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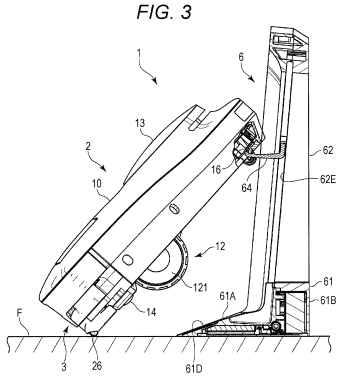
(54) SELF-PROPELLED VACUUM CLEANER

(57) An autonomous vacuum cleaner that can reduce the footprint in a standby state is provided. An autonomous vacuum cleaner (1) includes a vacuum cleaner body (2) and a charging station (6). The charging station (6) has a hook (64) that latches a latched member (16) provided to a rear side of the vacuum cleaner body (2), and a lift driver (61) that raises and lowers the hook (64), and is configured to be capable of storing the vacuum cleaner body (2) in a standing state where the vacuum cleaner body (2) is hoisted and the rear side is oriented upward.

FIG. 3



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Description

TECHNICAL FIELD

[0001] The present invention relates to an autonomous vacuum cleaner.

BACKGROUND ART

[0002] An autonomous vacuum cleaner including a travel means, a dust collection assembly that collects dust removed from the floor surface, and a battery that supplies electric power to the travel means and the like is conventionally known (refer to, for example, Patent Literature 1). The battery of the autonomous vacuum cleaner is configured to be installed separately on the floor surface and charged from a charging base connected to a power source. The autonomous vacuum cleaner controls a drive wheel of the travel means, depending on a return signal from the charging base, to return to the charging base. A charging terminal of the autonomous vacuum cleaner and a feeder terminal of the charging base are electrically connected to detect the completion of the return to the charging base and stop the drive of the travel means and the dust collection assembly.

CITATION LIST

PATENT LITERATURE

[0003] PATENT LITERATURE 1: JP-A-2014-188062

SUMMARY OF THE INVENTION

PROBLEMS TO BE SOLVED BY THE INVENTION

[0004] However, in such a known autonomous vacuum cleaner as is described in Patent Literature 1, the autonomous vacuum cleaner and the charging base are planarly connected in a standby state where the autonomous vacuum cleaner has returned and is on standby. Hence, an area of the floor surface results in being occupied by a combined projected area of the autonomous vacuum cleaner and the charging base, which leads a problem that the footprint in the standby state is large.

[0005] An object of the present invention is to provide an autonomous vacuum cleaner that can reduce the footprint in a standby state.

SOLUTIONS TO THE PROBLEMS

[0006] An autonomous vacuum cleaner according to the present invention is an autonomous vacuum cleaner capable of cleaning while travelling along a floor surface, including: a vacuum cleaner body including a cleaning means configured to suck up dirt and the like on the floor surface; and a storage device for storing the vacuum cleaner body during non-cleaning time. The storage device includes: a latch configured to latch a part of one end side of the vacuum cleaner body; and a lift means configured to raise and lower the latch, and the autonomous vacuum cleaner is configured to be capable of storing the vacuum cleaner body in a standing state where the vacuum cleaner body is hoisted and the one end side is oriented upward, by causing the lift means to raise the latch latching the part of the vacuum cleaner body.

[0007] According to such a present invention, the storage device causes the lift means to raise the latch, and stores the vacuum cleaner body in the standing state where the vacuum cleaner body latched by the latch is hoisted and the one end side is oriented upward. Accordingly, it is possible to reduce a projected area of the stored vacuum cleaner body on the floor surface and reduce the combined footprint of the vacuum cleaner body in a standby state and the storage device.

[0008] In the present invention, the storage device preferably includes a charging means for charging the vacuum cleaner body, and the latch functions as a feeder terminal to feed power from the charging means to the vacuum cleaner body.

[0009] According to such a configuration, the latch for hoisting the vacuum cleaner body functions as the feeder terminal. Accordingly, the storage device can easily feed power to the hoisted vacuum cleaner body without preparing an additional feeder terminal.

[0010] In the present invention, it is preferred that the charging means includes a power feeder capable of feeding power in contact with the latch, and the power feeder is configured including: a first terminal capable of coming into contact with the latch at a latch position before hoisting the vacuum cleaner body; and a second terminal capable of coming into contact with the latch at a storage position after hoisting the vacuum cleaner body.

[0011] According to such a configuration, the charging means has the power feeder that can feed power in contact with the latch. The power feeder has the first and second terminals. Accordingly, each terminal comes into contact with the latch at both of the latch position before the hoist and the storage position after the hoist to apply power thereto. Consequently, it is possible to feed power to the vacuum cleaner body via the latch. Moreover, the necessity to directly connect a feeder wire to the moving latch is eliminated. Accordingly, the wire does not become entangled, or there is no need to secure space where the wire moves.

[0012] In the present invention, it is preferred that the storage device includes a detection means configured to detect whether or not the vacuum cleaner body is at a predetermined hoistable position, and on the basis of the detection by the detection means, the lift means keeps the latch down at a retracted position until the vacuum cleaner body comes to the predetermined position, and raises the latch to the latch position upon the vacuum cleaner body coming to the predetermined position.

[0013] According to such a configuration, the lift means keeps the latch down at the retracted position until the

vacuum cleaner body comes to the predetermined position. Accordingly, the storage device can prevent the latch from protruding and catching a person's leg and clothing and prevent the part of the vacuum cleaner body and the latch from coming into sliding contact with each other to reduce the wear-out of the latch. Moreover, the detection means detects that the vacuum cleaner body has come to the predetermined position, and then the lift means raises the latch to the latch position. Accordingly, the storage device can securely latch the part of the vacuum cleaner body with the latch, and can stably hoist the vacuum cleaner body.

[0014] In the present invention, the lift means preferably raises and lowers the latch along a backward and upward inclined direction with respect to the vacuum cleaner body.

[0015] According to such a configuration, the lift means raises and lowers the latch along the inclined direction. Accordingly, it is possible to hoist the one end side of the vacuum cleaner body obliquely upward and stably and smoothly hoist the vacuum cleaner body as compared to a case of vertically hoisting the vacuum cleaner body.

[0016] In the present invention, the storage device preferably includes a slope configured to guide the one end side of the vacuum cleaner body obliquely upward before the vacuum cleaner body comes to the predetermined hoistable position.

[0017] According to such a configuration, the one end side of the vacuum cleaner body is guided obliquely upward by the slope of the storage device. Accordingly, it is possible to hoist the vacuum cleaner body with the latch after inclining the vacuum cleaner body and more smoothly hoist the vacuum cleaner body. Moreover, a portion higher than the floor surface is formed by the slope. Accordingly, the portion can be used as a retraction space for the latch.

[0018] In the present invention, it is preferred that the latch includes an extension piece extending toward the vacuum cleaner body, a latch recess recessed in an arc shape is formed in a top surface of the extension piece, and the part of the vacuum cleaner body is provided with a latched member formed into a columnar shape with a smaller diameter than that of the latch recess, the latched member being configured to be latched in the latch recess.

[0019] According to such a configuration, the latch recess recessed in an arc shape is formed in the top surface of the extension piece of the latch. The part of the vacuum cleaner body is provided with the latched member formed into a columnar shape with a smaller diameter than that of the latch recess. Accordingly, it is possible to securely latch the latched member in the latch recess. Moreover, as the one end side of the vacuum cleaner body is hoisted, the angle formed by the vacuum cleaner body and the storage device changes. However, the columnar latched member can rotate in the arc-shaped latch recess. Accordingly, it is possible to reduce resistance while maintaining a stable latched state and smoothly hoist the vacuum cleaner body.

[0020] In the present invention, preferably, at least one of the vacuum cleaner body and the storage device is provided with a guide means configured to roll or slide and guide the other end side of the vacuum cleaner body midway through the hoist.

[0021] According to such a configuration, the vacuum cleaner body or storage device is provided with the guide means. The guide means rolls or slides and guides the other end side of the vacuum cleaner body. Accordingly, it is possible to reduce sliding contact resistance between the other end side of the vacuum cleaner body where the angle changes as the vacuum cleaner body moves up or down, and the floor surface or storage device, and more smoothly raise and lower the vacuum cleaner body.

BRIEF DESCRIPTION OF THE DRAWINGS

[0022]

Fig. 1 is a front view of an autonomous vacuum cleaner according to one embodiment of the present invention.

