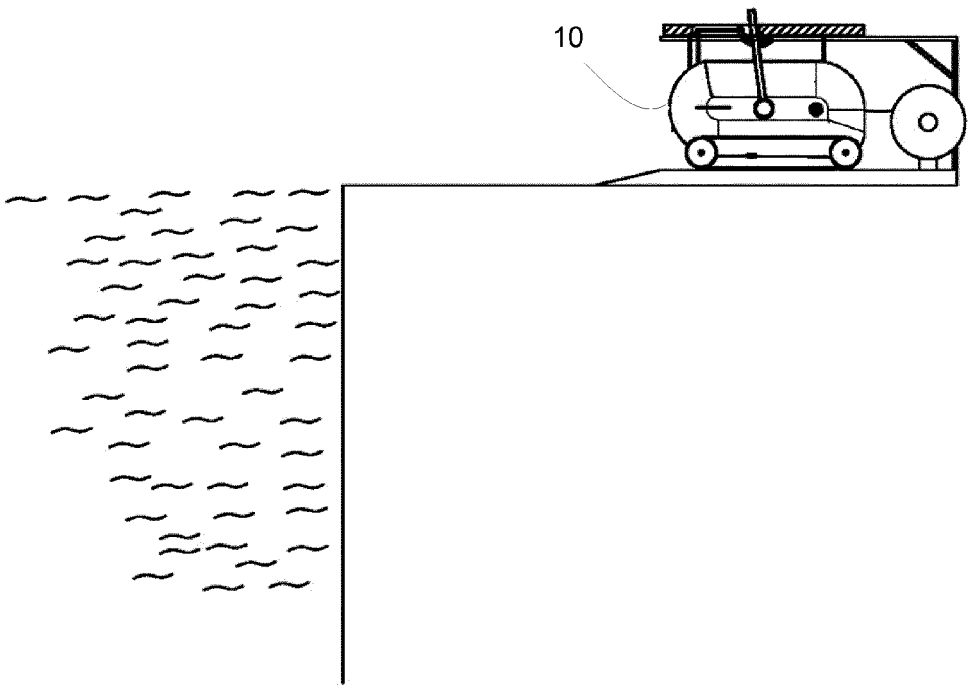


FIG. 8B

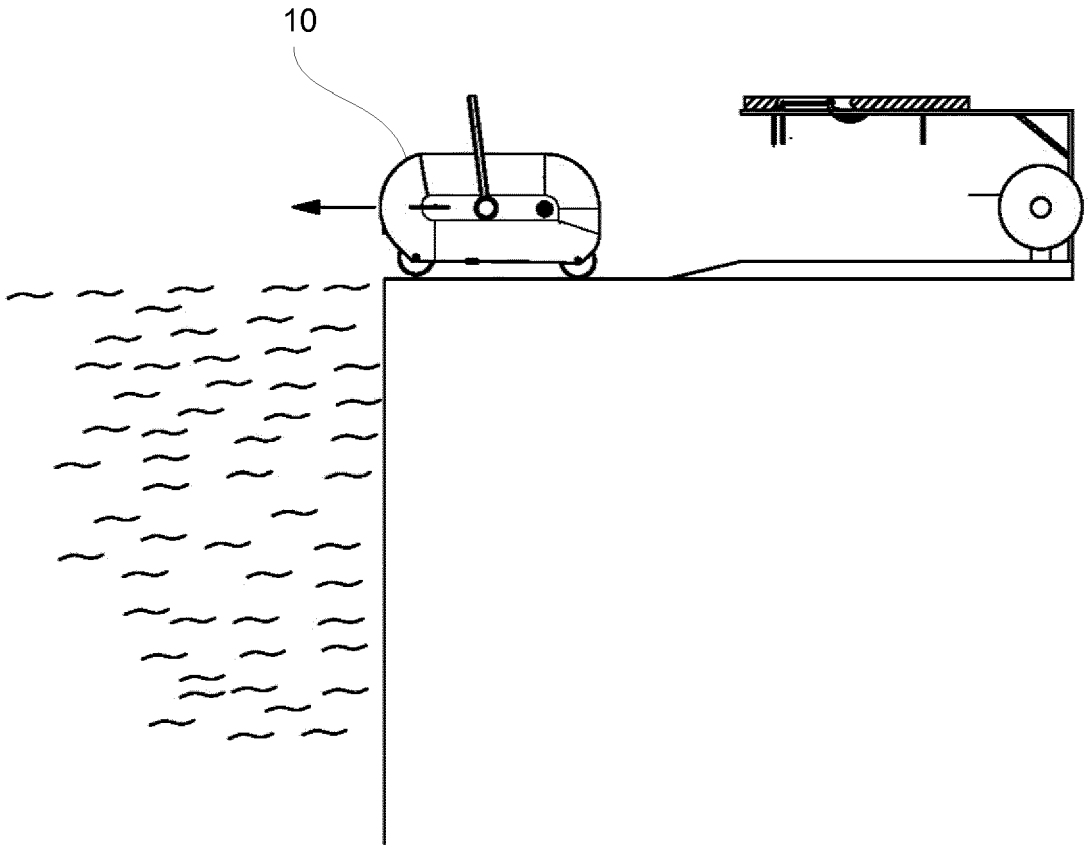


