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(54) **Pool cleaning robot**

(57) A pool cleaning robot (10) adapted for climbing a sidewall of a pool. The robot comprises a bottom (27) and two side panels (14), and is adapted for moving in a direction substantially parallel to said side panels. At least one of the side panels comprises a freely-rotating roller (136) being located adjacent to the bottom of the robot.

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Description

FIELD OF THE INVENTION

[0001] This invention relates to devices for cleaning swimming pools, basins, and the like. More particularly, the invention relates to an automatic self-propelled cleaning robot.

BACKGROUND OF THE INVENTION

[0002] Pool cleaning robots which automatically scan the floor and/or sidewalls of a swimming pool are well known in the art. These units are powered internally, by one or more battery packs, or externally, by way of a power cable. A robot of this type typically comprises a drive motor, a pump motor with an impeller, a filter, brushwheels, and a track. All of these components are contained within a housing. The housing comprises inlets at the bottom, and an outlet at the top. The robot comprises several sections, which permits at least partial disassembly of the robot.

[0003] The drive motor drives the track, which propels the robot. In addition, the motion of the track imparts a rotation to the brushwheels, which scrubs the surface of the pool.

[0004] The pump motor drives the impeller to create an upwardly directed suction. This suction draws water, and with it debris, through the inlets and exiting the outlet via the filter.

[0005] The drawing of the water through the inlets further provides a suction force which helps maintain the robot's position on the floor of the swimming pool, and is especially important for maintaining the robot on the sidewalls when scanning there.

[0006] The various components of pool cleaning robots, by the very nature of their functions, need to be replaced every so often. These parts, in conventional robots, are typically replaced by a professional, either at a customer's premises, or, more frequently, at a service location. The customer usually brings the robot to a service location where the robot is disassembled and the replacement is performed, or it will be sent to a central service facility where the replacement or repair takes place.

SUMMARY OF THE INVENTION

[0007] According to one aspect of the present invention, there is provided a pool cleaning robot of which functional elements may be removed with a minimum of disassembly. Ideally, only the cover should be removed in order to access components for removal or replacement.

[0008] According to another aspect of the present invention, there is provided a pool cleaning robot comprising a frame, at least one inlet, at least one outlet, and a motor carrying module. The robot further comprises a filter unit mountable to the frame. The filter unit has a filter bag with an inlet facing surface and an outlet facing surface. The robot further comprises a filter cavity formed between the outlet facing surface of the filter bag and the frame. The frame has an open area above the cavity. The open area faces the outlet and is designed for the insertion therethrough of the module into the filter cavity when the filter unit is mounted to the frame. The frame may have a module carrying portion formed integrally with the frame. The motor carrying module is detachably attachable to the module carrying portion.

[0009] The motor-carrying module is preferably sealed and comprises a drive motor, a pump motor, or both.

[0010] The robot may further include wheels, and the frame may include wheel carrying portions formed integrally therewith. The robot may also comprise tracks driven by the drive motor mounted in said module. The tracks are adapted to permit retention of the wheels by the frame. The frame has track carrying portions, being formed integrally therewith, to which said tracks are mounted.

[0011] According to a further aspect of the present invention, there is provided a pool cleaning robot comprising a housing having at least one inlet and at least one outlet, a filter unit with a filter bag, and a motor-carrying module. The housing comprises a frame having front, back and side walls forming a hollow therebetween. The front, back, and side walls have inner surfaces facing the hollow and outer surfaces facing away from the hollow. The hollow has an open bottom portion adjacent to the inlet designed to receive therethrough the filter bag. The hollow further has an open top portion adjacent to the outlet designed to receive therethrough the module. The filter unit is detachably attachable to the frame when inserted into the hollow through its bottom portion, and the motor-carrying module is detachably attachable to the frame when inserted into the hollow through its top portion. The front, back and side walls of the frame may be integrally connected.

[0012] The side walls may comprise wheel carrying portions, and the robot may further comprise wheels detachably attachable to wheel carrying portions of the side walls. The wheel carrying portions are each formed with a notch and the wheels are each formed with a groove adapted to receive said notch. The side walls may also comprise module-carrying portions and the motor-carrying module is detachably attachable thereto.

[0013] The side wall may further comprise track carrying portions, and the robot may further comprise tracks driven

by a drive motor mounted in said module. The track is adapted, when mounted, to permit retention of the wheels by the wheel carrying portion.

[0014] According to a still further aspect of the present invention, there is provided a wheel adapted for use with a pool cleaning robot and adapted to be received by a frame of the robot. The wheel comprises a longitudinal axis along its length, a track receiving portion, and a guide portion. The guide portion is disposed adjacent the track receiving portion and comprises a groove, adapted to the carried by a notch of the pool cleaning robot, and a rim adapted to prevent dislocation of the wheel from the notch along the axis.

[0015] According to a still further aspect of the present invention, there is provided a motor carrying module adapted for use with a pool cleaning robot. The module is designed to be supported by and detachably fastened to horizontal module carrying portions of the robot.

[0016] According to a still further aspect of the present invention, there is provided a pool cleaning robot having an axis of symmetry and a weight imbalance across the axis of symmetry. The robot is adapted to propel itself along a trajectory in the direction of the axis of symmetry by generating a first suction, and to alter its trajectory as a result of the imbalance by generating a second suction which is of a lower power than the first suction. The second suction is sufficient to maintain filtering, and is typically approximately 1.5 cum/hr.

[0017] The altered trajectory is preferably a curved path.

[0018] According to a still further aspect of the present invention, there is provided a pool cleaning robot adapted for climbing a sidewall of a pool, the robot comprising a bottom and two side panels, and being adapted for moving in a direction substantially parallel to the side panels, at least one of the side panels comprising a freely-rotating roller.

[0019] The robot may comprise a weight imbalance. At least the side panel on the heavier side of the robot may comprise the roller.

[0020] The roller may be located adjacent to the bottom of the robot, and it may be a wheel.

[0021] According to still further aspect of the present invention, there is provided a pool cleaning robot comprising two side panels and a front end therebetween and being adapted for moving generally parallel to said side panels; the robot is adapted for moving in a first direction which is perpendicular to an expected sidewall of the pool, and capable of moving in a second direction which is oriented at an acute angle to the first direction; at least one of the side panels comprises at least one projection whose leading area is disposed remote from the robot and projects beyond any other part of the robot in the first direction, at least when the front end of the robot faces in the second direction.

[0022] The at least one projection may be located substantially adjacent to the front end of the robot.

[0023] The robot may comprise a weight imbalance, and the side panel on the lighter side of the robot may comprise projections.

[0024] The at least one projection may be made of a high-friction elastomer material. In may be formed integrally with the sidewall or be detachably attachable thereto.

[0025] According to a still further aspect of the present invention, there is provided a filter unit for use with a pool cleaning robot, said filter unit comprising a bottom panel having at least one robot inlet, and a frame made of frame walls; one of the frame walls is a top walls, and all other frame walls are disposed substantially transverse to the bottom panel and extend between the top wall and the bottom panel; at least a part of one of the frame walls constitutes a filter; the frame and at least a portion of the bottom panel define therebetween an enclosed volume in fluid communication with at least one of the robot inlets.

[0026] The robot inlet may be formed within the portion of the bottom panel which defines the enclosed volume.

[0027] The filter may comprise a rigid filter screen, and it may be detachably secured to the frame.

[0028] The frame may comprise at least one cleaning outlet. The at least one cleaning outlet may be adapted, the filter unit is installed in a pool cleaning robot, to be blocked to exit therethrough of water.

BRIEF DESCRIPTION OF THE DRAWINGS

[0029] In order to understand the invention and to see how it may be carried out in practice, embodiments will now be described, by way of non-limiting examples only, with reference to the accompanying drawings, in which:

Fig. 1A is a perspective view of a pool cleaning robot according to one embodiment of the present invention, with its cover removed to show internal components;

Fig. 1B is a bottom view of the pool cleaning robot illustrated in Fig. 1A;

Fig. 2 is a perspective view of an internal frame of the pool cleaning robot illustrated in Fig. 1A;

Fig. 3 is a perspective view of the internal frame illustrated in Fig. 2, with some internal components mounted thereupon;

Fig. 4A is a perspective view of a brushwheel of the pool cleaning robot illustrated in Fig. 1A;

Fig. 4B is a side view of a side cap of the brushwheel illustrated in Fig. 4A;

Fig. 5 is a perspective view of the internal frame illustrated in Fig. 2, with additional components mounted thereupon;

Figs. 6A through 6D are perspective views illustrating the installation of the module illustrated in Fig. 6A into the internal frame illustrated in Fig. 2;

Figs. 7A and 7B perspective views of a module of the pool cleaning robot illustrated in Fig. 1A, with a cover of the module on and removed, respectively;

Fig. 8A is a perspective view of a part of a filter unit of the pool cleaning robot illustrated in Fig. 1A, according to one embodiment of the invention;

Fig. 8B is a perspective view the filter unit whose part is illustrated in Fig. 8A;

Fig. 8C is a perspective view a filter unit for use with the pool cleaning robot illustrated in Fig. 1A, according to another embodiment of the invention;

Fig. 8D is a perspective unit of the filter unit illustrated in Fig 8C, with one filter screen thereof detached;

Fig. 9 is a cross-sectional perspective view of the pool cleaning robot, taken along line II-II in Fig. 1B;

Fig. 10A schematically illustrates a pool cleaning robot advancing toward a sidewall at an angle thereto;

Fig. 10B schematically illustrates a pool cleaning robot at a sidewall with its front end facing it;

Fig. 10C schematically illustrates a pool cleaning robot having a fin projecting from a side panel thereof impacting a sidewall of a pool;

Fig. 11 is a perspective view of a modified side panel of the pool cleaning robot illustrated in Fig. 1A;

Fig. 12 schematically a pool cleaning robot climbing a sidewall of a swimming pool;

Fig. 13 is a perspective view of another modified side panel of the pool cleaning robot illustrated in Fig. 1A; and

Figs. 14A through 14C schematically illustrate sequential side views of a robot, having the modified side panel as illustrated in Fig. 13, in different positions relative to a sidewall of a swimming pool.

DETAILED DESCRIPTION OF EXEMPLARY EMBODIMENTS

[0030] As seen in Figs. 1A, 1B and 2, there is provided a pool cleaning robot 10, in accordance with one embodiment of the present invention, which comprises a housing including an internal frame 16 (seen in more detail in Fig. 2), side panels 14, a bottom panel 27 and a cover 12, and mounted in the internal frame an internal module 22 (seen in more detail in Figs. 7A and 7B), a filter screen 11, a filter unit with a filter bag 13, front and rear brushwheels 18, and two tracks 20. The cover 12 comprises a pair of handles 23 and an outlet opening 26. The cover 12 and the side panels 14 are attached with screws to the internal frame 16. The robot further comprises a power cord 24 with a float 19 and inlets 25 formed in the bottom panel 27.

[0031] As seen in Fig. 2, the internal frame 16 is integral and comprises two sidewalls 28 and two outwardly curved front/back walls 30 (since the robot is bidirectional, each of these walls may be alternately a front wall and a back wall, depending on the direction of movement). A central receiving portion 32, comprising a hollow open toward the inlet and the outlet, is defined between the sidewalls 28 and the front/back walls 30. Front/back wheel receiving portions 35. Wheel wells 34 are defined in the area below a front/back wall 30. Each sidewall 28 comprises two extensions 42, each of which is disposed adjacent one end of a wheel well 34.

[0032] Figs. 8A and 8B illustrate the filter unit 55, which comprises the bottom panel 27, a frame 118, and the filter bag 13. The bottom panel 27 comprises an upright wall 116 offset slightly from the perimeter thereof. The filter bag 13 is adapted to be fitted to the wall 116, as illustrated in Fig. 8B. The frame 118, adapted to keep side portions of the filter bag 13 upright, is attached to the bottom panel. Due to this construction (i.e., the juxtaposition of the inlets 25 with relation to the filter bag 13), all water which enters the inlets must pass through the filter bag before being ejected via the outlet opening 26.