Fig. 2 is a side view of a vacuum cleaner body and a cross-sectional view of a storage device in the autonomous vacuum cleaner.

Fig. 3 is a side view illustrating a hoisted state of the vacuum cleaner body in the autonomous vacuum cleaner.

Fig. 4 is a side view illustrating a stored state of the vacuum cleaner body in the autonomous vacuum cleaner.

Fig. 5 is a functional block diagram illustrating the schematic configuration of the autonomous vacuum cleaner.

Fig. 6 is a perspective view of the vacuum cleaner body as viewed from above.

Fig. 7 is a perspective view of the vacuum cleaner body as viewed from below.

Fig. 8 is a perspective view of a protruding state of a surrounding cleaning means in the vacuum cleaner body as viewed from above.

Fig. 9 is a perspective view of the protruding state of the surrounding cleaning means in the vacuum cleaner body as viewed from below.

Fig. 10 is a front view illustrating the protruding state of the surrounding cleaning means in the vacuum cleaner body.

Fig. 11 is a right-side view illustrating the protruding state of the surrounding cleaning means in the vacuum cleaner body.

Fig. 12 is a back view illustrating the protruding state of the surrounding cleaning means in the vacuum cleaner body.

Fig. 13 is a perspective view illustrating the storage device of the autonomous vacuum cleaner.

Fig. 14 is a front view illustrating the storage device.

Fig. 15 is a cross-sectional view illustrating the stor-

age device.

Figs. 16(A) to 16(D) are cross-sectional views illustrating the operation of the storage device.

Figs. 17(A) and 17(B) are cross-sectional views illustrating a part of the enlarged storage device.

Fig. 18 is a cross-sectional view illustrating a detection means of the storage device.

Figs. 19(A) and 19(B) are cross-sectional views illustrating a lift means of the storage device.

Fig. 20 is a cross-sectional view illustrating the enlarged lift means of the storage device.

Fig. 21 is a cross-sectional view illustrating the enlarged lift means of the storage device.

Figs. 22(A) and 22(B) are a side view and a cross-sectional view, which illustrate the operation of the storage device.

Figs. 23(A) and 23(B) are a side view and a cross-sectional view, which illustrate the operation of the storage device, and are continued from Figs. 22(A) and 22(B).

Figs. 24(A) and 24(B) are a side view and a cross-sectional view, which illustrate the operation of the storage device, and are continued from Figs. 23(A) and 23(B).

Figs. 25(A) and 25(B) are a side view and a cross-sectional view, which illustrate the operation of the storage device, and are continued from Figs. 24(A) and 24(B).

Figs. 26(A) to 26(C) are cross-sectional views illustrating an enlarged charging means of the storage device.

DESCRIPTION OF THE EMBODIMENTS

[0023] One embodiment of the present invention is described hereinafter on the basis of Figs. 1 to 26(A) to 26(C).

[0024] Fig. 1 is a front view of an autonomous vacuum cleaner according to one embodiment of the present invention. Fig. 2 is a side view of a vacuum cleaner body and a cross-sectional view of a storage device in the autonomous vacuum cleaner.

[0025] An autonomous vacuum cleaner 1 includes a vacuum cleaner body 2 being a cleaning robot that cleans a floor surface F while travelling along the floor surface F, and a charging station 6 as a storage device for storing the vacuum cleaner body 2 during non-cleaning time.

[0026] As described below, the vacuum cleaner body 2 includes a travel driver 12 having a pair of left and right wheels 121 for travelling autonomously, a lift 13 that is provided, configured to be capable of lifting up from a top surface 101 of a body 10, a vacuum assembly 14 for sucking up dust and dirt on the floor surface F, and a body operator 15 (refer to Fig. 5) for operating the vacuum cleaner body 2. The charging station 6 is installed in a predetermined location in a room in such a manner as to be immovable, and is connected to a power source such as a receptacle.

[0027] Fig. 3 is a side view illustrating a hoisted state of the vacuum cleaner body in the autonomous vacuum cleaner. Fig. 4 is a side view illustrating a stored state of the vacuum cleaner body in the autonomous vacuum cleaner.

[0028] As illustrated in Figs. 3 and 4, the charging station 6 is configured in such a manner as to be capable of storing the vacuum cleaner body 2 in a standing state where a rear side thereof being one end side is oriented upward by hoisting the vacuum cleaner body 2. The charging station 6 is configured including hooks 64 as latches that latch latched members 16 (described below) provided to the rear side of the vacuum cleaner body 2, and a lift driver 51 (described below) as a lift means that raises and lowers the hooks 64.

[0029] Fig. 5 is a functional block diagram illustrating the schematic configuration of the autonomous vacuum cleaner.

[0030] As illustrated in Fig. 5, the vacuum cleaner body 2 includes a surrounding cleaning means 3 for cleaning around the vacuum cleaner body 2, a sensor system 4 for detecting an obstacle around the vacuum cleaner body 2, and a controller 5 as a control means that controls and drives the vacuum cleaner body 2, the surrounding cleaning means 3, and the sensor system 4.

[0031] The surrounding cleaning means 3 are provided in a pair on left and right sides of a front part of the vacuum cleaner body 2. The surrounding cleaning means 3 includes a pivotable arm 21 that protrudes sideway from the vacuum cleaner body 2, a motor 22 that drives the arm 21 to pivot, a load sensor 23 that detects load acting on the motor 22 from the outside, and an angle sensor 24 that detects the pivot angle of the arm 21.

[0032] The sensor system 4 includes a front sensor 31 provided on the front part of the vacuum cleaner body 2, a surroundings sensor 32 provided in the lift 13, and a rear sensor 33 provided on a rear part of the vacuum cleaner body 2.

[0033] The controller 5 includes a travel controller 41 that controls the travel driver 12, a vacuum controller 42 that controls the vacuum assembly 14, a detection computer 43 that processes detection signals from the front sensor 31, the surroundings sensor 32, and the rear sensor 33 of the sensor system 4, and the load sensor 23 and the angle sensor 24 of the surrounding cleaning means 3, and an arm controller 44 that controls and drives the motor 22 of the surrounding cleaning means 3 and causes the arm 21 to pivot.

[0034] The charging station 6 includes the lift driver 51 as the lift means that raises and lowers the hooks 64, a charger 52 as a charging means for feeding and charging a battery of the vacuum cleaner body 2, a position detector 53 as a detection means that detects the position of the vacuum cleaner body 2 that has returned to the charging station 6, and a charge controller 54 that controls power feed by the charger 52.

[0035] Next, the structure of the vacuum cleaner body 2 is described on the basis of Figs. 6 to 12.

[0036] Fig. 6 is a perspective view of the vacuum cleaner body as viewed from above. Fig. 7 is a perspective view of the vacuum cleaner body as viewed from below. Fig. 8 is a perspective view of a protruding state of the surrounding cleaning means in the vacuum cleaner body as viewed from above. Fig. 9 is a perspective view of the protruding state of the surrounding cleaning means in the vacuum cleaner as viewed from below. Figs. 10 to 12 are a front view, a right-side view, and a back view, which illustrate the protruding state of the surrounding cleaning means in the vacuum cleaner body.

[0037] The vacuum cleaner body 2 includes the body 10 having the top surface 101, a front surface 102, left and right side surfaces 103, and a rear surface 104, a chassis 11 forming an undersurface 105, the travel driver 12 having the pair of left and right wheels 121 for travelling autonomously, the lift 13 that is provided, configured to be capable of lifting up from the top surface 101 of the body 10, the vacuum assembly 14 that is provided on the undersurface 105 of the body 10 to suck up dust and dirt on the floor surface F, and the body operator 15 (refer to Fig. 5) for operating the vacuum cleaner body 2. The body operator 15 is, for example, a touch sensor switch (not illustrated) provided on the top surface 101 of the vacuum cleaner body 2, and operates the vacuum cleaner body 2 with a touch operation by a user and stops the vacuum cleaner body 2 with a touch operation during operation.

[0038] The arm 21 of the surrounding cleaning means 3 is configured including a first arm 21A rotatably supported on one end side thereof by the vacuum cleaner body 2, and a second arm 21B rotatably supported on the other end side of the first arm 21A. The first arm 21A as a whole is formed into a hollow shape, and is rotatably supported on the one end side by the chassis 11. The second arm 21B as a whole is formed into an extra-long cup shape that opens downward. A middle portion of the second arm 21B is rotatably supported on the other end side of the first arm 21A. The second arm 21B includes a sub-vacuum inlet 25 that opens downward to suck up dirt and the like on the floor surface F. The sub-vacuum inlet 25 communicates with a duct and a dust collection chamber of the vacuum assembly 14 through internal spaces of the second arm 21B and the first arm 21A. Moreover, as described below, an undersurface of the second arm 21B is provided with a rotating ball 26 as a guide means that rolls and guides the front side (the other end side) of the vacuum cleaner body 2 that is being hoisted by the charging station 6.