FIG. 8C

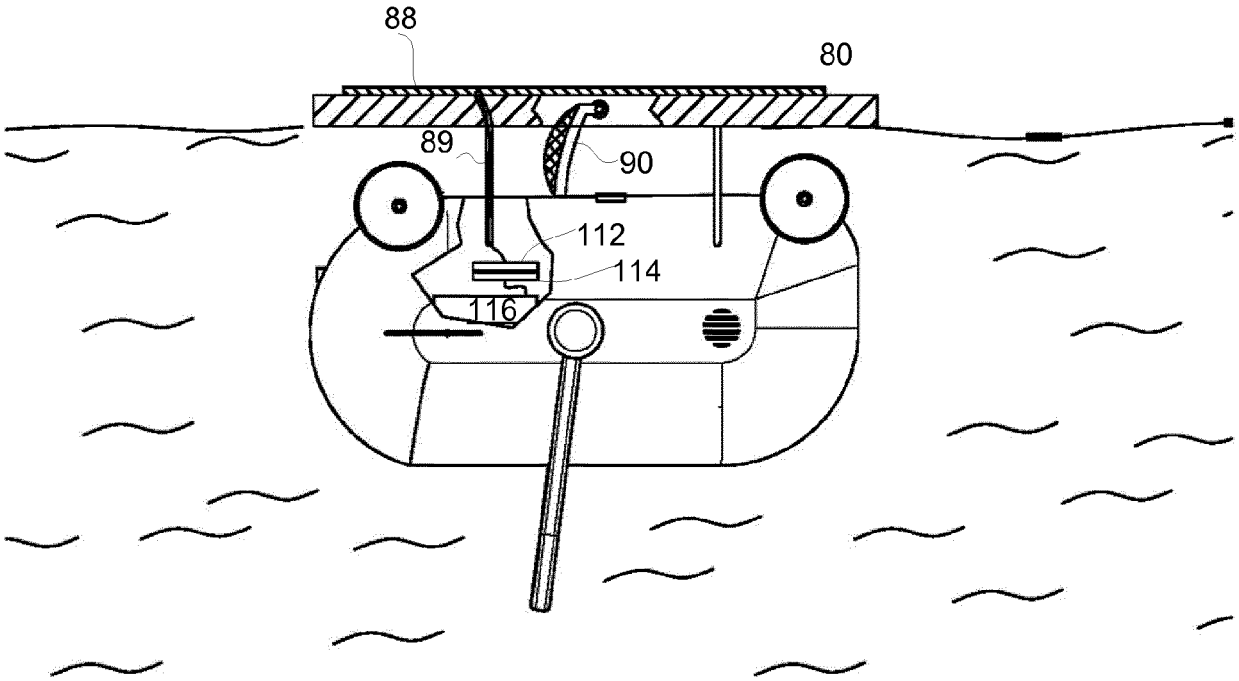
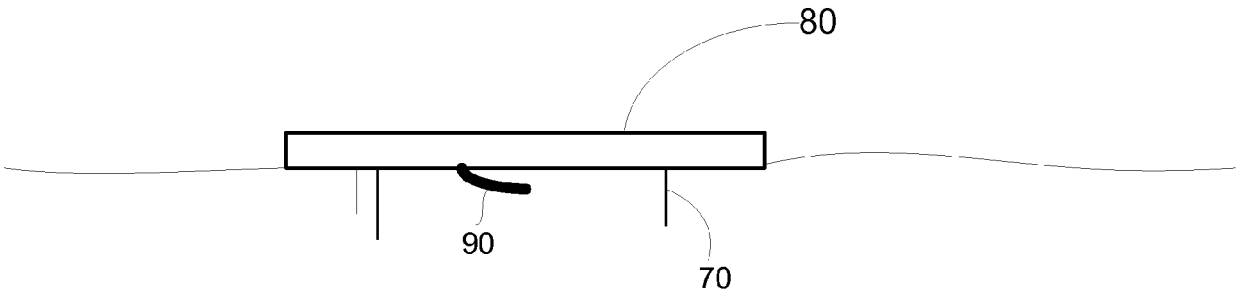