[0033] In order for the filter unit 55 to be attached to the internal frame 16, the bottom panel 27 is provided with a raised area 57 on each side. Each raised area 57 is adapted to be received within a recess 51 provided in each sidewall 28 of the internal frame 16. The bottom panel 27 is further provided with pivotable tabs 59 within the raised areas. The tabs 59 are adapted to be received within slits 53 provided within the recesses 51 in the internal frame, and, when received therewithin, serve to lock the filter unit 55 in place. When the filter unit 55 is installed in the internal frame 16, interior surfaces 115 of the filter bag 13 together with portions of the sidewalls 28 define therebetween a cavity which has an open area thereabove.

[0034] Figs. 8C and 8D illustrate an alternative filter unit 140, which may be mounted in the robot 10 instead of the filter unit 55. The filter unit 140 comprises a bottom panel 144 with inlets 125 (Fig. 8D) at two opposite ends thereof, similar to those of the filter unit 55 in Fig. 8A, and two filter assemblies 142 mounted at two ends of the bottom panel 144 in a juxtaposed position relative to the inlets 125. Each filter assembly 142 comprises a rigid frame 146 with a top wall 154, and two side walls 156 extending transversely between the bottom panel 144 and the top wall, two side windows 156 (Fig. 8D), and two filter screens 150, each adapted to fit and being detachably mountable within one of the windows. The rigid frame 146 further comprises a locking arrangement 152, such as rotatable pressure latches as shown, for detachably securing the filter screens in the windows 156 of the frame 146. Each filter assembly 142 is so mounted on the bottom panel 144 that an enclosed volume 158 is defined therein between the top wall 154, the side walls 156, the

filter screens 150 (when mounted on the frame), and the bottom panel 144. At least one of the inlets 125 is located within the enclosed volume 158. The frame 146 of each assembly 142 is formed, at one or both of its frame walls 156 adjacent or near the bottom panel 144, with least one cleaning outlet 148 in fluid communication with the enclosed volume 158. The filter unit 140 is designed such that when it is installed in the internal frame 16 of the robot, the cleaning outlet 148 is blocked from exit of water therethrough.

[0035] During use of the robot 10, water and debris are pulled through the inlet 125 into the enclosed volume 158 of the filter assembly 142, and the water is pulled therefrom via the filter screens 150 to the exterior of the filter assembly and further to the outlet opening 26 of the robot, with the debris being retained on the filter screens 150, on the enclosed-volume-facing side thereof. Since the cleaning outlet 148 is blocked, no water may exit therethrough. Therefore, all water passes through the filter before being ejected via the outlet opening 26.

[0036] The above design of the filter unit 140 allows for its easy cleaning. Due to the relative rigidity of the filter screens 150, at least when secured to the frames 146, debris may be removed cleaning the filter assemblies 142 from the outside, such as by spraying water on the filter screens. This becomes possible when by the filter unit 140 is removed from the robot 10 and its cleaning outlet 148 is unblocked. The water which enters the enclosed volume 158 via the filter screens 150, along with any debris disposed on the interior of the filter screens 150, exits via the cleaning outlet 148. In the event that debris, such as leaves or other similar objects, remains on the interior of the filter screen 150, the screen may be removed from the frame 146, as illustrated in Fig. 8D, by opening the locking arrangements 152.

[0037] Reverting to Fig. 2, the internal frame 16 comprises several features directed towards supporting the brush-wheels 18. The extensions 42 of the sidewalls 28 each comprise a rounded notch 44. As illustrated in Fig. 4A, the brushwheel 58 comprises a brushing portion 60 and an end cap, generally indicated at 62. The end cap 62, as seen in more detail in Fig. 4B, comprises a track receiving portion, generally indicated at 64, and a guide portion, generally indicated at 66. The guide portion 66 comprises an annular groove 72 and a rim 74. The annular groove is sized to be received within the rounded notch 44 of the internal frame 16, between the rim 74 and the track receiving portion 64. The track receiving portion 64 comprises teeth 68 similar in size and gauge to those of the timing belt pulley 48, and may further comprise a safety rim 70. The brushwheels are illustrated in their installed position on the internal frame in Fig. 3.

[0038] It should be noted that while the brushwheels 18 are free to rotate within the notches 44, they are not retained thereby. The track 20 is adapted to retain the brushwheels in position, as will be explained below.

[0039] Reverting to Figs. 2 and 3, additional features of the internal frame 16, directed toward supporting the tracks 20, are illustrated. A shaft aperture 36 surrounded by an annular pulley support 38 is provided in each sidewall 28. Each sidewall 28 further comprises two cylindrical tension supports 40 projecting therefrom, one on each side of the shaft aperture 36. A timing belt pulley, generally indicated at 48, is provided, adapted to be mounted to the pulley support 38. The timing belt pulley 48 comprises an inner bore 50, which is coaxial with the shaft aperture 36 when mounted to annular pulley support 38, and teeth 52 circumferentially arranged thereabout. It should be noted that although two timing belt pulleys 48 are provided (one on each sidewall 28), only one, constituting a drive pulley, is typically driven directly by a motor. The other constitutes an idler pulley. The timing belt pulley 48 may further comprise safety rims 54. Tension pulleys 56, adapted to be mounted to the pulley supports 40, are also provided. Both the timing belt pulley 48 and the tension pulleys 56 are free to rotate when mounted.Fig. 5 illustrates the tracks 20 in more detail and how they are mounted on the internal frame 16. Each track 20 is a continuous loop, and comprises, on an inner side thereof, teeth 76 adapted to mesh with the teeth 52, 68 of the timing belt pulley 48 and with track receiving portion 64 of the brushwheels 18. Each track 20 further comprises, on an outer side thereof, treads 78 adapted to provide traction to the robot 10 when the robot scans the surface of a pool during cleaning. When installed, each track 20 is looped around the timing belt pulley 48 and the track receiving portions 64 of the brushwheels 18, and under the tension pulleys 56.

[0040] In order to remove the brushwheels 18 and/or the track 20, a side panel 14 is removed, exposing the track. One or both of the tension pulleys 56 are removed, making the track 20 slack, allowing for its easy removal. If a wheel brush 18 is to be removed, the same procedure is carried out on the second side of the robot 10. In the absence of the tracks 20, the wheel brushes may be easily slid out of the notches 44. Replacing the brushwheels 18 or the track 20 is simply accomplished by receiving the brushwheels within the notches 44 and replacing the timing belt. Alternatively, the track 20 may be made of a material of sufficient elasticity to allow the brushwheel 18 to be removed by simply stretching the track so that the brushwheels disengage from the notches 44. The brushwheels 18 are thereby easily removed, and may be replaced by the same process.

[0041] Reverting to Fig. 2, the internal module 16 comprises further features directed toward retaining the internal module 22. Four seats, generally designated at 80 and constituting a module carrying portions of the internal frame 16, are provided on the sidewalls 28 extending into the central receiving portion 32 of the frame 16 (only two seats are visible in Fig. 2). Each seat comprises a horizontal support surface 82 and a vertical restraining wall 84. A receiving member 86, adapted to receive a screw via an aperture 88 in the horizontal support surface 82 is disposed therebelow.

[0042] The module may be installed in the frame 16 as illustrated in Figs. 6A through 6D. (It will be appreciated that the module 22 may be removed by reversing the installation steps.) The module 22 is inserted, as indicated by arrow

85, and positioned so that it rests on the horizontal support surfaces 82 of the four seats 80 located on the frame 16. Four screws 90 are provided, each adapted to be received by one of the receiving members 86. The vertical restraining walls 84 restrict the movement of the module 22 to prevent it from sliding. Internal floats 92 are provided between upper side edges 94 of the module 22 and the sidewalls 28 of the frame 16 in order to fully secure the module within the frame. They also help to impart an upright orientation to the robot 10 when submerged in water.

[0043] Figs. 7A and 7B illustrate the internal module 22 in more detail. It is a self-contained unit and is attached to the frame 16 by a number of screws. When closed, it is preferably sealed to prevent ingress thereto of water. The module 22 comprises an impeller 100 associated with a pump motor 104, a shaft 110 associated with a drive motor 106, a receptacle 102, and a clasp 114. Although a single module is shown, it should be appreciated that there may be several, for example separate modules for each motor, a transmission system, electronic controllers, etc.

[0044] The impeller 100 projects from the top side of the module 22. When driven by the pump motor 104, it creates an upward pressure head which draws water into the robot 10 via the inlets, through the filter screen 11, and out of the robot through the outlet opening 26. Besides imparting the necessary movement of water for filtering, this action also provides suction which tends to bias the robot 10 toward the surface which is being cleaned. This is especially useful when the robot 10 is cleaning a sidewall.

[0045] The drive motor 106 comprises a stator housing 108, in which the motion is produced, and the shaft 110. The shaft protrudes from a sidewall of the module 22. It may be located non-concentrically to the main shaft of the motor (i.e., that which is located within the stator housing 108), and rotated by any mechanism, a plethora of which are known per se in the art. The shaft 110 is of a generally circular cross-section. However, two sides 112 thereof are planar. This allows it to be received within a correspondingly shaped aperture in the timing belt pulley 48, thereby transmitting full rotational force thereto without slippage.

[0046] The receptacle 102 is adapted for plugging therein the power cord 24. The receptacle is adapted to be waterproof, at least when the power cord is plugged in. The clasp 114 is adapted to retain the power cord 24 in position, at least when it is plugged into the receptacle 102.

[0047] As seen in Fig. 9, the filter screen 11 is installed between the filter bag 13 and the internal frame 16. It is affixed by one screw in each side to a screw hole 120 which is disposed in the internal frame 16 (see Fig. 2). As may be easily seen from the juxtaposition of the screw hole 120 to the seats 80, the filter screen 11 is disposed between the internal module 22 and the filter bag 13.

[0048] Besides those features directed toward retaining other components, as detailed above, the internal module 16 comprises several auxiliary outlets 45 provided near the bottom of the sidewalls 28. Each auxiliary outlet 45 comprises four openings 47 and a center hole 49 adapted to retain a diaphragm (not shown) on the outside of outer surface of the sidewall. The diaphragm is a disc of rubber with a central protrusion adapted to be retained by the center hole 49. When the robot 10 is lifted from the water, the auxiliary outlets 45 provide an additional means for water to exit therefrom. During operation of the robot, the diaphragms block water from entering the robot through the auxiliary outlets 45. The sidewalls 28 further comprise receiving members 46 which are internally threaded and disposed so that they receive screws adapted to secure the cover 12.

[0049] The internal components of the robot 10 are arranged in such a way so that there is a weight imbalance about an axis of symmetry 96 (seen in Fig. 1 B) which is parallel to the track 20. (It will be appreciated that the robot 10 moves in the direction of the track 20, and thus of the axis of symmetry 96.) Due to this imbalance, the robot 10, when moving, tends to curve away the side with the imbalance (i.e., if the left side of the robot 10 is heavier, the robot will tend to follow a trajectory which curves right). The imbalance is such that the heavier side of the robot 10 is attached to the float 19. In this way, the weight of the heavier side is offset somewhat, allowing the robot to sit on the floor of the swimming pool in a more balanced way when no suction is applied. Otherwise, the robot 10, experiencing too great an imbalance, may be tilted to such a degree that even when suction is applied, only one track 20 rests on the pool floor.

[0050] The imbalance IB_{robot} of the robot can be expressed as follows:

$$IB_{robot} = \frac{W_2 - W_1}{W} \qquad (1)$$

where W_2 is the weight of the heavier side, W_1 is the weight of the lighter side, and W is the total weight of the robot. By rearranging the above formula, it is found that for a given IB_{robot}, the ratio of the weight of the heavier side of the robot to the weight of the lighter side of the robot can be expresses as follows:

$$\frac{1+IB_{robot}}{1-IB_{robot}}=\frac{W_2}{W_1}. \qquad (2)$$

[0051] In order to effect a straight trajectory in spite of the imbalance, a counter-weight is provided. This is typically done by increasing the suction of the robot 10 through the inlets.

[0052] It has been empirically found that for IB_{robot} = 0.5, the robot will tend to follow a curved trajectory. In one example, the total weight of the robot was 0.6 kg. According to (2), the heavier side of the robot was 3 times the weight of the lighter side, resulting in the heavier side being 0.45 kg, and the lighter side being 0.15 kg. In order to effect a straight trajectory, a counter weight was provided by increasing the suction to 1.1 kg.