[0039] The sensor system 4 is configured including the front sensor 31 provided on the front surface 102 of the body 10, the surroundings sensor 32 as a surrounding detection means provided in the lift 13, and the rear sensor 33 provided on the rear surface 104 of the body 10. The front sensor 31 includes an ultrasonic sensor, an infrared sensor, or the like, and detects an obstacle ahead of the vacuum cleaner body 2. The surroundings sensor 32 is a laser scanner (LIDAR (Light Detection and Ranging or Laser Imaging Detection and Ranging)) that is driven and rotated inside the lift 13 and measures distance by applying laser light such as infrared laser light, and calculates the distance to an obstacle and the shape of the obstacle. The surroundings sensor 32 is not limited to the one provided in the lift 13 and is simply required to be provided at any position in the body 10. The rear sensor 33 is for detecting its distance and position with respect to the charging station 6, and communicates with infrared light or the like with infrared emitters 53C (refer to Fig. 13) of the position detector 53 of the charging station 6.

[0040] The travel driver 12 includes the pair of left and right wheels 121, and a motor (not illustrated) that drives and rotates the pair of wheels 121 independently. Moreover, an auxiliary wheel 122 is provided to a rear part of the chassis 11. The vacuum assembly 14 is connected to a roller brush 141, and the duct, a suction fan, the dust collection chamber, and an exhaust port, which are not illustrated. The vacuum assembly 14 is configured in such a manner as to collect the sucked dust and the like through a filter of the dust collection chamber and exhaust the sucked air from the exhaust port. The duct of the vacuum assembly 14 communicates with the internal space of the arm 21 of the surrounding cleaning means 3.

[0041] Next, the structure of the charging station 6 is described with reference to Figs. 13 to 18.

[0042] Fig. 13 is a perspective view illustrating the storage device of the autonomous vacuum cleaner. Fig. 14 is a front view illustrating the storage device. Fig. 15 is a cross-sectional view illustrating the storage device, and is a cross-sectional view taken at a position indicated by line A-A in Fig. 14. Figs. 16(A) to 16(D) are cross-sectional views illustrating the operation of the storage device. Figs. 17(A) and 17(B) are cross-sectional views illustrating a part of the enlarged storage device, and a partial enlarged view of Fig. 2. Fig. 18 is a cross-sectional view illustrating a detection means of the storage device.

[0043] As illustrated in Figs. 13 to 15, the charging station 6 as the storage device includes a base 61 mounted on the floor surface F, a pair of left and right columns 62 rising from left and right parts of the base 61, an arch-shaped top 63 coupling upper ends of the columns 62, and a pair of the hooks 64 as the latches. The base 61 has a wedge-shaped base front portion 61A inclined upward from the front side to the rear side (from the bottom left side to the top right side in Fig. 13), and a box-shaped base rear portion 61B rising at the back of the base front portion 61A. The base 61 as a whole is formed into a hollow shape. The column 62 rises continuously from the base rear portion 61B. The column 62 has a column front portion 62A, a column inner side portion 62B, a column outer side portion 62C, and a column rear portion 62D. The column 62 as a whole is formed into a hollow shape. The lift driver 51, the charger 52, the position detector 53, and the charge controller (control board) 54 are provided inside such a base 61 and column 62.

[0044] A slope 61C that guides the auxiliary wheel 122

of the vacuum cleaner body 2 is provided in the middle of a top surface of the base front portion 61A. The slope 61C has an ascent from the front side to the rear side. It is configured in such a manner that the auxiliary wheel 122 of the vacuum cleaner body 2 that has approached the charging station 6, moving back, runs up onto the slope 61C; accordingly, as illustrated in Fig. 2, the rear side (the one end side) of the vacuum cleaner body 2 is guided obliquely upward. A rear end of the slope 61C is provided with a substantially horizontal flat portion (refer to Fig. 18). The auxiliary wheel 122 runs up onto the flat portion to make it difficult for the vacuum cleaner body 2 to slip down to the front side. Moreover, each of left and right ends on the top surface of the base front portion 61A is provided with a second slope 61D. As illustrated in Fig. 4, it is configured in such a manner that the second slope 61D guides the rotating ball 26 provided on the front side (the other end side) of the vacuum cleaner body 2.

[0045] A front surface of the base rear portion 61B is provided with a plurality of the infrared emitters 53C configuring the position detector 53. The infrared light emitted by the infrared emitters 53C is received by the rear sensor 33 of the vacuum cleaner body 2. Accordingly, the vacuum cleaner body 2 detects its sideward position and distance with respect to the charging station 6 while moving back to the charging station 6. The vacuum cleaner body 2 moves back while appropriately adjusting the travel driver 12 on the basis of the detection of the rear sensor 33, and approaches a predetermined hoistable position (a docking position illustrated in Fig. 2) on the charging station 6. Moreover, a slit 62E that guides the hook 64 upward and downward is formed from the base rear portion 61B to the column inner side portion 62B of the column 62. The column front portion 62A and the slit 62E of the column 62 are provided, inclined upward to the rear. Consequently, as illustrated in Figs. 2 to 4, it is configured in such a manner that the rear side of the vacuum cleaner body 2 is hoisted obliquely upward.

[0046] As illustrated in Figs. 16(A) to 16(D), the hook 64 is provided in such a manner as to be driven by the lift driver 51 and be movable up and down from the base 61 all the way along the column 62. In other words, the hook 64 is configured in such a manner as to be movable up and down between a retracted position illustrated in Fig. 16(A) and a storage position illustrated in Fig. 16(D) through a latch position illustrated in Fig. 16(B) and a hoist midway position illustrated in Fig. 16(C).

[0047] As illustrated in Figs. 17(A) and 17(B), the hook 64 includes a hook base 64A that is coupled to the lift driver 51, and an extension piece 64B extending substantially horizontally from the hook base 64A to the front, that is, the vacuum cleaner body 2. A latch recess 64C recessed in an arc shape is formed in a top surface of a distal end of the extension piece 64B. On the other hand, as illustrated in Figs. 7, 9, and 17(A) and 17(B), the rear side (the one end side) of the undersurface of the vacuum cleaner body 2 is provided with a pair of the latched members 16 that is latched by the hooks 64. The latched member 16 is formed into a columnar shape with a smaller diameter than that of the latch recess 64C, and is configured in such a manner as to be movable back and forth a very short distance inside the latch recess 64C and be capable of being rotatably latched in the latch recess 64C. Moreover, the latched member 16 is electrically connected to the battery (not illustrated) of the vacuum cleaner body 2, and functions as a charging terminal of the vacuum cleaner body 2 as described below.

[0048] As illustrated in Fig.18, the position detector 53 includes, in addition to the infrared emitters 53C, a Hall effect sensor board 53A provided inside the base front portion 61A, and a Hall effect sensor 53B provided on the Hall effect sensor board 53A. On the other hand, the rear side (the one end side) on the undersurface of the vacuum cleaner body 2 is provided with a magnet 17. When the vacuum cleaner body 2 moved back and the auxiliary wheel 122 run over the slope 61C and onto the flat portion, it indicates that the vacuum cleaner body 2 has returned to the docking position where the vacuum cleaner body 2 can be hoisted with the hooks 64. At this point in time, the Hall effect sensor 53B detects the magnet 17, and the position detector 53 detects that the vacuum cleaner body 2 has returned to the docking position.

[0049] It is configured in such a manner that until the position detector 53 detects that the vacuum cleaner body 2 returns to the docking position, the lift driver 51 keeps the hooks 64 down at the retracted position to prevent the hooks 64 and the latched members 16 from coming into contact with each other while the vacuum cleaner body 2 moves back as illustrated in Fig. 17(A). On the other hand, when the position detector 53 detects that the vacuum cleaner body 2 has returned to the docking position, the lift driver 51 raises the hooks 64 to the latch position to latch the latched members 16 in the latch recesses 64C, as illustrated in Fig. 17(B). Moreover, it is configured in such a manner that the hook 64 functions as a feeder terminal that feeds power from the charger 52 to the vacuum cleaner body 2, the latched member 16 is electrically connected to the unillustrated battery inside the vacuum cleaner body 2, and the power fed by the hook 64 is supplied to the battery via the latched member 16.