FIG. 9



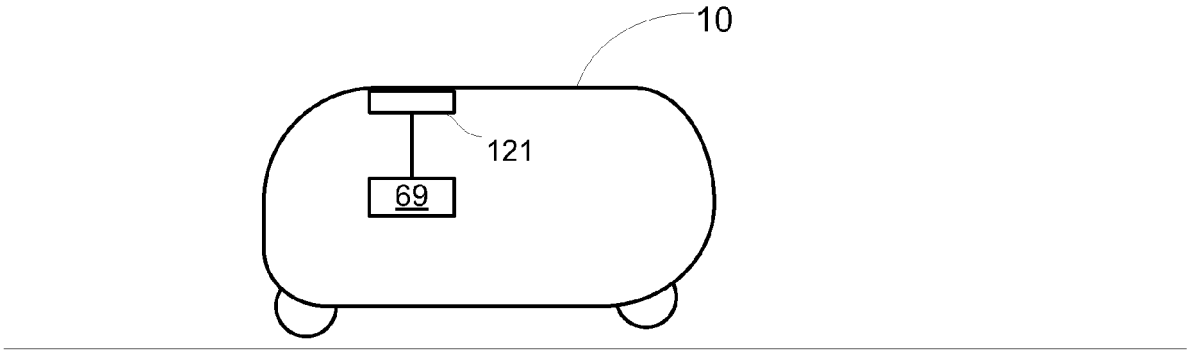


FIG. 10

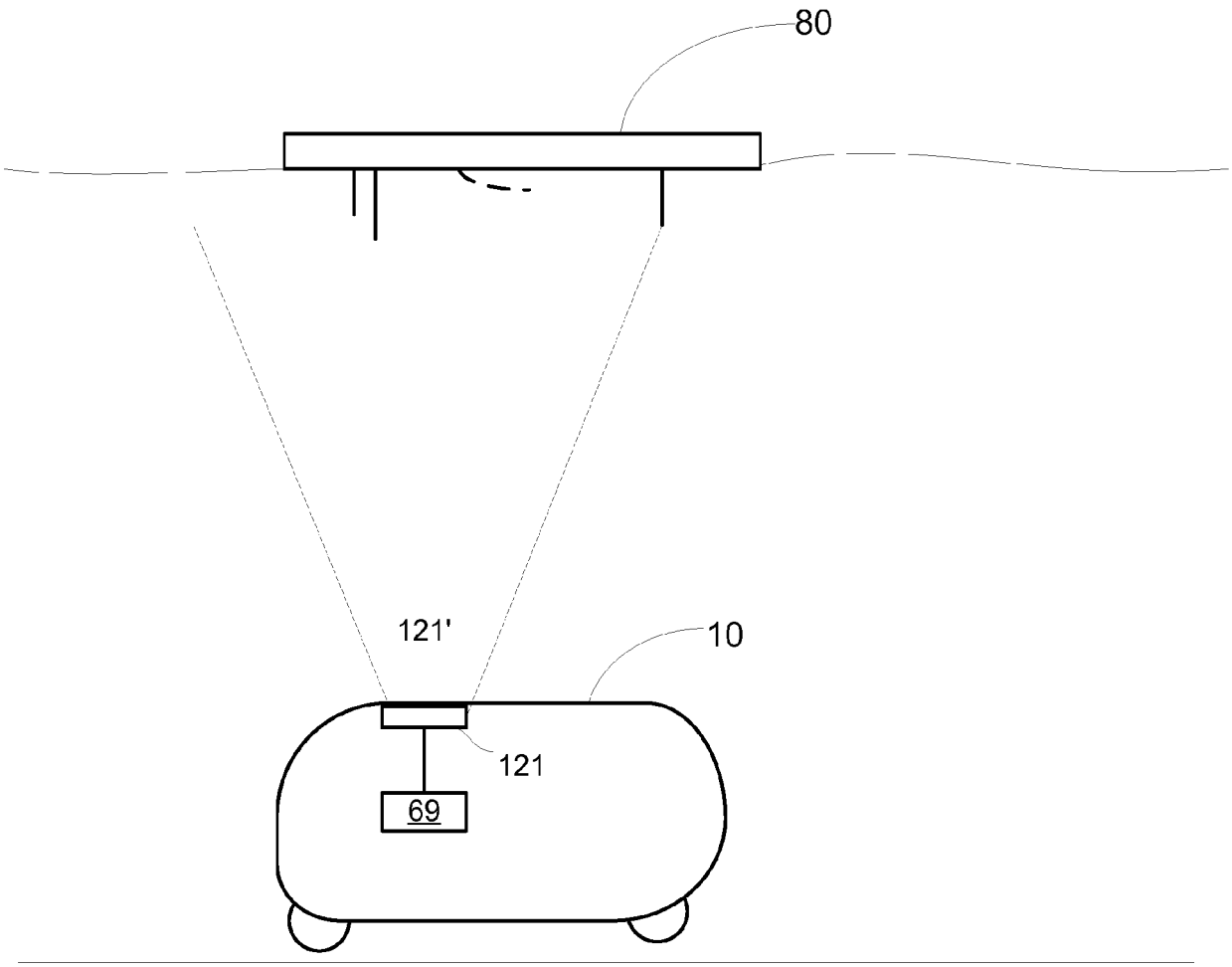