[0053] The robot 10 may have arrangements facilitating its operation with the imbalance. For example, it may have its side panel 14 which is located on the lighter side of the robot 10, modified as shown with respect to panel 14a in Fig. 11. The side panel 14a comprises fins 132, constituting a fulcrum, which are made of a high-friction elastomer material, and which may be formed integrally with the side panel 14a. Each fin 132 is typically located at an end of the side panel 14a near one of the brushwheels 18, and projects from the side panel 14a so as to form with the side panel, an angle θ which faces in the expected direction of movement of the robot and which does not exceed 90°. In addition, the side panel 14a may comprise auxiliary fins 133, located adjacent one of the fins 132 and projecting from the side panel at an angle different from that of the fins 132.

[0054] During operation, the robot 10, which is designed for moving essentially parallel to its side panels, with one of the brushwheels 18a constituting its front end, may approach a sidewall of a swimming pool with its side panels oriented perpendicular to the sidewall or with its side panels oriented at an angle to the side wall, e.g. along a direction indicated by arrow 130 in Fig. 10A. In the latter case, the first part of the robot to impact the sidewall is a corner thereof, e.g. corner 160 between brushwheel 18a and the side panel 14a and it is desirable to make sure that the robot will pivot around this corner, in a clockwise direction indicated by arrow 145, so as to bring the brushwheel 18a in a position parallel to the sidewall, as shown in Fig. 10B. With the side panel 14 having a fin 132 as described above, disposed adjacent the corner 160, and projecting from the side panel toward the sidewall, farther than any other part of the robot, such pivoting is ensured by the fin 132 whose leading area 132a impacts the sidewall before the brushwheel 18a, as illustrated in Fig. 10C and prevents the robot from pivoting in the counterclockwise. In this way, the robot 10 begins to pivot around the leading area 132a of the fin 132 in the direction along the arrow 145, ensuring that the front end of the robot ends up against the wall as in Fig. 10B.

[0055] Since the robot 10 according to the present invention has a weight imbalance, it only requires the side panel 14 which is on the lighter side thereof to be replaced to have the fin 132. However, it will be appreciated that both side panels 14 may have fins. The auxiliary fin 133 is useful for ensuring that the robot 10 pivot in the desired direction as described above when either robot 10 approaches the sidewall at an angle such that the fin 132 will not effect the desired pivoting, or if the sidewall is formed at such an angle that the fin 132 will effect the desired pivoting.

[0056] The robot 10 may comprise another modification in its side panel 14, as illustrated in Fig. 13 with respect to a side panel 14b. The side panel 14b comprises a freely rotating roller 136 such as a wheel, which may be located near the bottom of the side panel 13b, and which is adapted to rotate in a direction, indicated by arrows 137, which is generally perpendicular to the bottom of the robot 10. This modification is directed to improve the robot's behavior associated with its climbing a sidewall of a swimming pool, especially when the robot has an imbalance as described above.

[0057] As illustrated in Fig. 12, if it so happens that the robot 10, after having climbed the sidewall, falls or tips onto one side, as indicated by arrow 134, the roller 136 will allow the robot, which is now lying on its side with its bottom toward the wall, to roll away from the wall, as schematically illustrated in sequence in Figs. 14A through 14C, to finally bring it to the bottom of the pool in an operative position.

[0058] Since the robot 10 has a weight imbalance, if it falls as described above with reference to Fig. 12, it will usually fall onto its heavier side. Therefore, it may be sufficient to provide the roller 136 only on that side panel 14 which is on the heavier side thereof to be replaced. However, it will be appreciated that, for example, a robot without a weight imbalance, or which may tip to either side, may have modified side panels 14b on both sides thereof.

[0059] Those skilled in the art to which this invention pertains will readily appreciate that numerous changes, variations and modifications can be made without departing from the scope of the invention mutatis mutandis.

Claims

1. A pool cleaning robot adapted for climbing a sidewall of a pool, said robot comprising a bottom and two side panels, said robot being adapted for moving in a direction substantially parallel to said side panels, at least one of said side panels comprising a freely-rotating roller being located adjacent to the bottom of the robot.

2. A pool cleaning robot according to Claim 1, further comprising a weight imbalance.

3. A pool cleaning robot according to any one of Claims 1 and 2, wherein at least the side panel on the heavier side of the robot comprises said roller.