[0050] Next, the lift driver (lift means) 51 of the charging station 6 is described with reference to Figs. 19(A) and 19(B) to 21.

[0051] Fig. 19(A) and 19(B) are cross-sectional views illustrating the lift means of the storage device, respectively, and are cross-sectional views taken at positions indicated by line B-B and line C-C in Fig. 14. Fig. 20 is a cross-sectional view illustrating the enlarged lift means of the storage device. Fig. 21 is a cross-sectional view illustrating the enlarged lift means of the storage device.

[0052] As illustrated in Figs. 19(A) and 19(B) to 21, the lift driver 51 includes a motor 71, a drive shaft 72, a pair of left and right ball screw shafts 73, ball screws 74 fixed respectively to the left and right hooks 64, and linear

guides 75 that guide the ball screw 74 upward and downward.

[0053] The drive shaft 72 is provided extending to the left and right. A worm gear 72A is fixed at either end portion of the drive shaft 72. As illustrated in Fig. 19, a pinion gear 71A is fixed to an output shaft of the motor 71. A driven gear 72B is fixed in the middle on one side (the left side in Fig. 20) of the drive shaft 72. A gear train including a first gear 76A and a second gear 76B is provided between the pinion gear 71A of the motor 71 and the driven gear 72B. The output of the motor 71 is transmitted to the drive shaft 72 via the gears 71A, 76A, 76B, and 72B to rotate the drive shaft 72.

[0054] The ball screw shaft 73 is provided extending up and down from the base 61 all the way along the column 62. An upper and a lower end of the ball screw shaft 73 are pivotally supported. A worm wheel 73A is fixed at the lower end of the ball screw shaft 73. The worm wheel 73A meshes with the worm gear 72A of the drive shaft 72. When the drive shaft 72 rotates, the rotation is converted into rotation of the ball screw shaft 73. The ball screw 74 meshes with the ball screw shaft 73. When the ball screw shaft 73 rotates, the ball screw 74 and the hook 64 move up and down. The linear guide 75 includes a rail 75A that is fixed, extending up and down from the base 61 all the way along the column 62, and a movable member 75B that is fixed to the ball screw 74 and is guided by the rail 75A. The linear guide 75 guides the ball screw 74 and the hook 64 in such a manner as to be linearly movable.

[0055] Next, the charger (charging means) 52 of the charging station 6 is described with reference to Figs. 22(A) and 22(B) to 26(A) to 26(C).

[0056] Figs. 22(A) and 22(B) to 25(A) and 25(B) are side views and cross-sectional views, which illustrate the operation of the storage device. Each figure (B) is a cross-sectional view taken at a position indicated by line A-A in each figure (A). Figs. 26(A) to 26(C) are cross-sectional views illustrating the enlarged charging means of the storage device. Fig. 26(A) is a cross-sectional view of an enlargement of a part of Fig. 22(B). Fig. 26(B) is a cross-sectional view of an enlargement of a part of Fig. 23(B). Fig. 26(C) is a cross-sectional view of an enlargement of a part of Fig. 25(B).

[0057] The charger 52 includes a power supply 52A (refer to Figs. 17(A) and 17(B) to 21) connected to a power source through a receptacle. As illustrated in Figs. 22(A) and 22(B) to 25(A) and 25(B), the power supply 52A is electrically connected to a first terminal 52B provided from a lower part inside each of the left and right columns 62 all the way to the inside of the base rear portion 61B, and a second terminal 52C provided to an upper part inside each of the left and right columns 62. The first terminal 52B is fixed at an upper end thereof to a terminal fixture 52D on an inner surface of the column outer side portion 62C, and cantilevered downward. The second terminal 52C is fixed at a lower end thereof to the terminal fixture 52E on the inner surface of the column outer side portion 62C, and is cantilevered upward. As illustrated in Figs. 26(A) and 26(B), the first terminal 52B includes a first contact 52F protruding inward in the left-and-right direction. As illustrated in Fig. 26(C), the second terminal 52C is formed including a second contact 52G protruding inward in the left-and-right direction. On the other hand, an electrically conductive portion 64D that protrudes outward in the left-and-right direction and can come into contact with the first contact 52F and the second contact 52G is formed on the hook 64.

[0058] As illustrated in Fig. 26(A), the first electrically conductive portion 52F of the first terminal 52B is not in contact with the electrically conductive portion 64D when the hook 64 is at the retracted position and, as illustrated in Fig. 26(B), is in contact with the electrically conductive portion 64D when the hook 64 is at the latch position. As illustrated in Fig. 26(C), the second contact 52G of the second terminal 52C is in contact with the electrically conductive portion 64D when the hook 64 is at the storage position. On the other hand, it is configured in such a manner that as illustrated in Figs. 24(A) and 24(B), when the hook 64 is at the hoist midway position, the electrically conductive portion 64D is in contact with neither the first electrically conductive portion 52F nor the second contact 52G.

[0059] As described above, the charger 52 brings the hook 64 at the latch position into conduction via the first terminal 52B, and brings the hook 64 at the storage position into conduction via the second terminal 52C. The latched member 16 of the vacuum cleaner body 2 is latched by the hook 64. Accordingly, it is configured in such a manner that the charge controller 54 supplies the power from the charger 52 to the battery inside the vacuum cleaner body 2 via the hooks 64 and the latched members 16 to charge the battery.

[0060] Next, the operation of the autonomous vacuum cleaner 1 is described. When the vacuum cleaner body 2 that has cleaned the floor surface F returns to the vicinity of the charging station 6, the vacuum cleaner body 2 turns the rear side (the rear surface 104 side) to the charging station 6, causes the rear sensor 33 to receive infrared light from the infrared emitters 53C of the charging station 6, and moves back while detecting its distance and position with respect to the charging station 6. Furthermore, the auxiliary wheel 122 runs up onto the slope 61C of the base front portion 61A, and the vacuum cleaner body 2 is guided obliquely upward and moves back to the docking position illustrated in Figs. 2, 17(A) and 17(B), and 18. As illustrated in Fig. 18, when the Hall effect sensor 53B of the position detector 53 detects the magnet 17 and accordingly detects that the vacuum cleaner body 2 has moved back to the docking position, the vacuum cleaner body 2 stops the drive of the travel driver 12.

[0061] When the vacuum cleaner body 2 has moved back to the docking position, the lift driver 51 of the charging station 6 raises the hooks 64 from the retracted position illustrated in Fig. 17(A) to the latch position illustrated in Fig. 17(B), and latches the latched members 16

in the latch recesses 64C. In this manner, the hooks 64 latch the latched members 16 at the latch position. Accordingly, as illustrated in Fig. 26(B), the charger 52 and the battery of the vacuum cleaner body 2 are brought into conduction via the first terminals 52B, the hooks 64, and the latched members 16. The charge controller 54 causes the charger 52 to feed power to charge the battery. In this manner, if the battery is charged at the docking position and then cleaning is resumed, the lift driver 51 lowers the hooks 64 to the retracted position, and then the vacuum cleaner body 2 drives the travel driver 12, travels forward, and leaves the charging station 6.

[0062] When the vacuum cleaner body 2 is stored in the charging station 6, the lift driver 51 raises the hooks 64 that have latched the latched members 16. In this manner, the hooks 64 move up; accordingly, as illustrated in Fig. 3, the rear side of the vacuum cleaner body 2 is hoisted obliquely upward. At the time of the hoist, the rotating balls 26 provided on the front side of the vacuum cleaner body 2 roll along the floor surface F. Furthermore, the rotating balls 26 run up onto the second slopes 61D of the base front portion 61A and roll along the second slopes 61D. Accordingly, the vacuum cleaner body 2 is configured in such a manner as to be smoothly guided. When the lift driver 51 further raises the hooks 64 and the hooks 64 reach the storage position, the vacuum cleaner body 2 is stored in the charging station 6 in the standing state where the rear side is oriented upward as illustrated in Fig. 4.

[0063] As illustrated in Fig. 26(C), in the state where the vacuum cleaner body 2 is stored in this manner, the charger 52 and the battery of the vacuum cleaner body 2 are brought into conduction via the second terminals 52C, the hooks 64, and the latched members 16, and the charge controller 54 causes the charger 52 to feed power; accordingly, the battery is charged. If cleaning is resumed, after the lift driver 51 lowers the hooks 64 to the retracted position, the vacuum cleaner body 2 drives the travel driver 12, travels forward, and then leaves the charging station 6.