FIG. 11

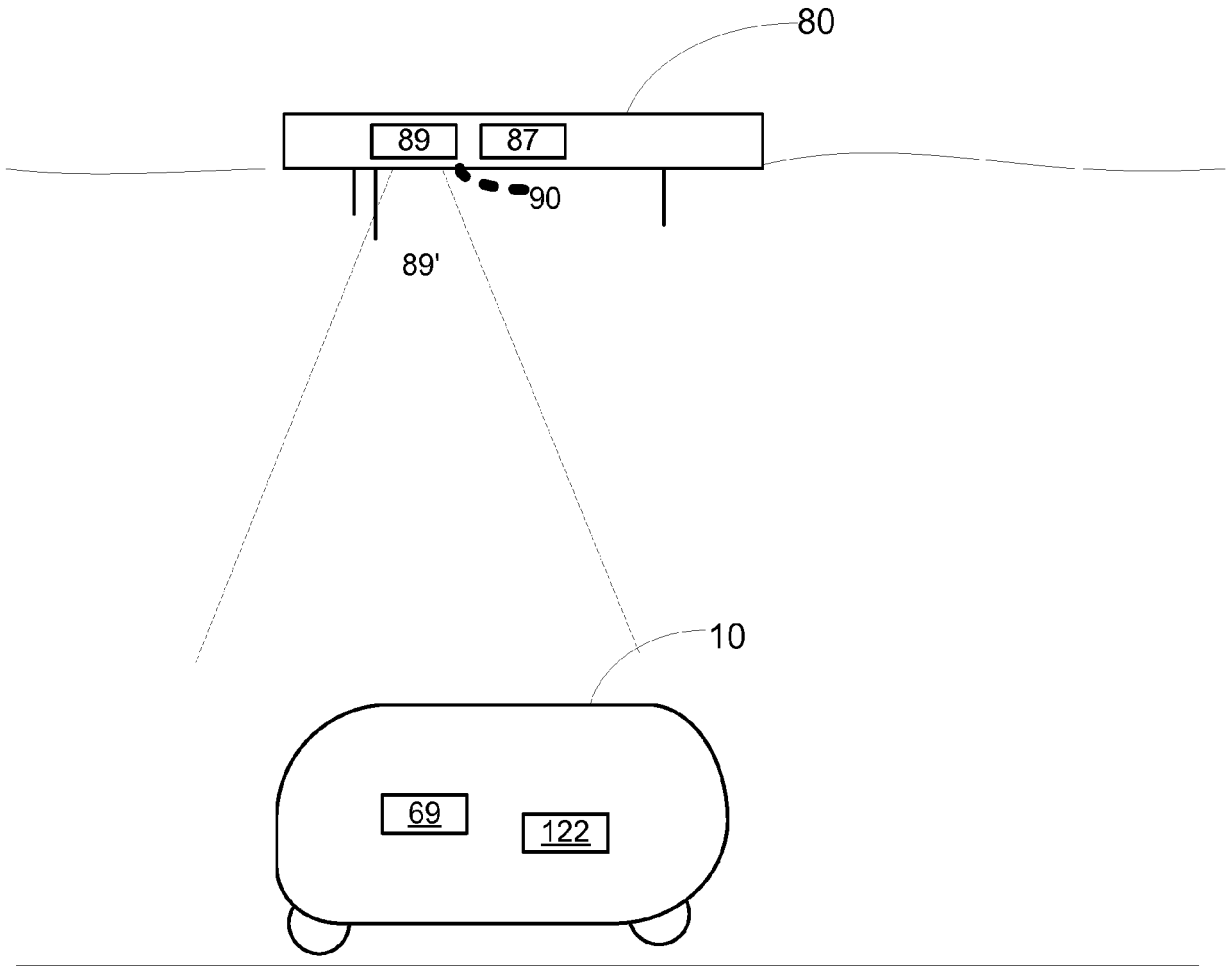


FIG. 12

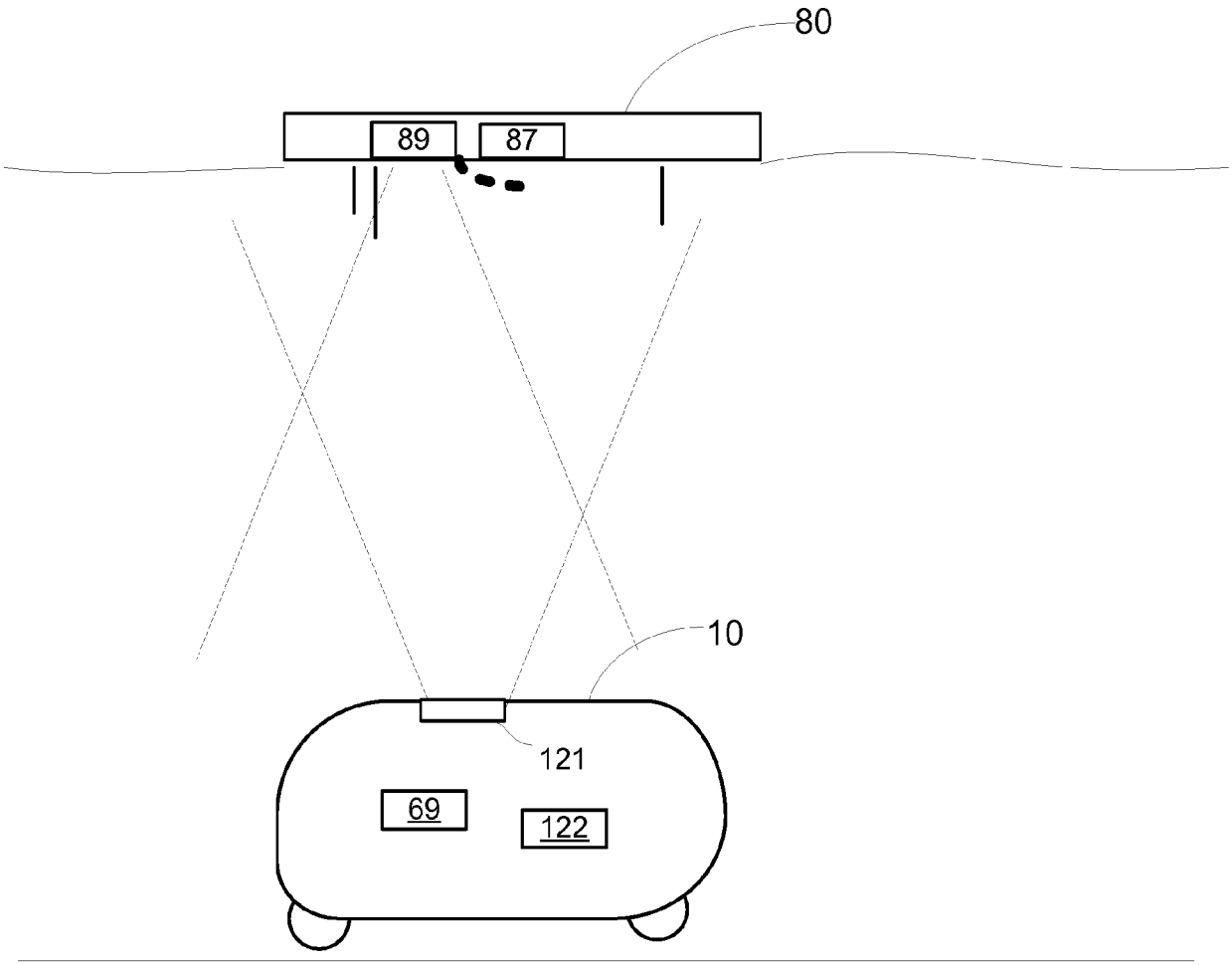