4. A pool cleaning robot according to any one of the preceding claims, wherein said roller is a wheel.

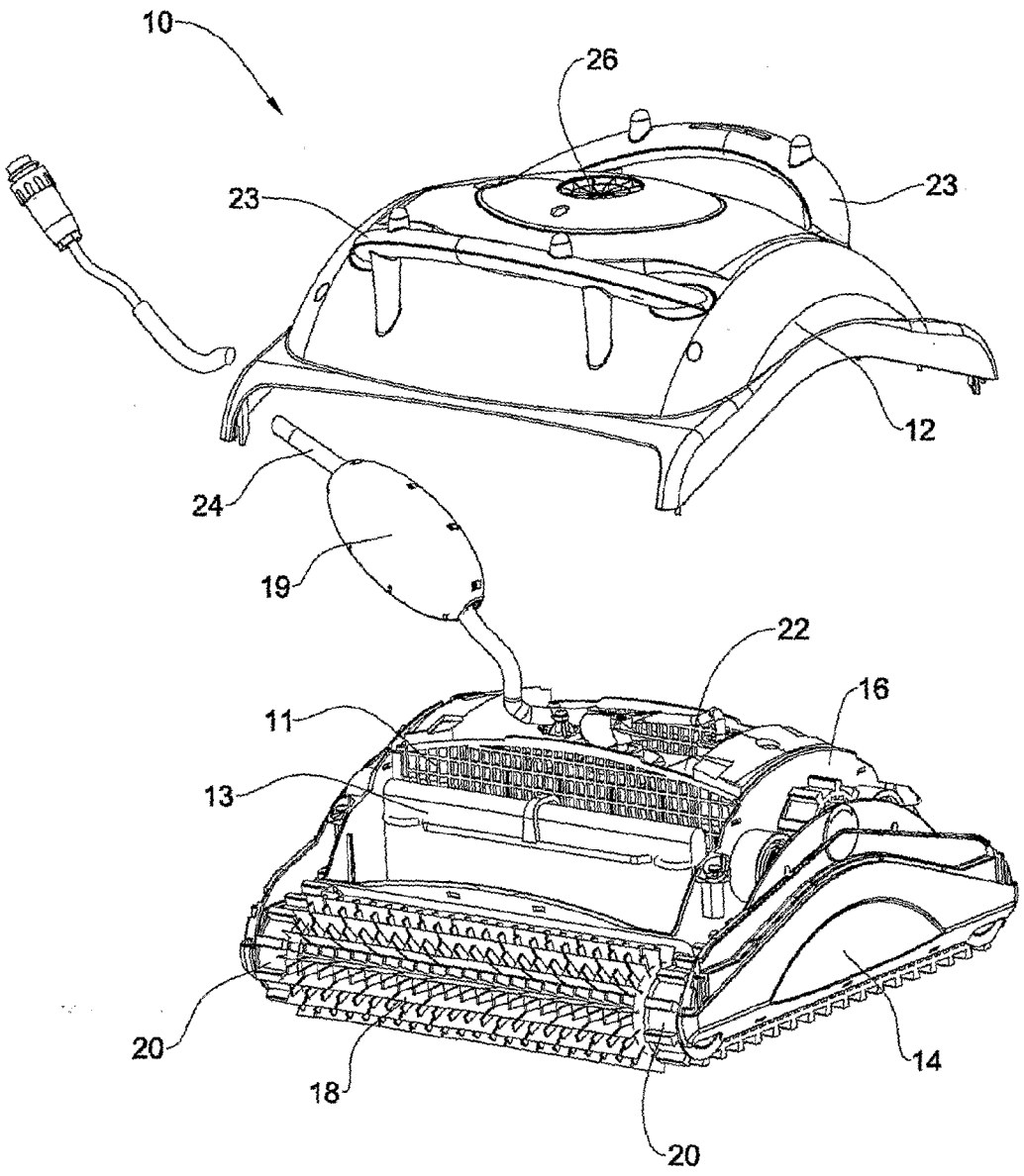

FIG. 1A

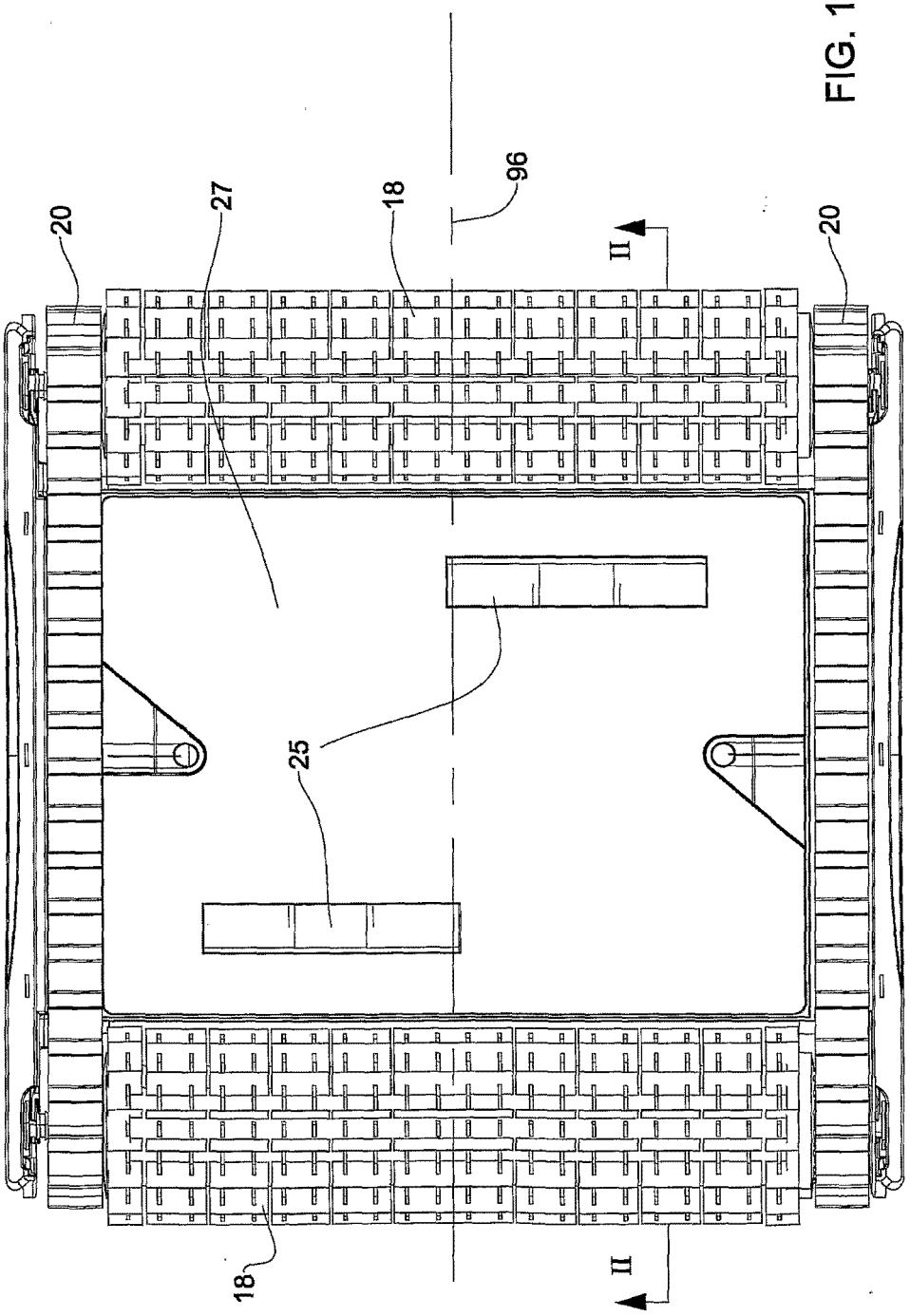

FIG. 1B

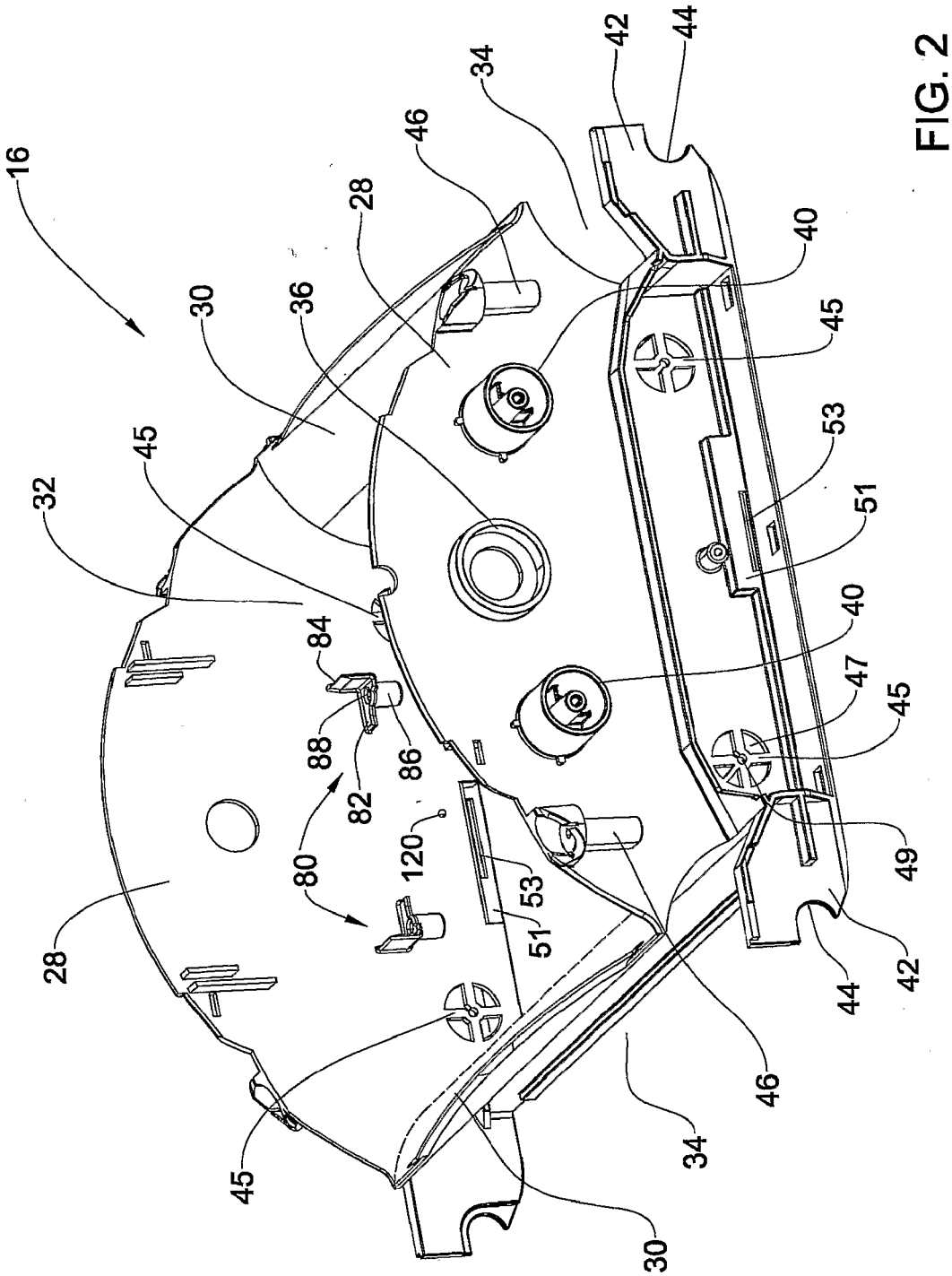

FIG. 2

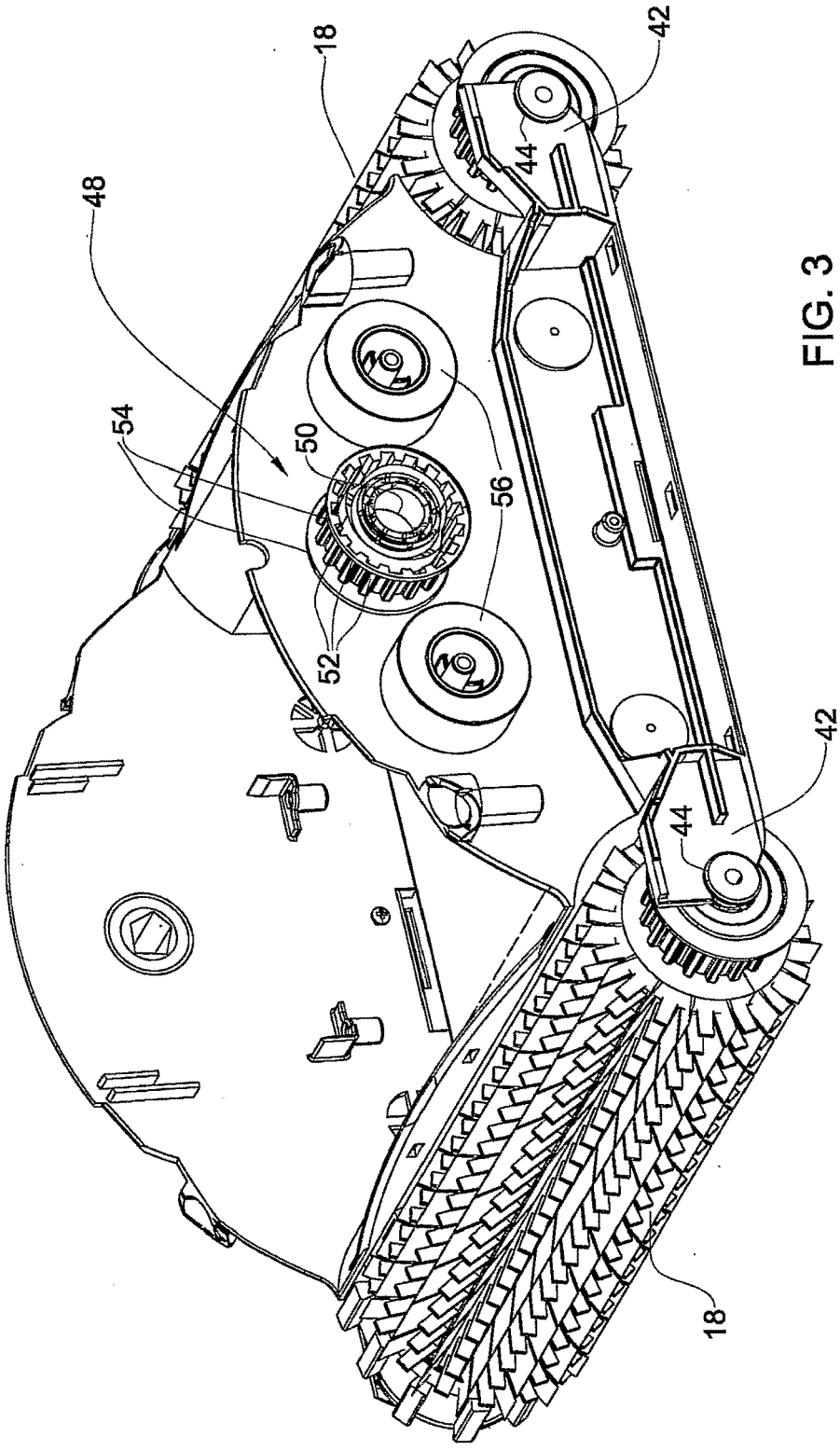