[0064] According to such an embodiment, the following operations/effects can be exerted:

(1) The charging station 6 stores the vacuum cleaner body 2 in the standing state by hoisting the rear side of the vacuum cleaner body 2. Accordingly, it is possible to reduce the projected area of the stored vacuum cleaner body 2 on the floor surface F and reduce the combined footprint of the vacuum cleaner body 2 in the stored state and the charging station 6.

(2) The hook 64 for hoisting the vacuum cleaner body 2 functions as the feeder terminal. Accordingly, the charging station 6 can easily feed power to the battery of the hoisted vacuum cleaner body 2 without preparing an additional feeder terminal, and charge the battery.

(3) The charger 52 includes the first terminals 52B and the second terminals 52C, which can feed power in contact with the hooks 64. The hook 64 is electrically connected to the first terminal 52B at the latch position before the hoist, and is electrically connected to the second terminal 52C at the storage position after the hoist. Accordingly, it is possible to charge the battery of the vacuum cleaner body 2 via the hooks 64 at both of the docking position and the storage position without connecting wiring directly to the moving hooks 64.

(4) The lift driver 51 keeps the hooks 64 down at the retracted position until the vacuum cleaner body 2 comes to the docking position. Accordingly, the charging station 6 can prevent a part of the vacuum cleaner body 2 and the hooks 64 from coming into sliding contact with each other and reduce the wear-out of the hooks 64, and can prevent the hooks 64 from catching a person's leg and clothing by eliminating the protrusion of the hooks 64 from the base 61 while the vacuum cleaner body 2 is away from the charging station 6.

(5) The position detector 53 detects that the vacuum cleaner body 2 has come to the docking position, and then the lift driver 51 raises the hooks 64 to the latch position. Accordingly, the charging station 6 can cause the hooks 64 to securely latch the latched members 16 of the vacuum cleaner body 2 and can hoist the vacuum cleaner body 2 stably.

(6) The lift driver 51 raises and lowers the hooks 64 along the backward inclined direction. Accordingly, it is possible to hoist the rear side of the vacuum cleaner body 2 obliquely upward and hoist the vacuum cleaner body 2 more stably and smoothly than in a case of vertically hoisting the vacuum cleaner body 2.

(7) The auxiliary wheel 122 of the vacuum cleaner body 2 that is moving back is guided obliquely upward by the slope 61C. Accordingly, it is possible to cause the hooks 64 to hoist the vacuum cleaner body 2 after inclining the vacuum cleaner body 2 with the rear side up and more smoothly hoist the vacuum cleaner body 2.

(8) The latch recess 64C recessed in an arc shape is formed in the top surface of the extension piece 64B of the hook 64. The vacuum cleaner body 2 is provided with the columnar latched member 16 with a smaller diameter than that of the latch recess 64C. Accordingly, it is possible to securely latch the latched member 16 in the latch recess 64C.

(9) As the rear side of the vacuum cleaner body 2 is hoisted, the angle formed by the vacuum cleaner body 2 and the charging station 6 changes. However, the columnar latched member 16 can rotate in the arc-shaped latch recess 64C. Accordingly, it is possible to reduce resistance while maintaining the stable latched state and smoothly hoist the vacuum cleaner body 2.

(10) The front side of the vacuum cleaner body 2 is provided with the rotating balls 26. The rotating balls

26 roll along the floor surface F and the second slopes 61D of the charging station 6. Accordingly, it is possible to reduce sliding contact resistance between the front side of the vacuum cleaner body 2 where the angle changes as it moves up and down, and the floor surface F or the charging station 6 and more smoothly raise and lower the vacuum cleaner body 2.

[Modifications of Embodiment]

[0065] The present invention is not limited to the embodiment, and includes modifications, improvements, and the like within the scope that can achieve the object of the present invention.

[0066] For example, in the autonomous vacuum cleaner 1 of the embodiment, the vacuum cleaner body 2 is provided with the surrounding cleaning means 3. However, the surrounding cleaning means 3 may be omitted. Moreover, the arm 21 of the surrounding cleaning means 3 is provided with the rotating ball 26. The guide means is configured in such a manner that the rotating ball 26 rolls along the floor surface F and the second slope 61D of the charging station 6. However, the rotating ball 26 may be provided to a lower part of the front part of the body 10 of the vacuum cleaner body 2. Moreover, the guide means is not limited to the one that rolls and guides the rotating ball 26, and a sliding surface with low frictional resistance may be provided to the front part of the vacuum cleaner body 2 and the sliding surface may be configured to be slid and guided along the floor surface F and the second slope 61D. Furthermore, the guide means is not limited to the one provided to the vacuum cleaner body and may be configured by a rolling portion or a sliding portion, which is provided to the storage device (for example, the second slope 61D).

[0067] In the embodiment, the hook 64 functions as the feeder terminal, and it is configured in such a manner as to feed power to the battery of the vacuum cleaner body 2 via the hook 64 and the latched member 16. However, a feeder terminal may be provided separately from the hook 64. In this case, in the storage device, the feeder terminal may be configured to move up and down in synchronization with the latch, or one or more feeder terminals may be provided at a predetermined height or heights without moving up and down. Furthermore, the feeding structure that feeds power to the battery of the vacuum cleaner body 2 is not limited to the one of the contact type where terminals come into contact with each other, and may be, for example, a noncontact feeding structure of an electromagnetic induction type.

[0068] In the embodiment, the charger 52 includes the first terminal 52B and the second terminal 52C, and is configured to charge the battery of the vacuum cleaner body 2 at the latch position before the hoist and at the storage position after the hoist. However, the rechargeable positions are not limited to the two positions: the latch position and the storage position, and may be any of the latch position and the storage position, or three or more rechargeable positions in addition to the two positions: the latch position and the storage position may be provided. Moreover, the charger (charging means) 52 is not limited to the one where the first terminal 52B and the second terminal 52C are provided separately, and may be configured by an integral terminal member where these terminals are continuous.

[0069] In the embodiment, the Hall effect sensor 53B of the position detector (detection means) 53 of the charging station 6 detects the magnet 17 of the vacuum cleaner body 2. Accordingly, it is detected that the vacuum cleaner body 2 is at the hoistable docking position. The hooks 64 start moving up on the basis of the detection. However, the configuration of the detection means is not limited, and, for example, a contact sensor may be used. Moreover, the configuration is not limited to the one where the hooks (latches) 64 stay down at the retracted position until the vacuum cleaner body 2 comes to the docking position, and may be a configuration where the latched members of the vacuum cleaner body move down to the latch position to be latched onto the latches.

[0070] In the embodiment, the hook (latch) 64 includes the latch recess 64C, and the latched member 16 is formed into a columnar shape. However, the structures of the latch and the latched member are not limited to those of the embodiment, and any latch structure can be employed. It may be, for example, one where the latch is formed into a columnar shape, a recess recessed upward is formed in an undersurface of the latched member, and the latch is latched in the recess.

[0071] In the embodiment, the lift driver (lift means) 51 of the charging station 6 is configured including the motor 71, the drive shaft 72, the pair of left and right ball screw shafts 73, the ball screws 74, and the linear guides 75. However, the configuration of the lift means is not especially limited. The lift means may be, for example, one configured including a wire, a belt, or the like for raising and lowering the latch, or one where a direct-acting motor raises and lowers the latch.

INDUSTRIAL APPLICABILITY

[0072] As described above, the present invention can be suitably used for an autonomous vacuum cleaner that can reduce the footprint in a standby state.

LIST OF REFERENCE NUMERALS

[0073]

1	Autonomous vacuum cleaner
2	Vacuum cleaner body
6	Charging station (storage device)
26	Rotating ball (guide means)
14	Vacuum assembly (cleaning means)
16	Latched member
51	Lift driver (lift means)

52	Charger (charging means)
52B	First terminal
52C	Second terminal
53	Position detector (detection means)
61C	Slope
64	Hook (latch)
64B	Extension piece
64C	Latch recess
121	Wheel
F	Floor surface

Claims

1. An autonomous vacuum cleaner capable of cleaning while travelling along a floor surface, comprising:

a vacuum cleaner body including a cleaning means configured to suck up dirt and the like on the floor surface; and
a storage device for storing the vacuum cleaner body during non-cleaning time,

wherein

the storage device includes:

a latch configured to latch a part of one end side of the vacuum cleaner body; and
a lift means configured to raise and lower the latch, and
the autonomous vacuum cleaner is configured to be capable of storing the vacuum cleaner body in a standing state where the vacuum cleaner body is hoisted and the one end side is oriented upward, by causing the lift means to raise the latch latching the part of the vacuum cleaner body.