FIG. 13

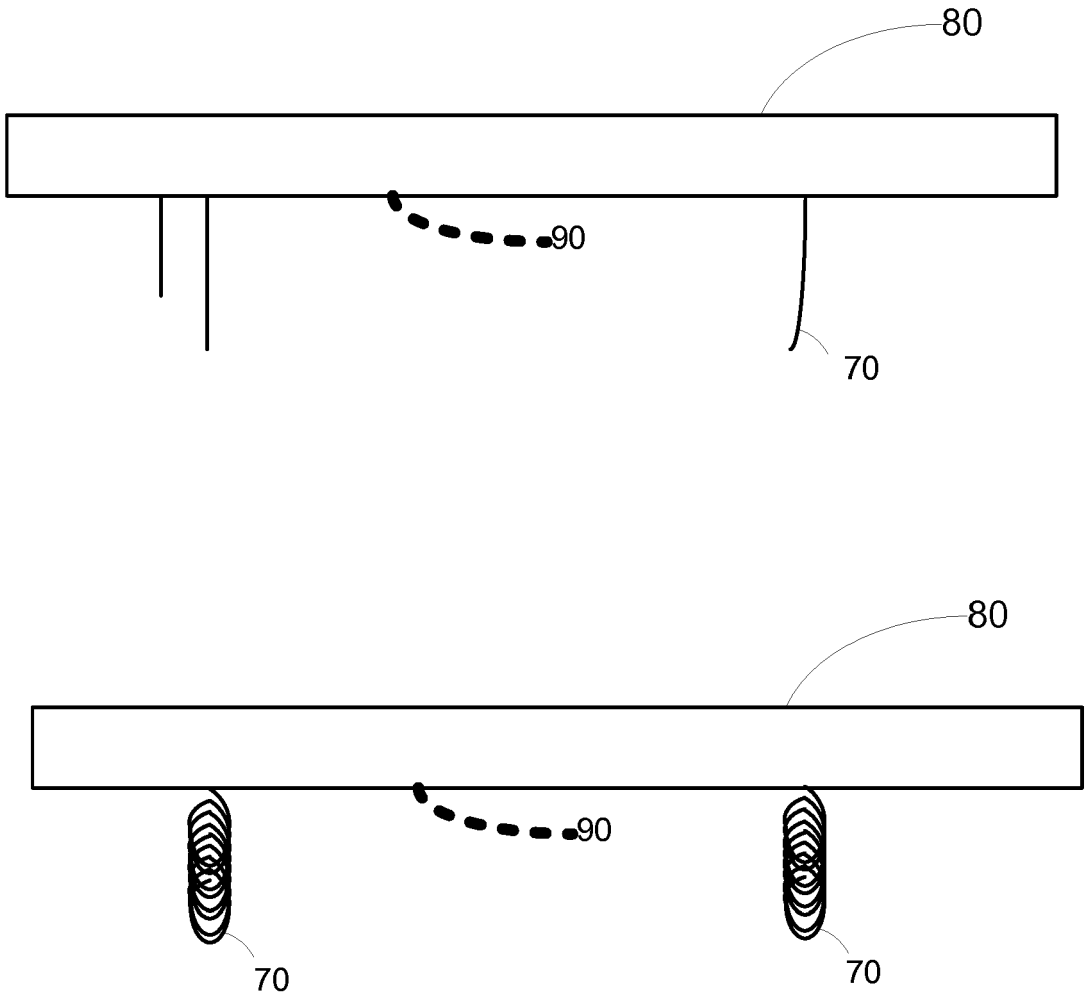


FIG. 14

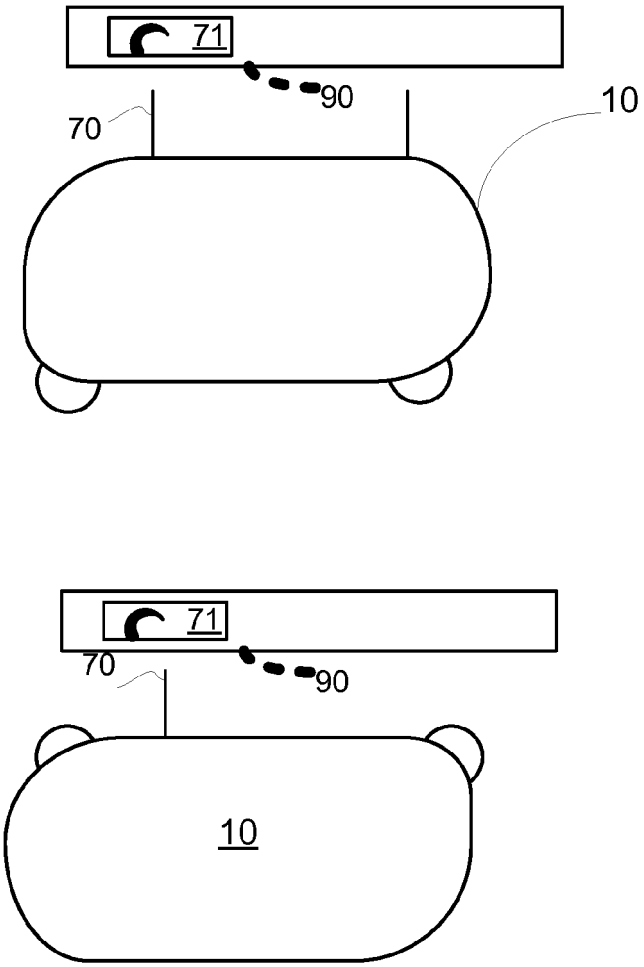