FIG. 3

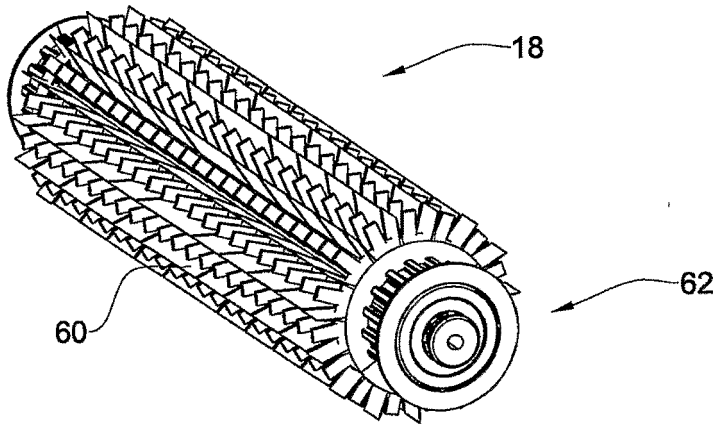

FIG. 4A

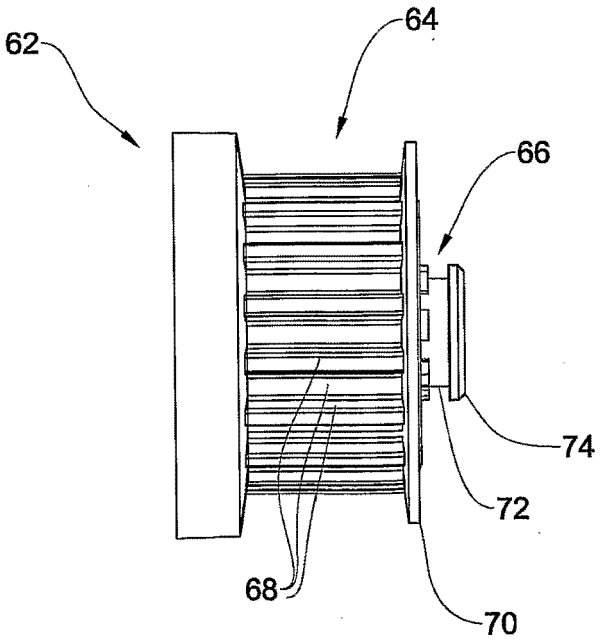

FIG. 4B

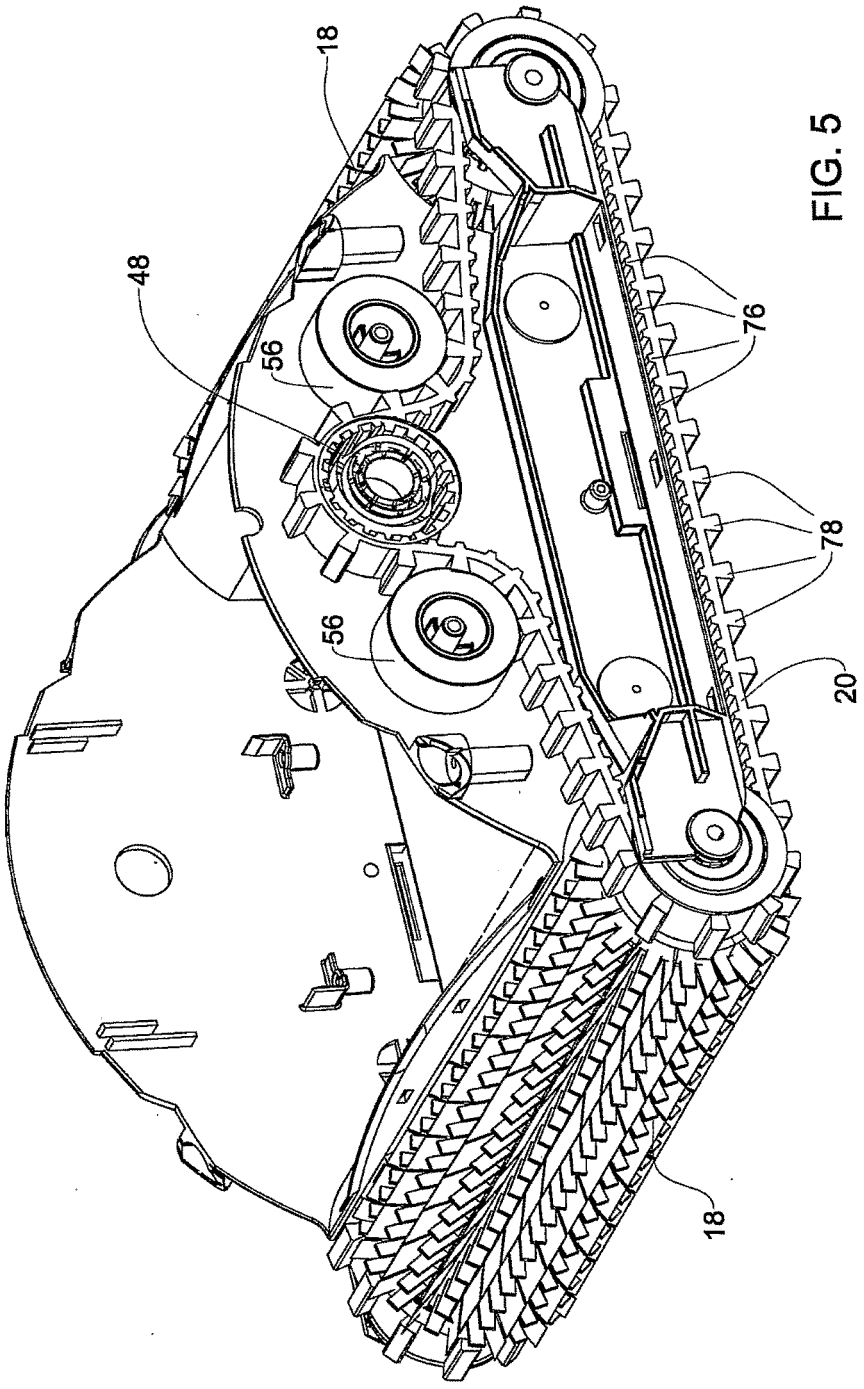

FIG. 5

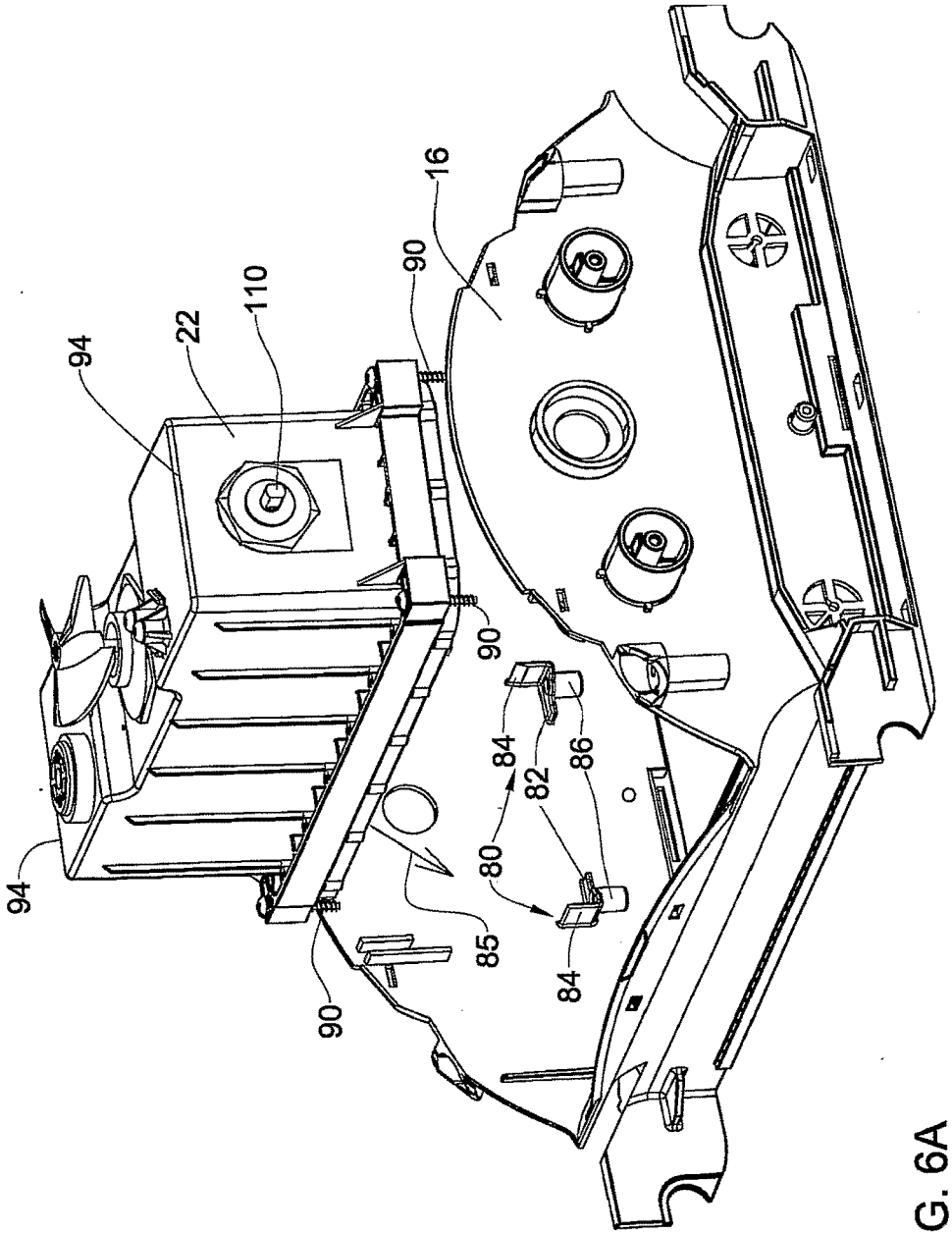

FIG. 6A

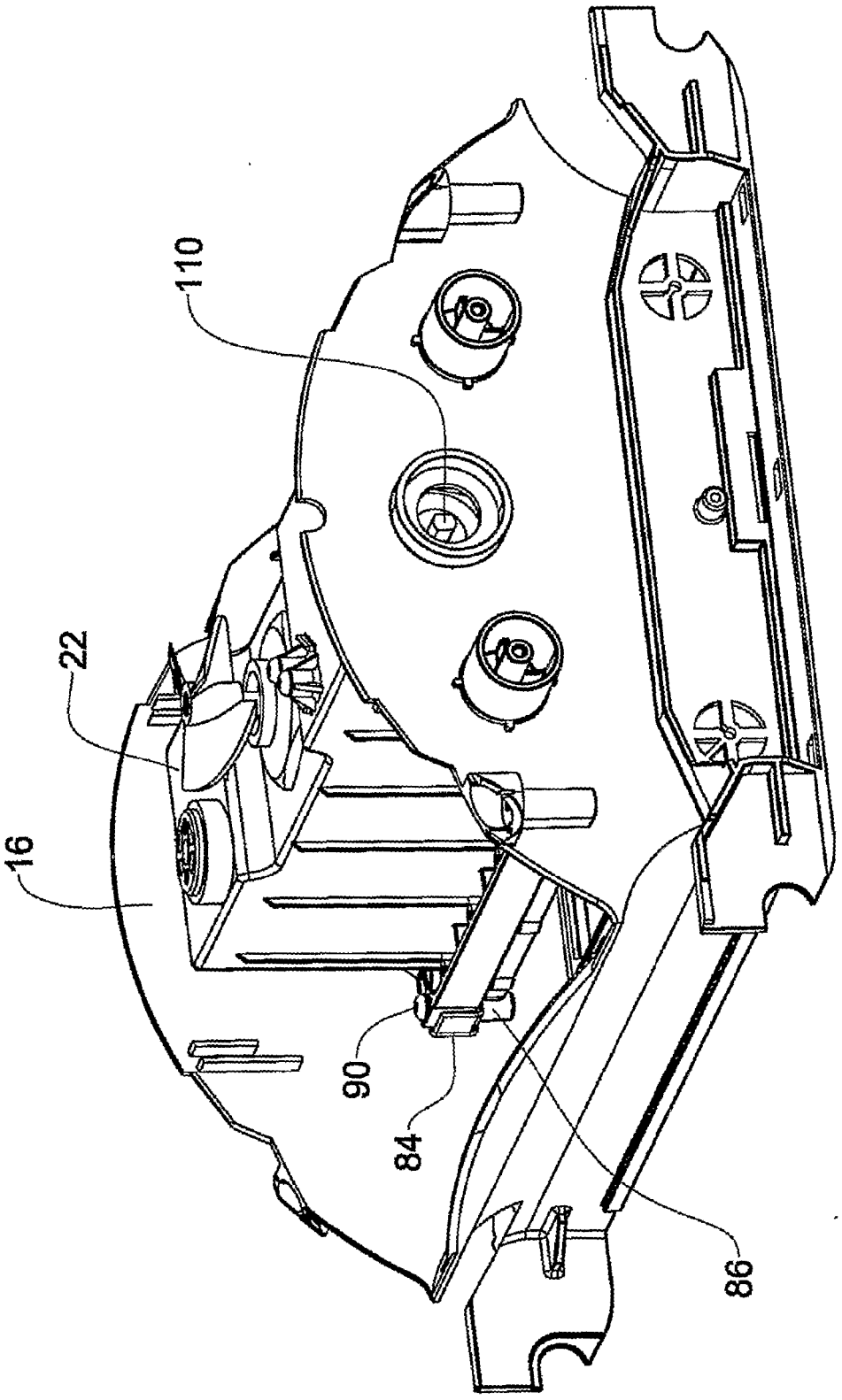

FIG. 6B

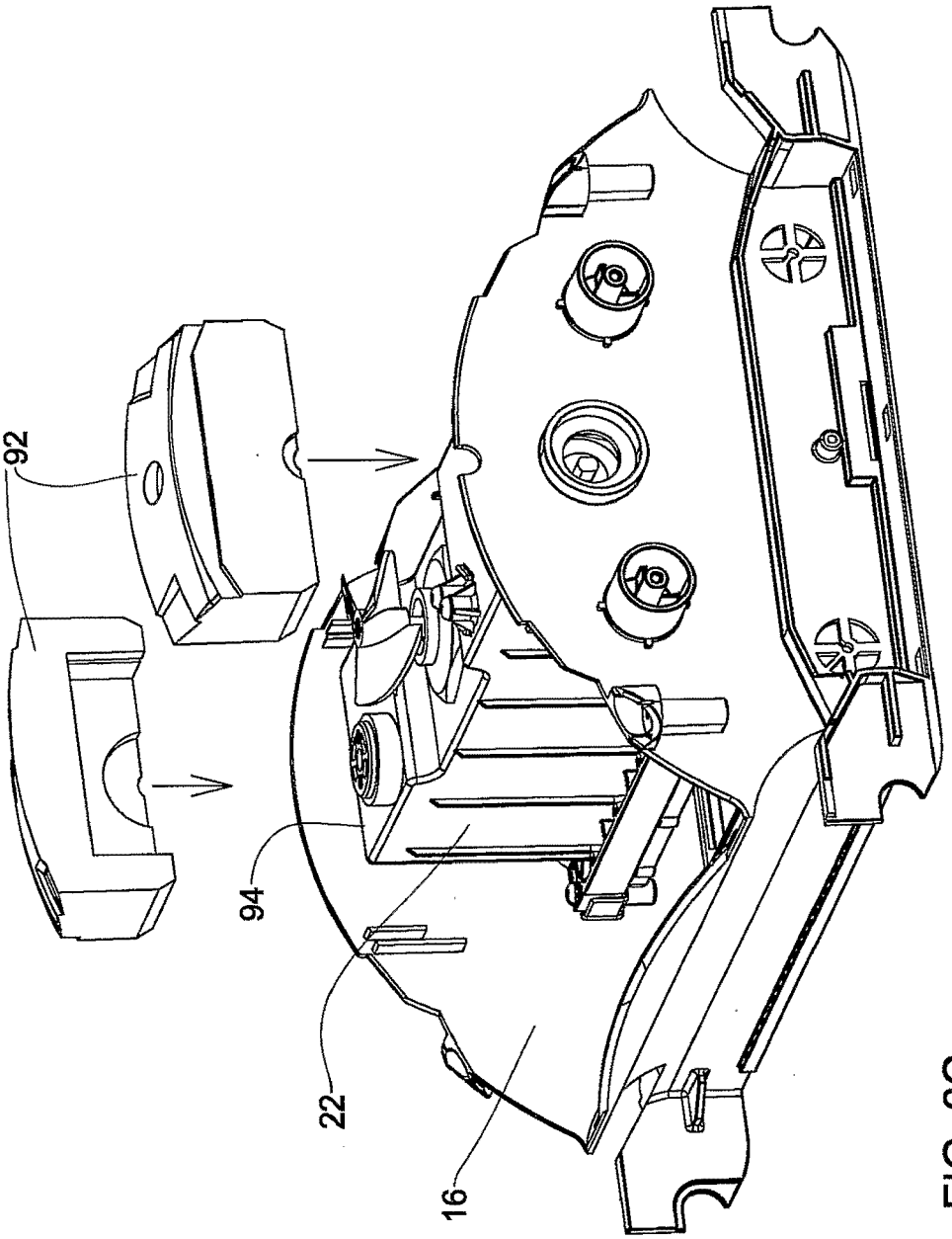