2. The vacuum cleaner body according to claim 1, wherein
the storage device includes a charging means for charging the vacuum cleaner body, and
the latch functions as a feeder terminal to feed power from the charging means to the vacuum cleaner body.

3. The autonomous vacuum cleaner according to claim 2, wherein
the charging means includes a power feeder capable of feeding power in contact with the latch, and
the power feeder is configured including: a first terminal capable of coming into contact with the latch at a latch position before hoisting the vacuum cleaner body; and a second terminal capable of coming into contact with the latch at a storage position after hoisting the vacuum cleaner body.

4. The autonomous vacuum cleaner according to any of claims 1 to 3, wherein
the storage device includes a detection means configured to detect whether or not the vacuum cleaner body is at a predetermined hoistable position, and
on the basis of the detection by the detection means, the lift means keeps the latch down at a retracted position until the vacuum cleaner body comes to the predetermined position, and raises the latch to the latch position upon the vacuum cleaner body coming to the predetermined position.

5. The autonomous vacuum cleaner according to any of claims 1 to 4, wherein the lift means raises and lowers the latch along a backward and upward inclined direction with respect to the vacuum cleaner body.

6. The autonomous vacuum cleaner according to any of claims 1 to 5, wherein the storage device includes a slope configured to guide the one end side of the vacuum cleaner body obliquely upward before the vacuum cleaner body comes to the predetermined hoistable position.

7. The autonomous vacuum cleaner according to any of claims 1 to 6, wherein
the latch includes an extension piece extending toward the vacuum cleaner body,
a latch recess recessed in an arc shape is formed in a top surface of the extension piece, and
the part of the vacuum cleaner body is provided with a latched member formed into a columnar shape with a smaller diameter than that of the latch recess, the latched member being configured to be latched in the latch recess.

8. The autonomous vacuum cleaner according to any of claims 1 to 7, wherein at least one of the vacuum cleaner body and the storage device is provided with a guide means configured to roll or slide and guide the other end side of the vacuum cleaner body midway through the hoist.