FIG. 15

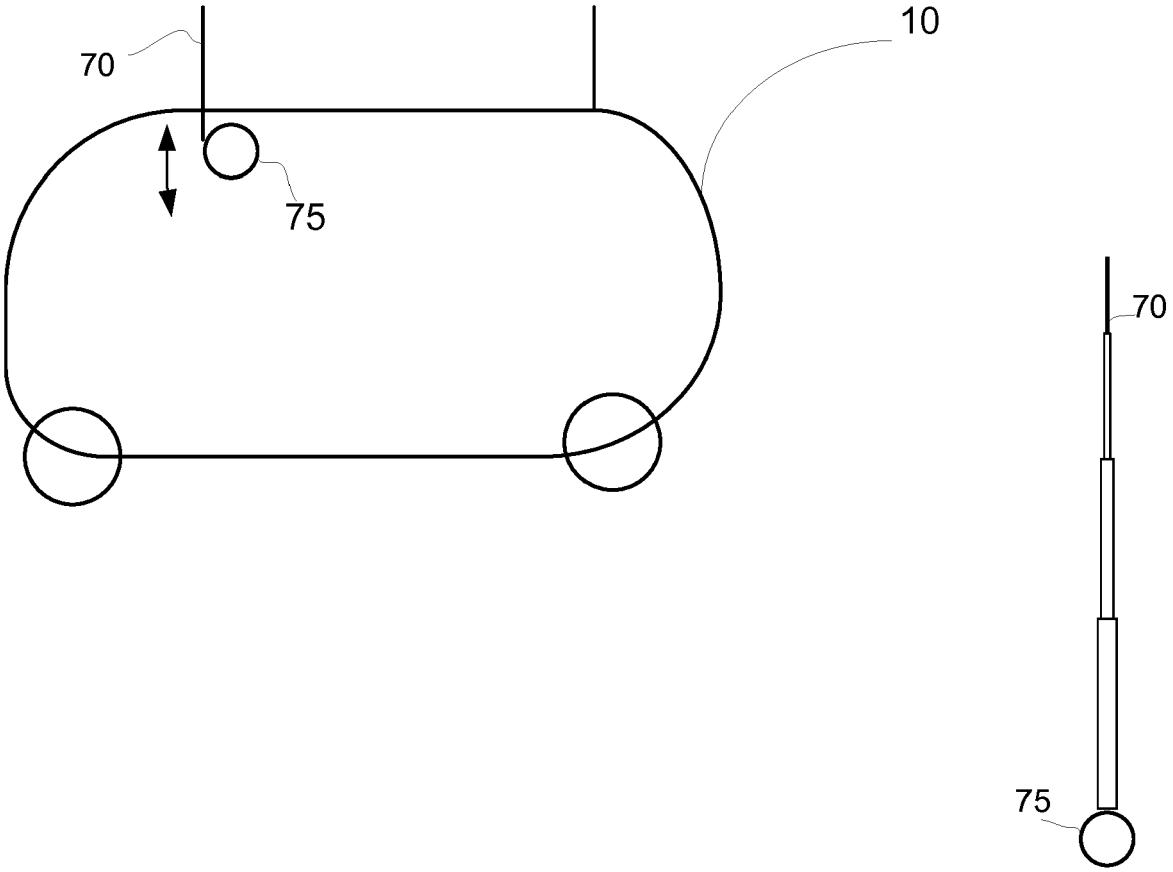


FIG. 16

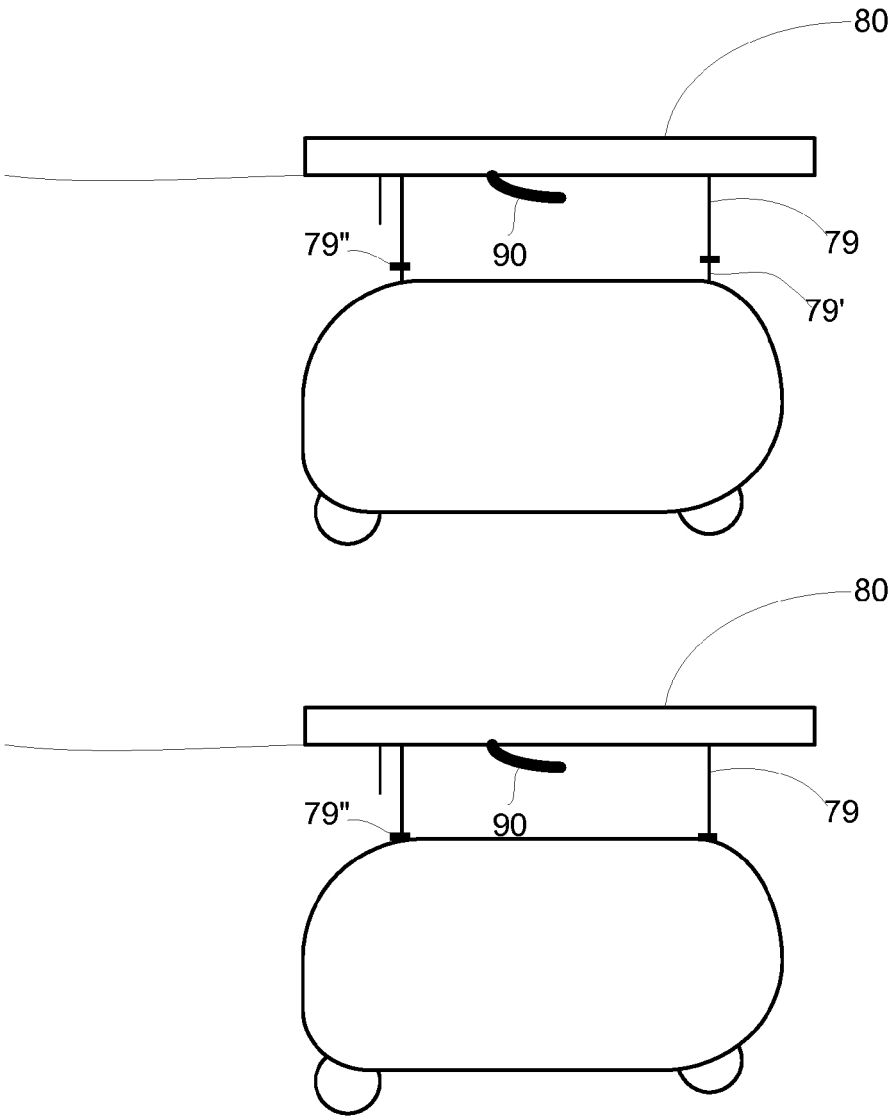