FIG. 6C

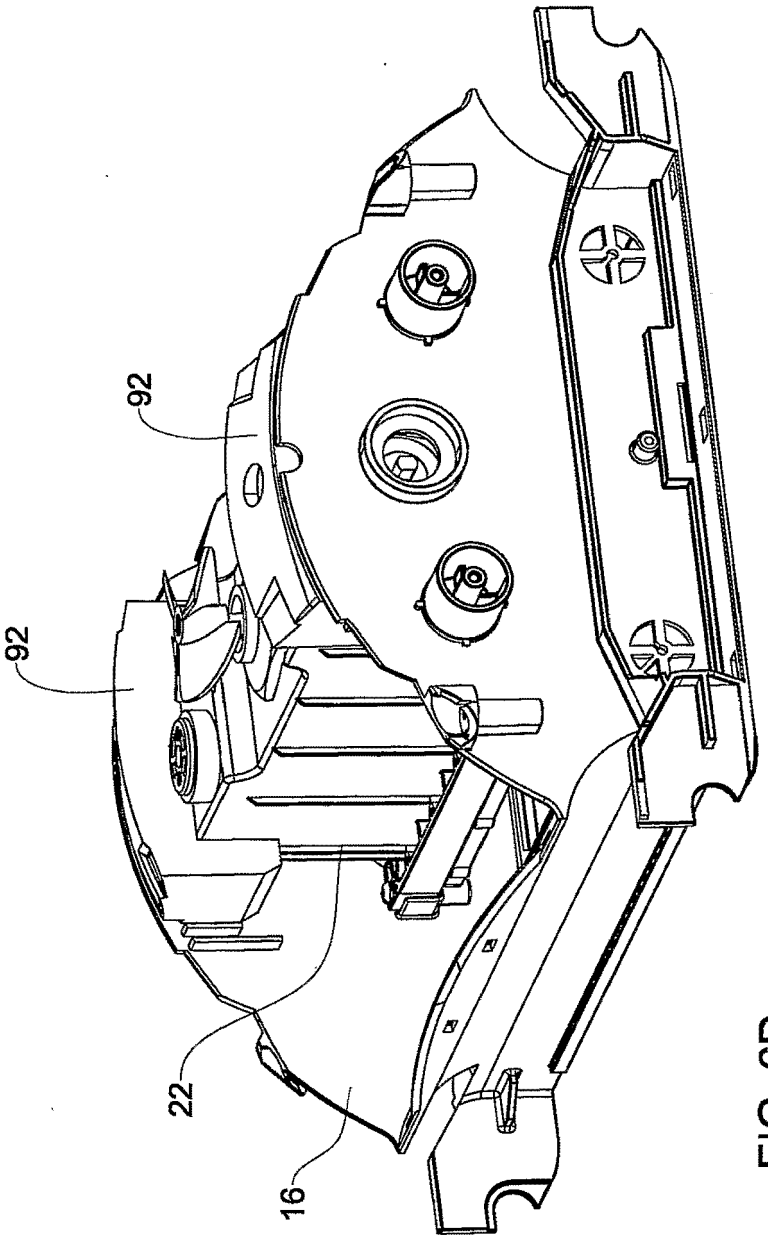

FIG. 6D

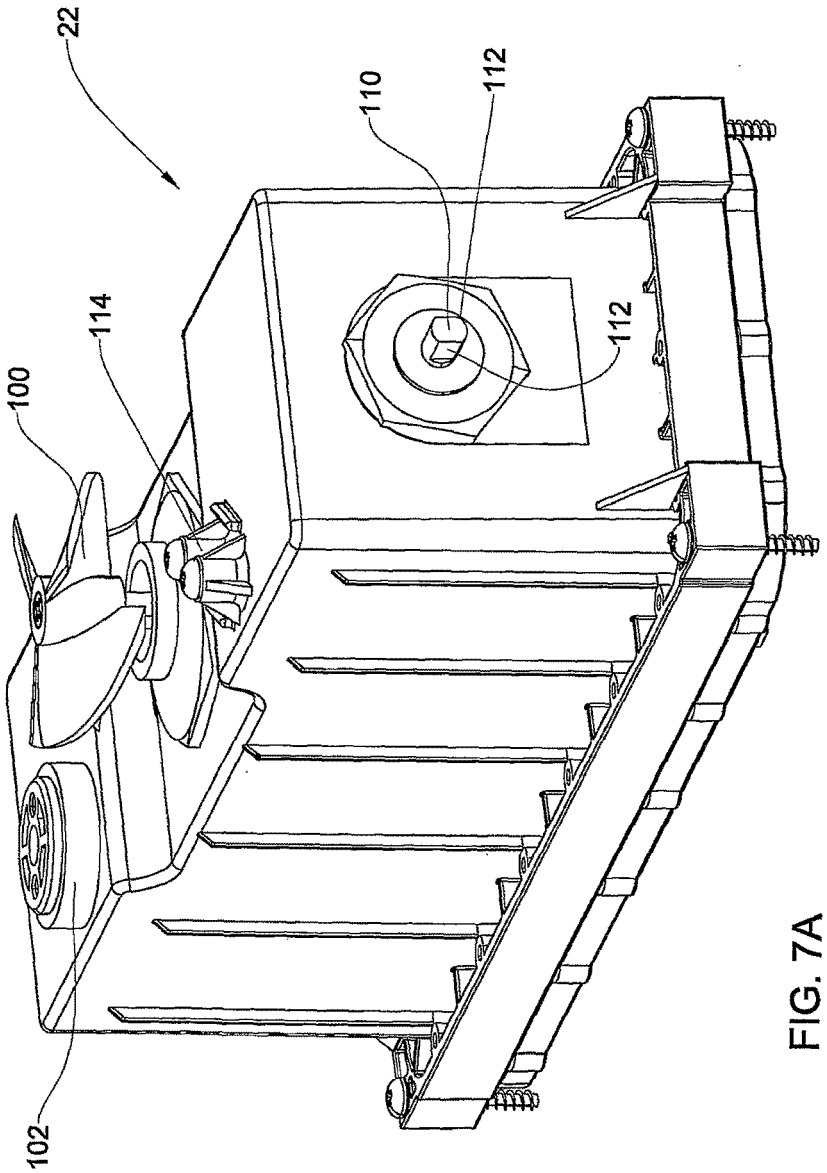

FIG. 7A

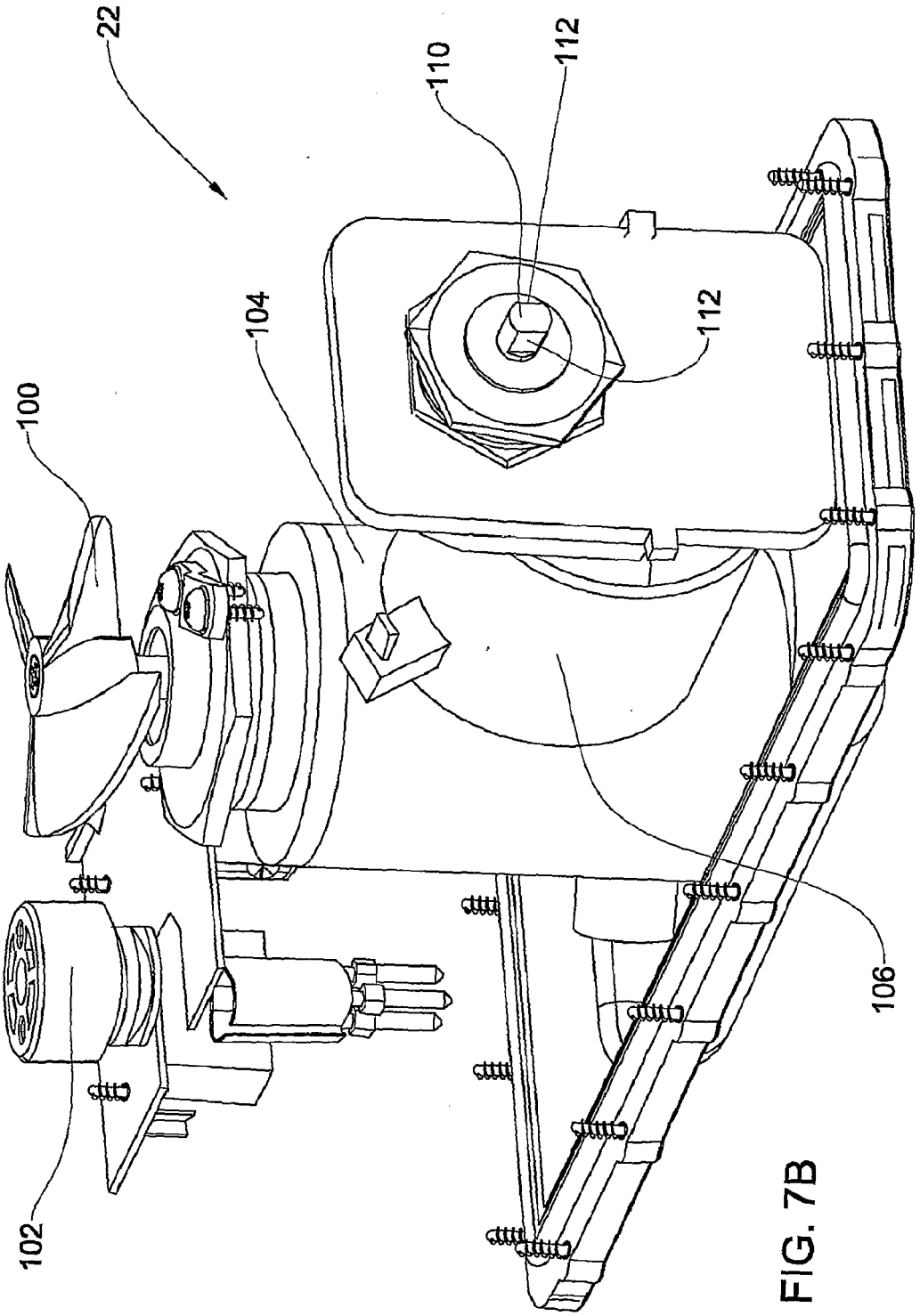

FIG. 7B

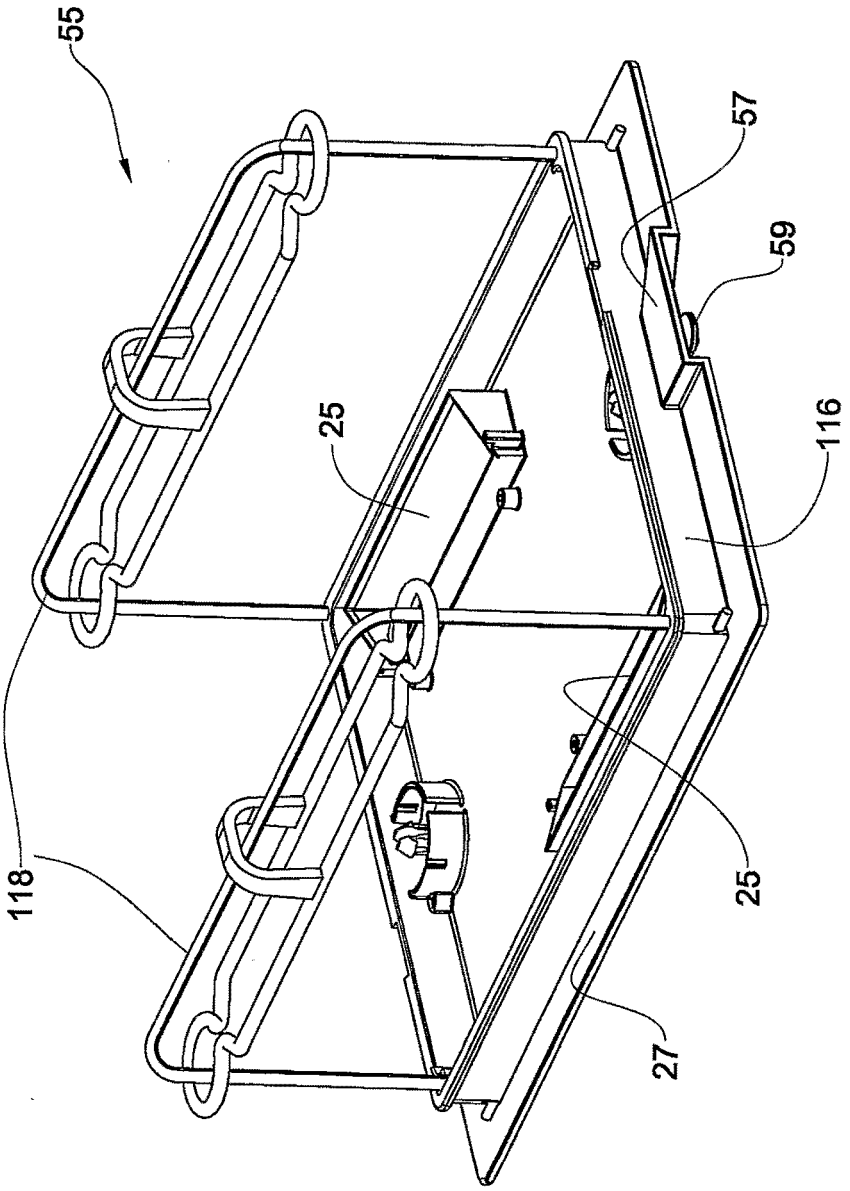

FIG. 8A

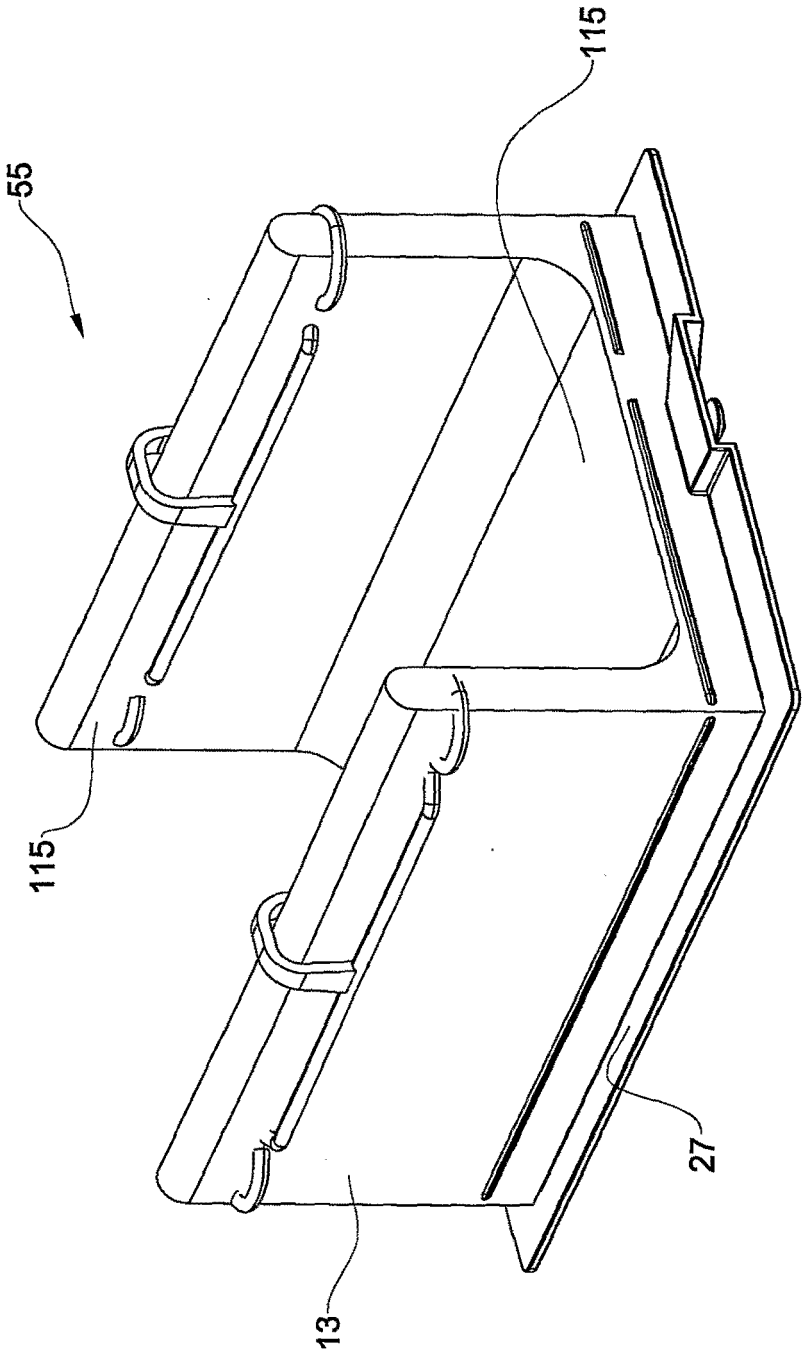

FIG. 8B

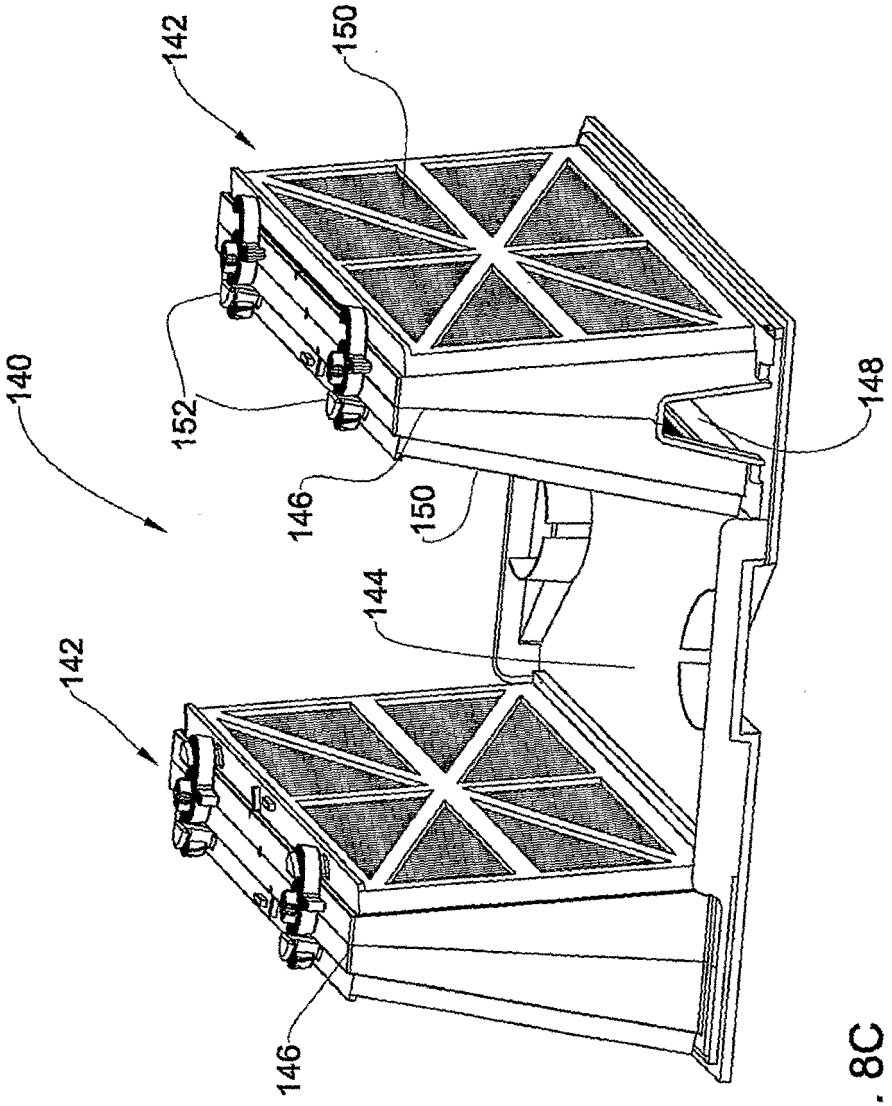