FIG. 17

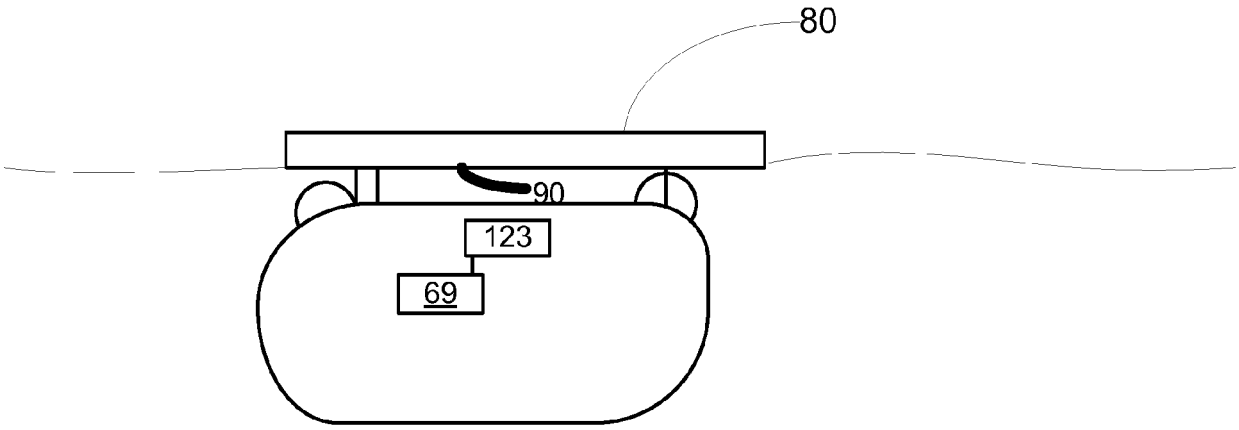
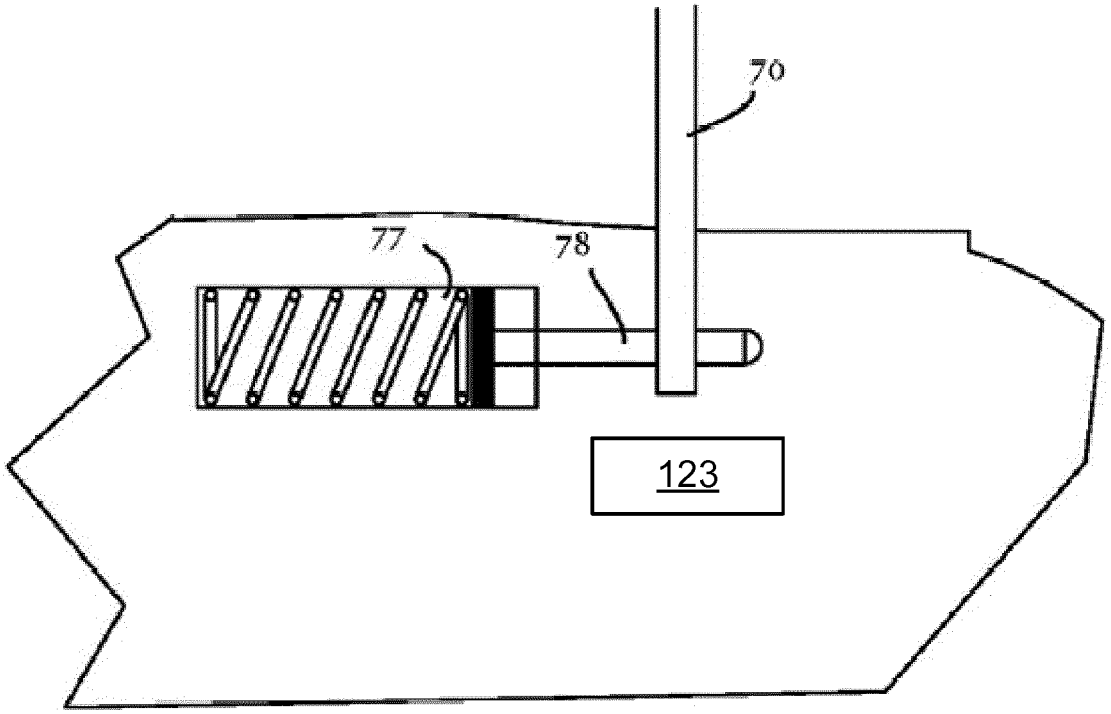