FIG. 8C

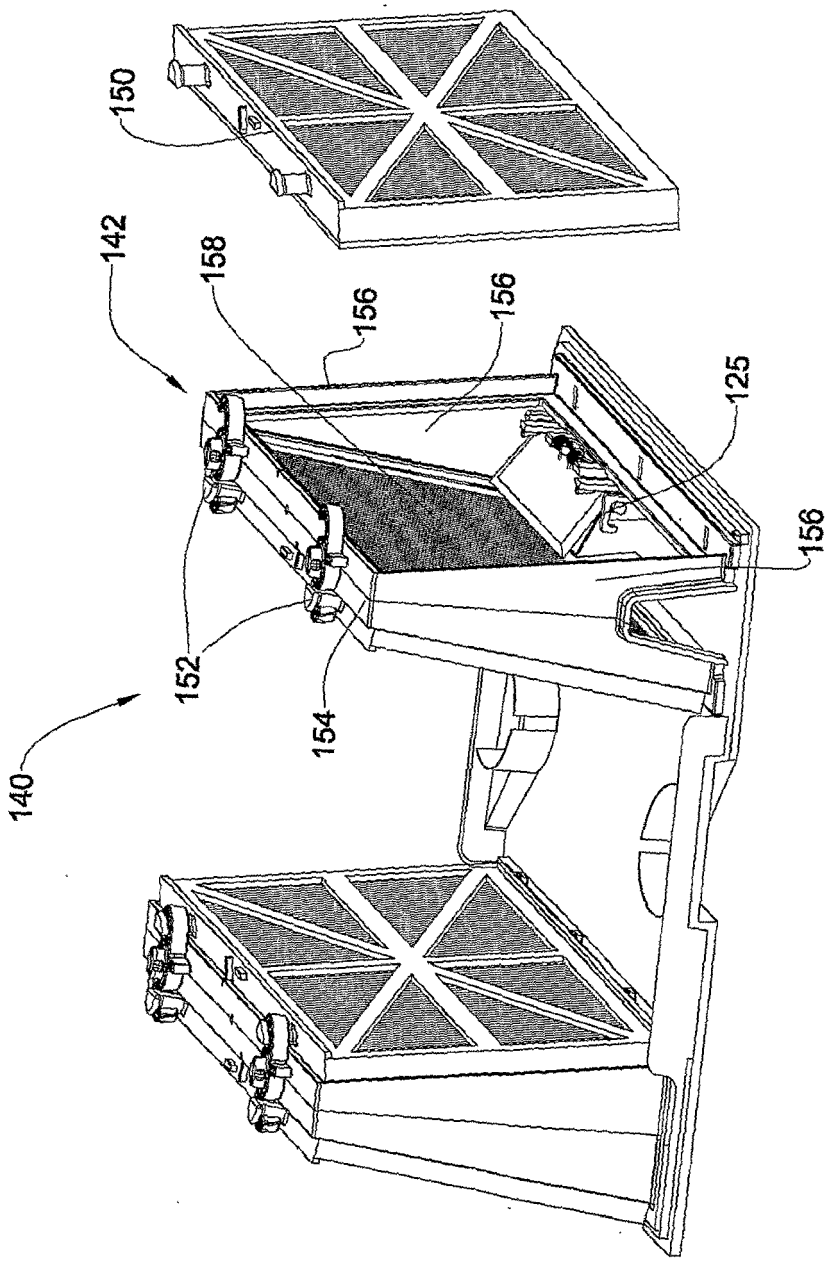

FIG. 8D

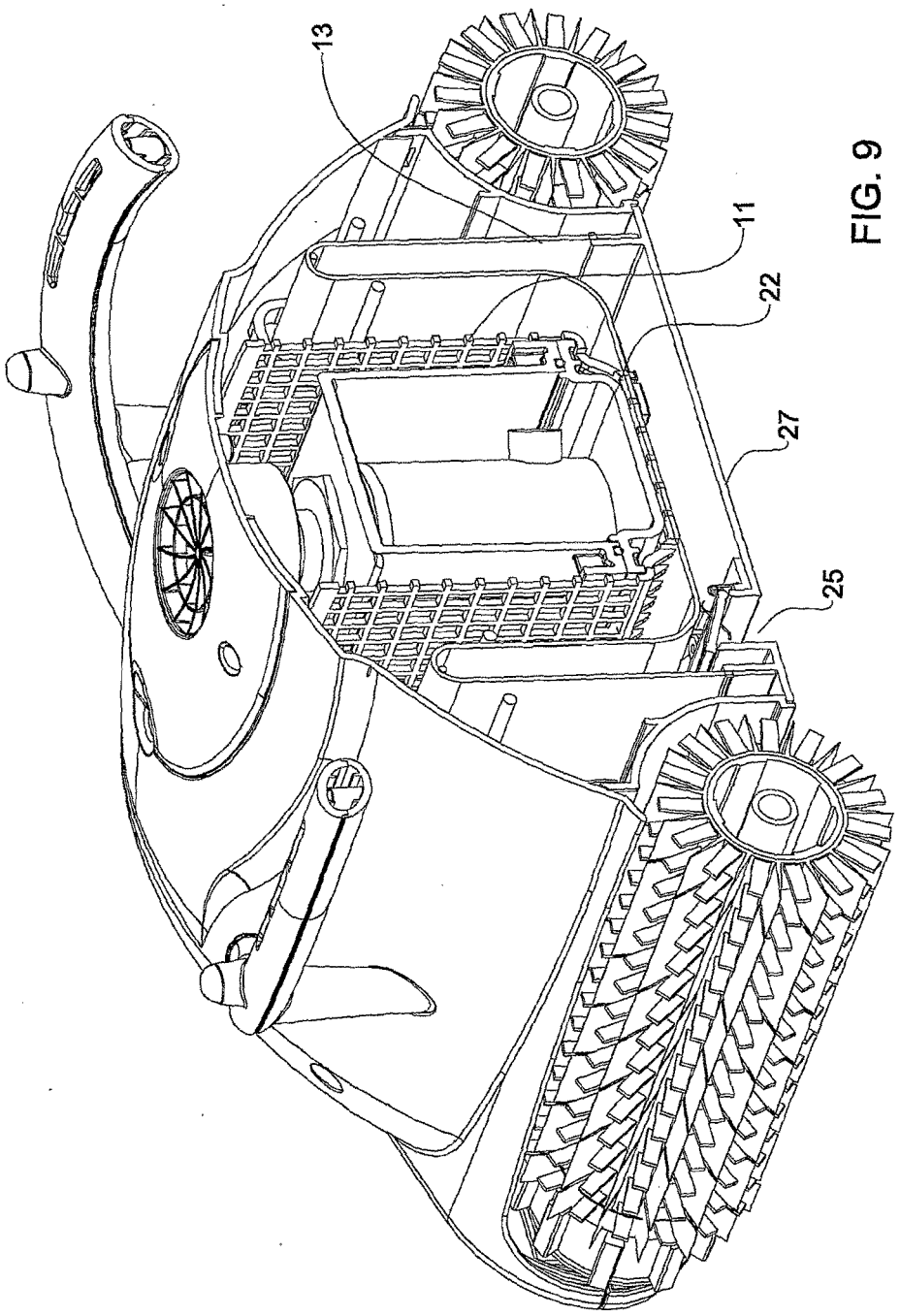

FIG. 9

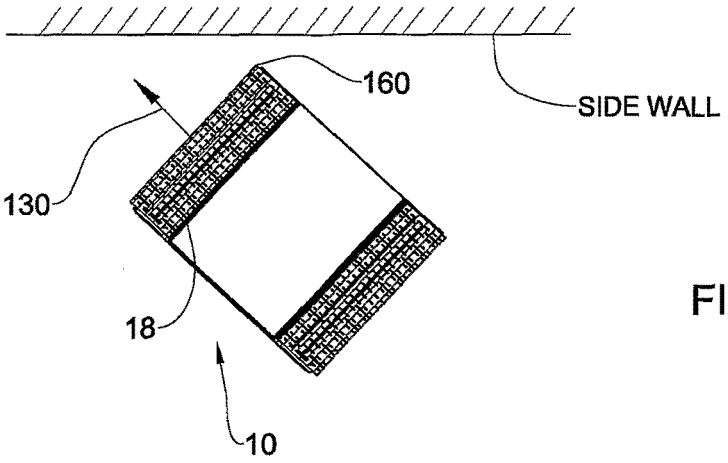

FIG. 10A

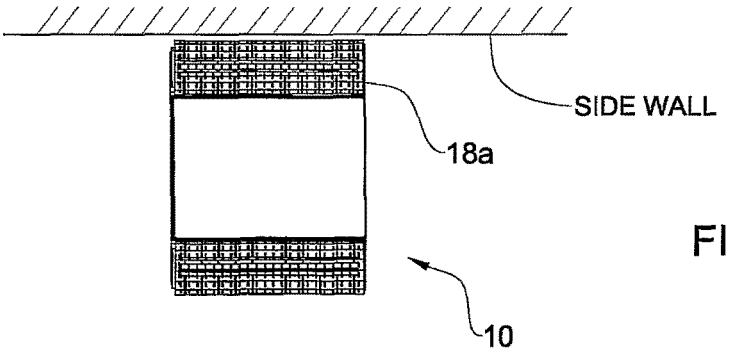

FIG. 10B

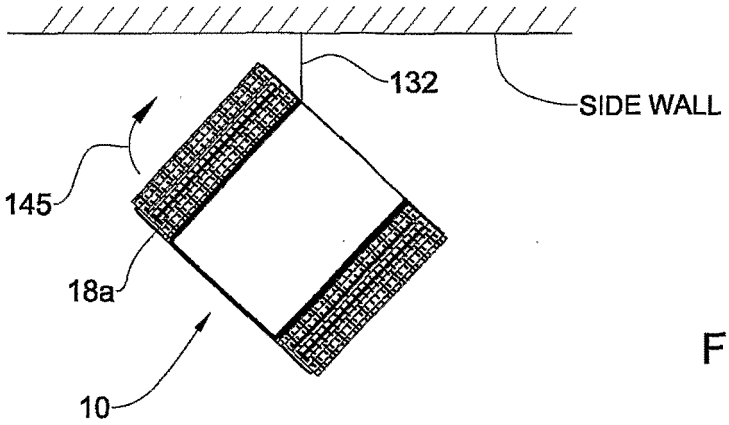

FIG. 10C