FIG. 18



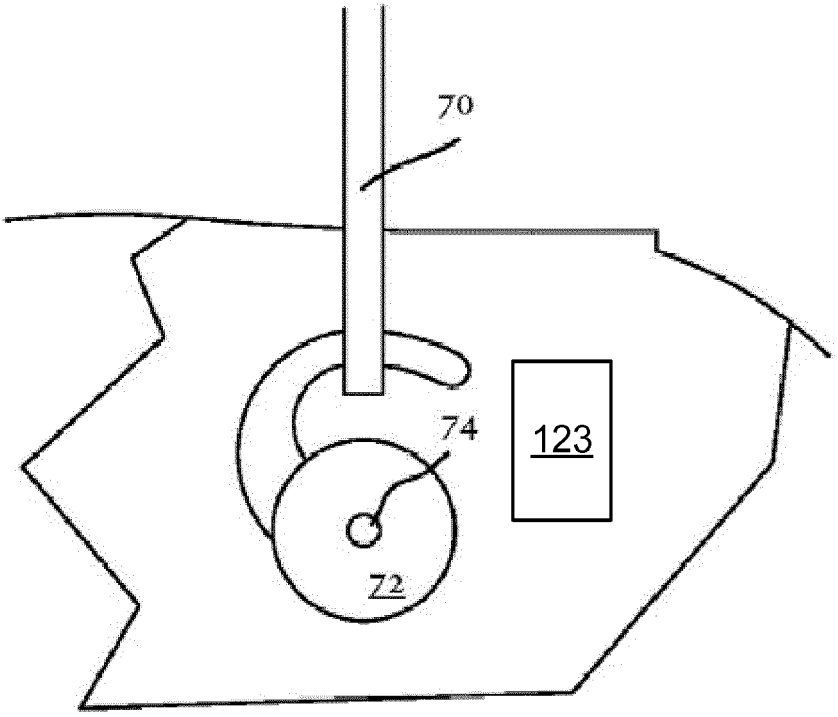


FIG. 19

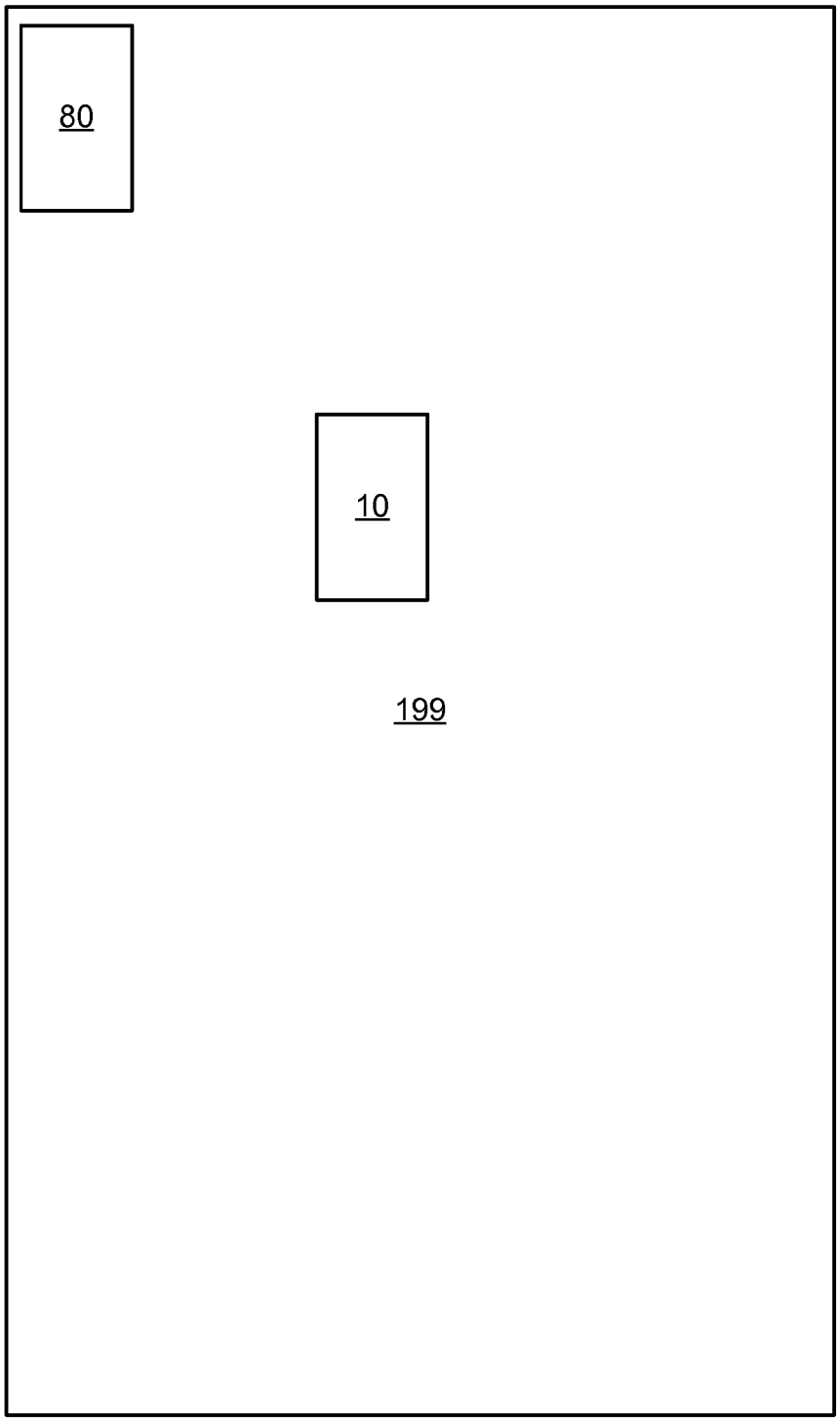


FIG. 20

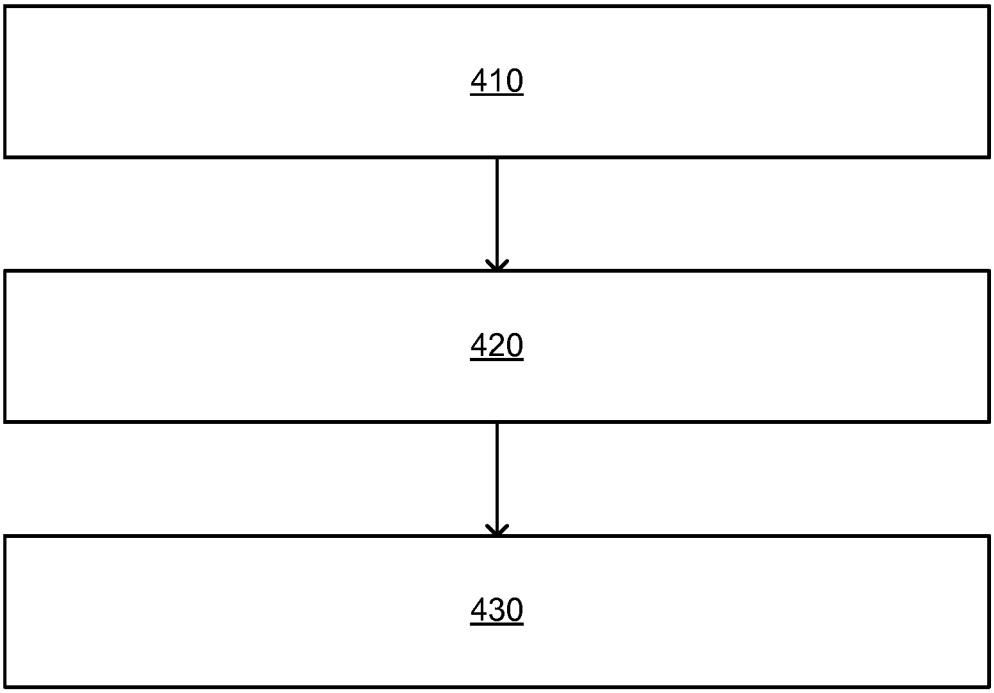


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FIG. 21

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- US 62568894 B **[0001]**