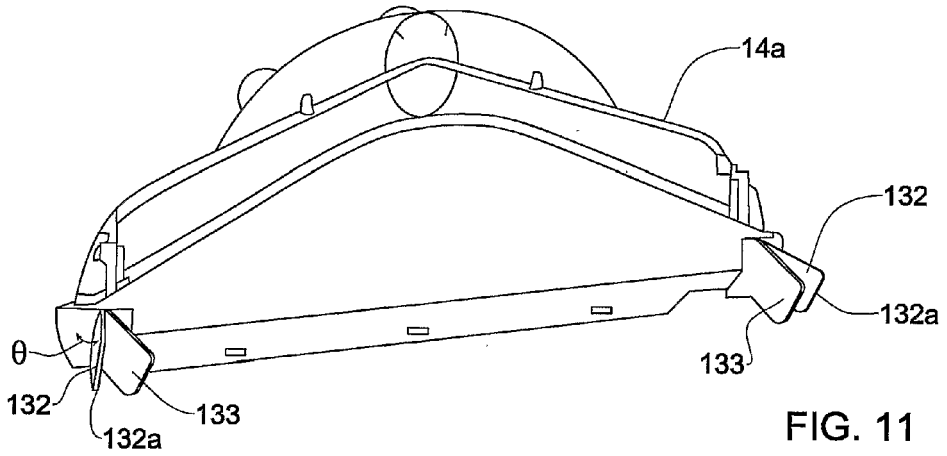

FIG. 11

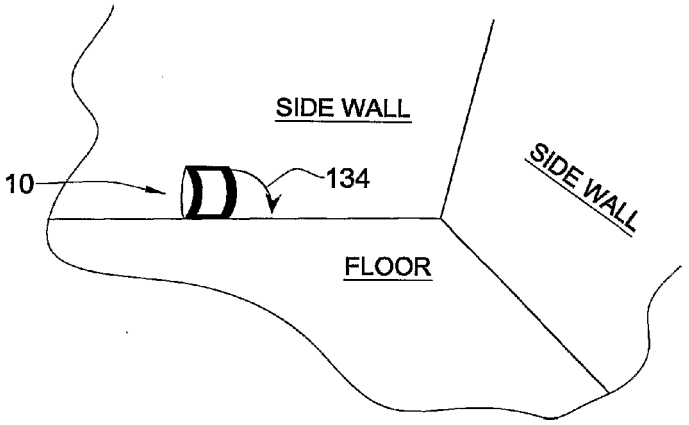

FIG. 12

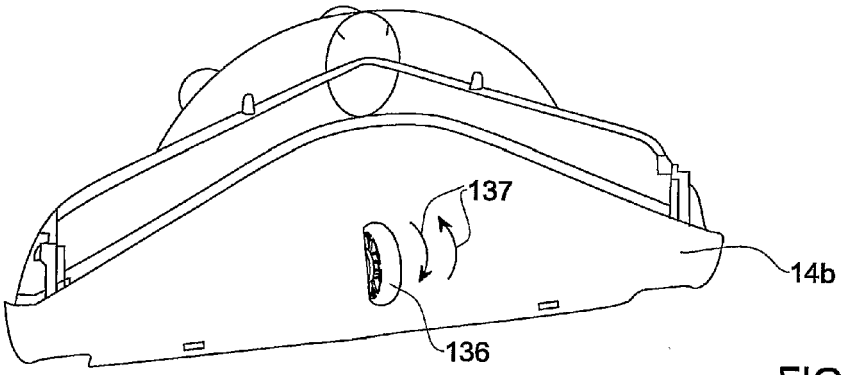

FIG. 13

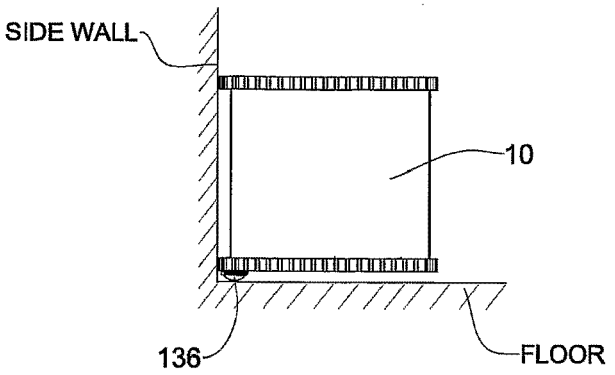

FIG. 14A

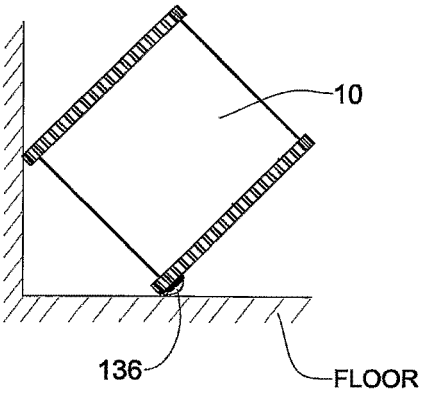

FIG. 14B

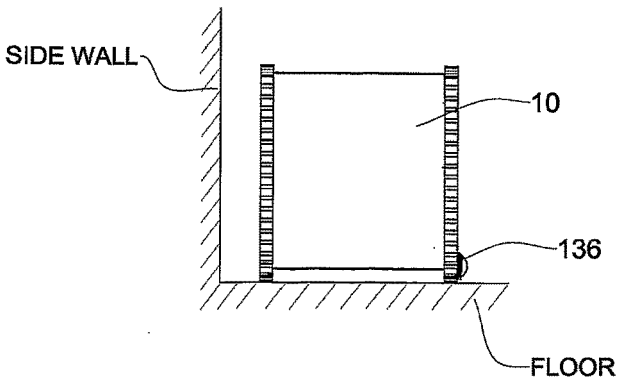

FIG. 14C