FIG. 1

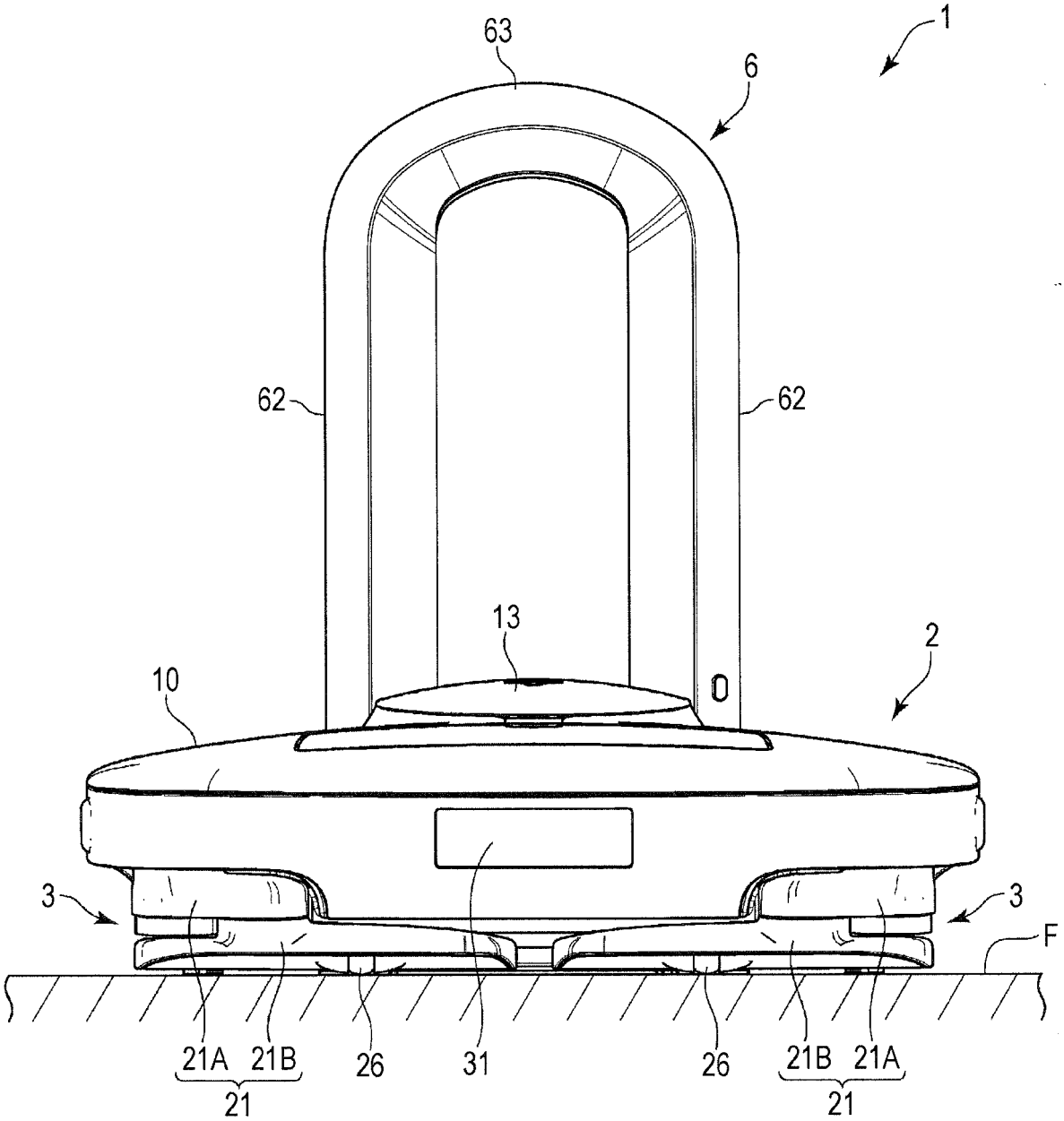


FIG. 2

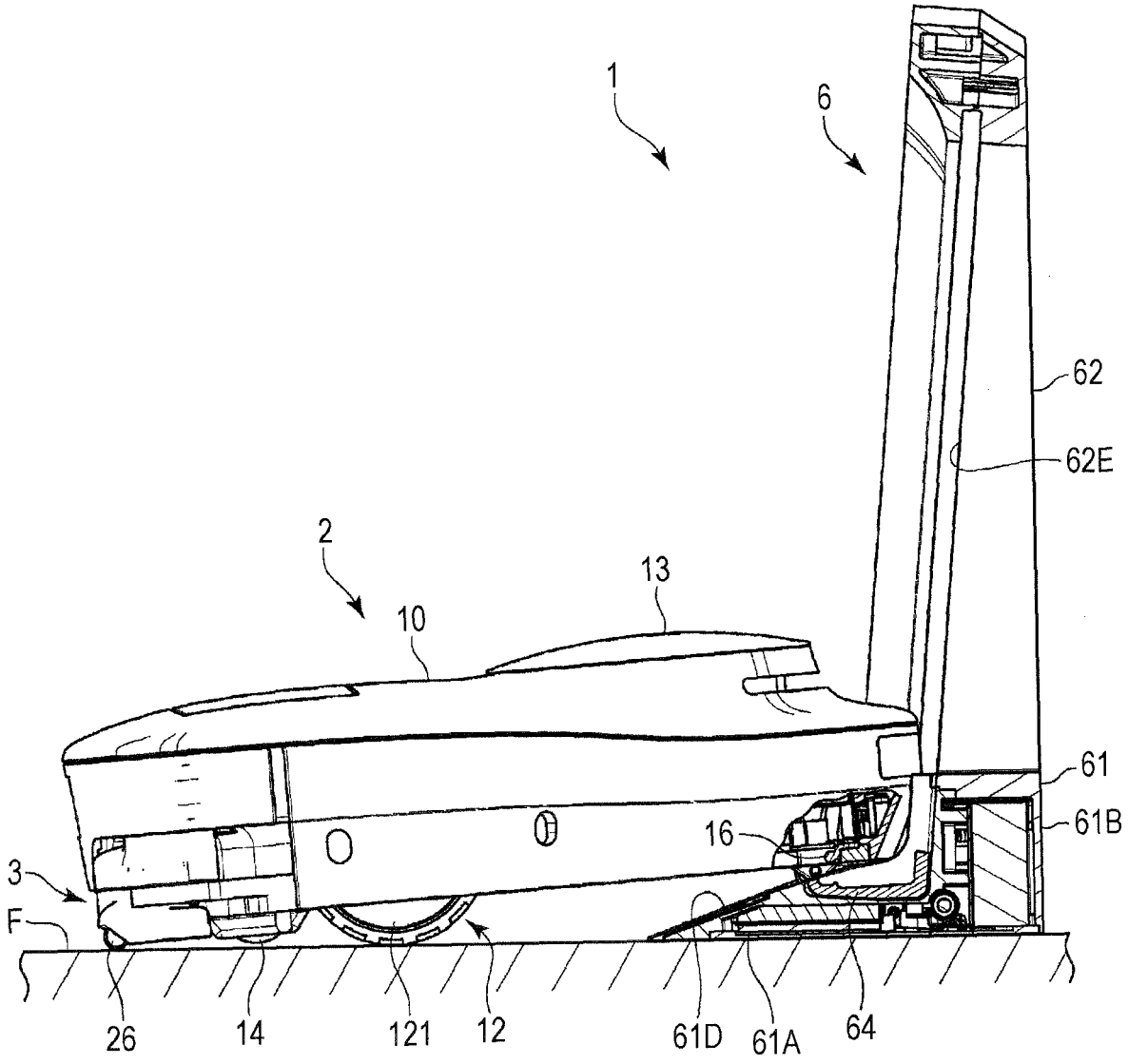


FIG. 3

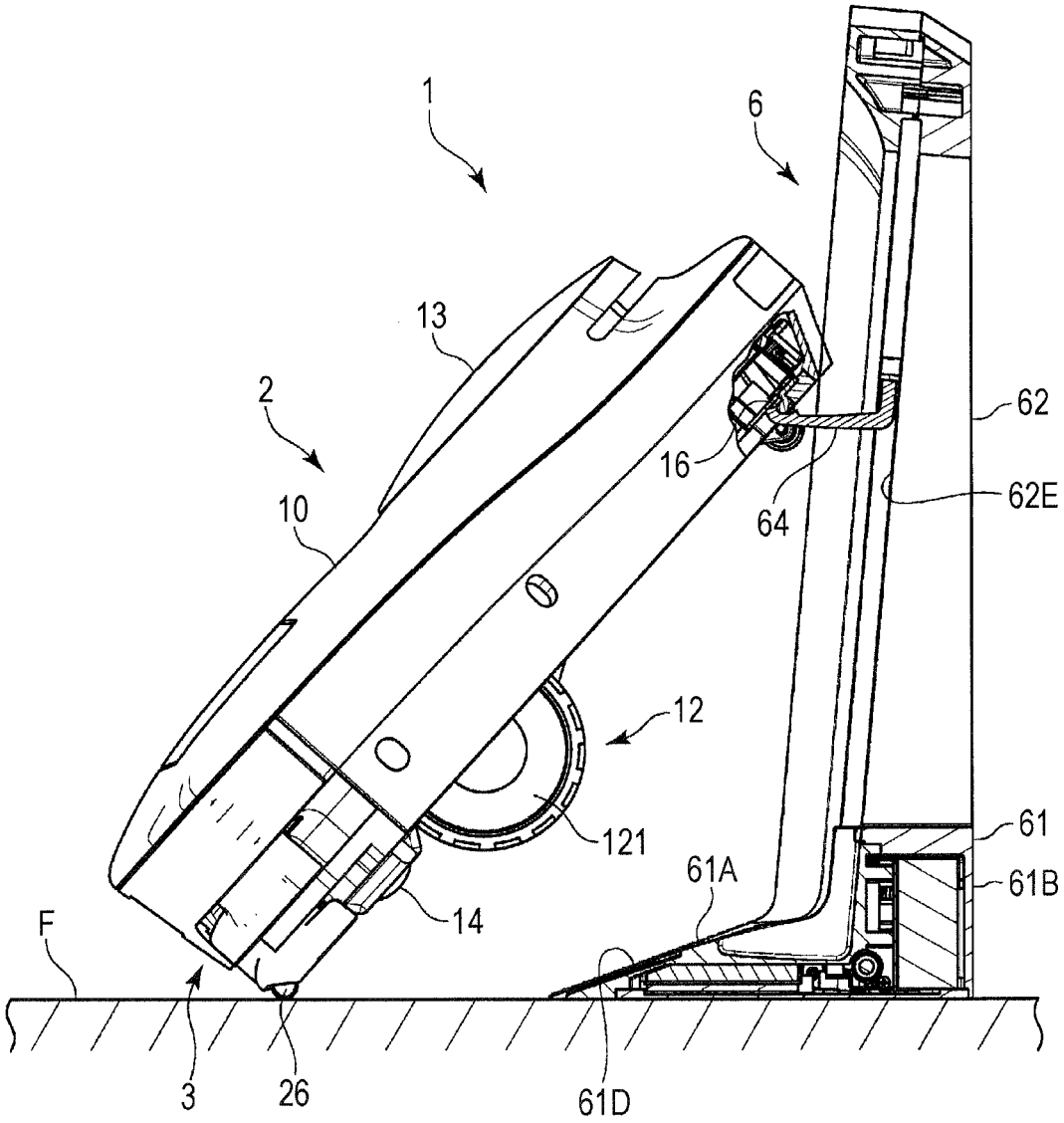


FIG. 4

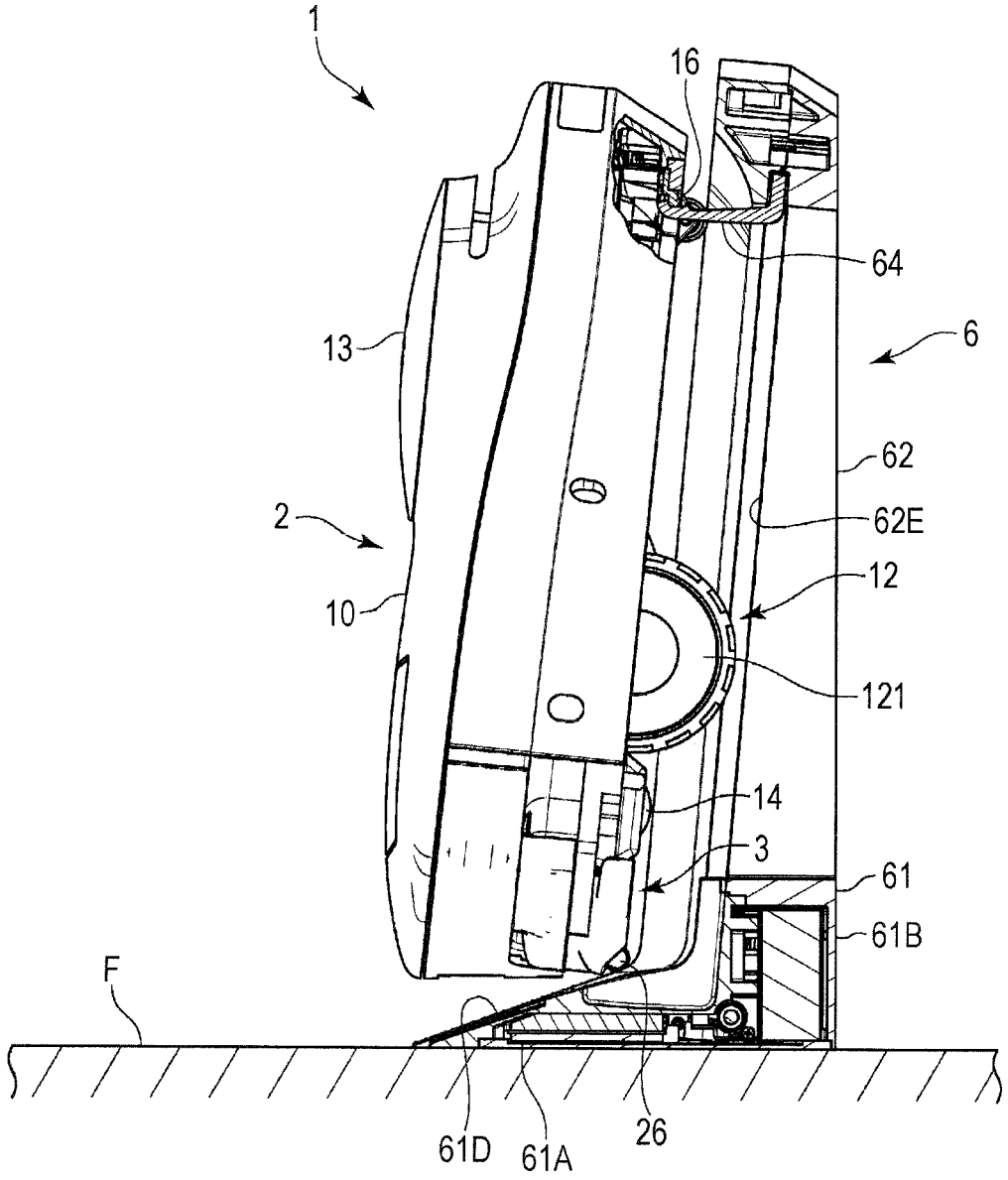


FIG. 5

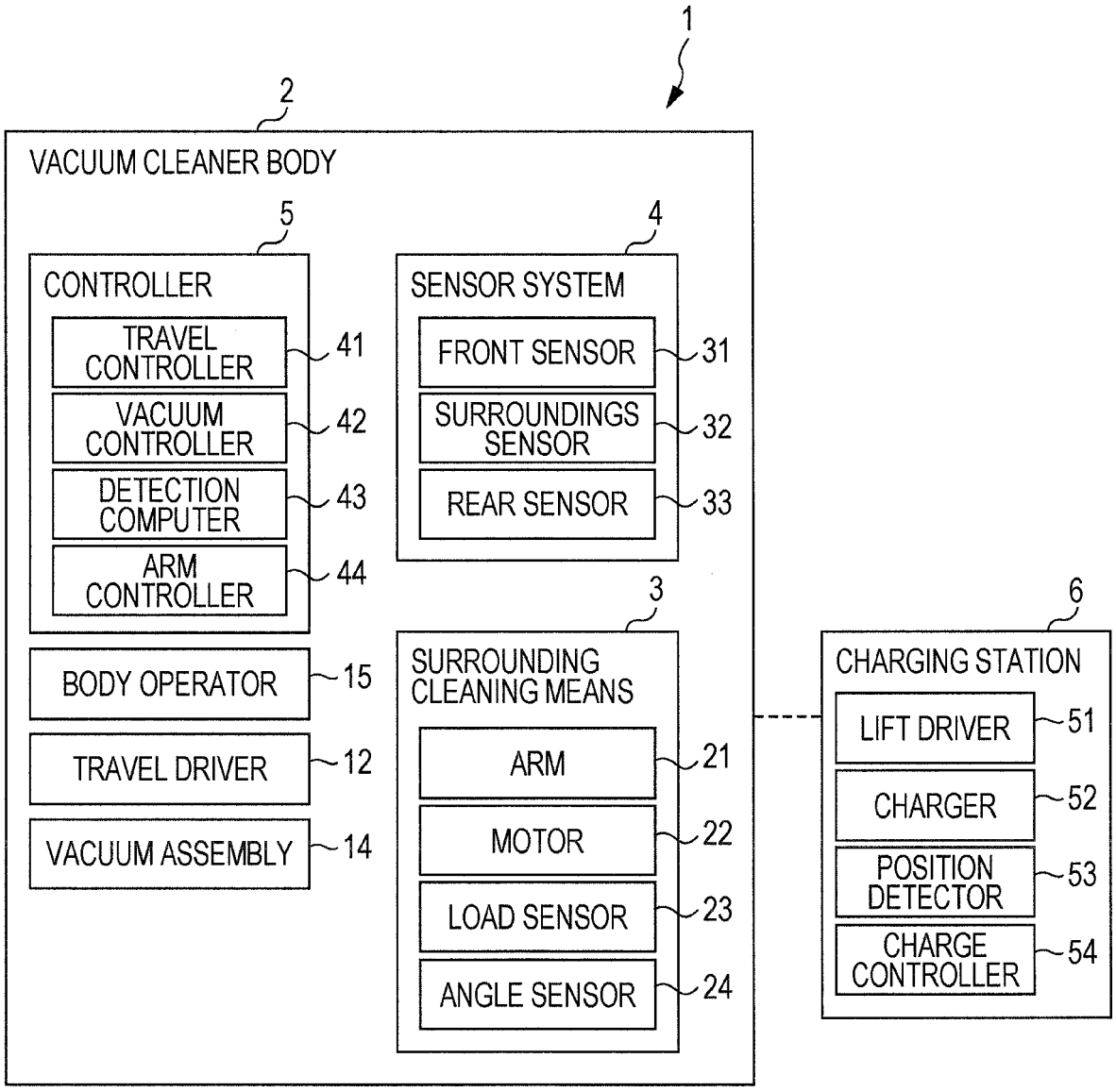
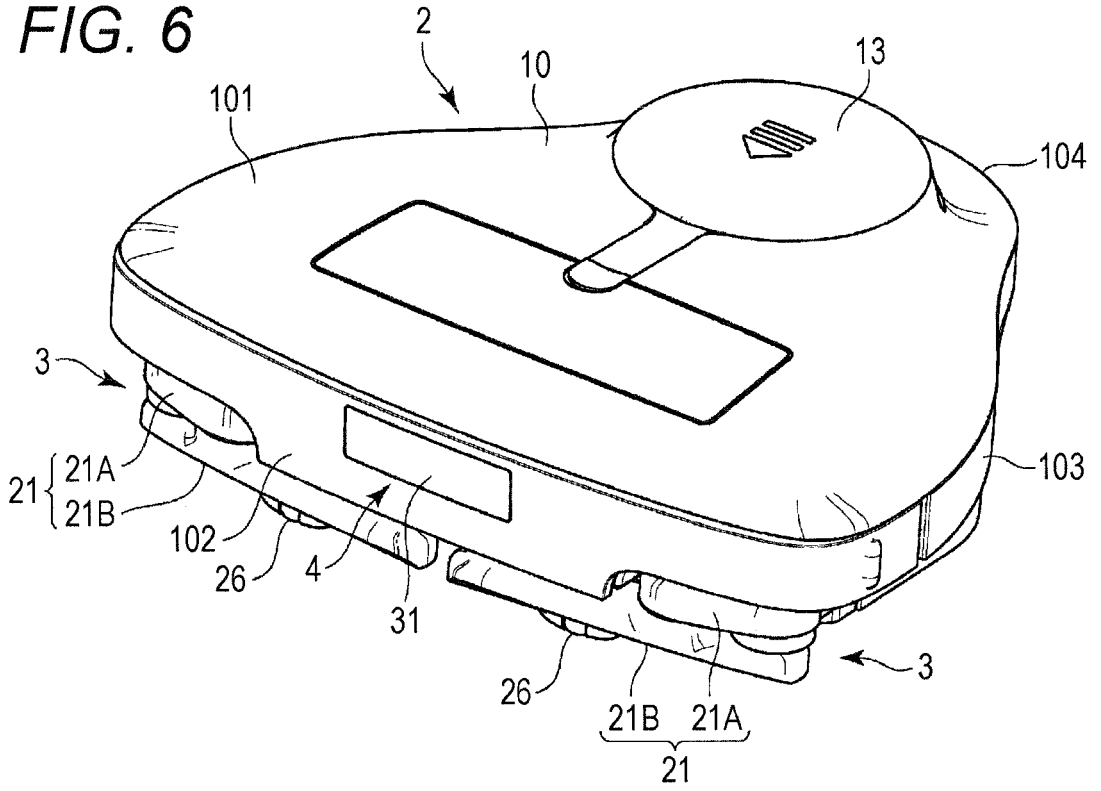

1
2
VACUUM CLEANER BODY
5
CONTROLLER
TRAVEL CONTROLLER
41
VACUUM CONTROLLER
42
DETECTION COMPUTER
43
ARM CONTROLLER
44
BODY OPERATOR
15
TRAVEL DRIVER
12
VACUUM ASSEMBLY
14
4
SENSOR SYSTEM
FRONT SENSOR
31
SURROUNDINGS SENSOR
32
REAR SENSOR
33
3
SURROUNDING CLEANING MEANS
ARM
21
MOTOR
22
LOAD SENSOR
23
ANGLE SENSOR
24
6
CHARGING STATION
LIFT DRIVER
51
CHARGER
52
POSITION DETECTOR
53
CHARGE CONTROLLER
54

FIG. 6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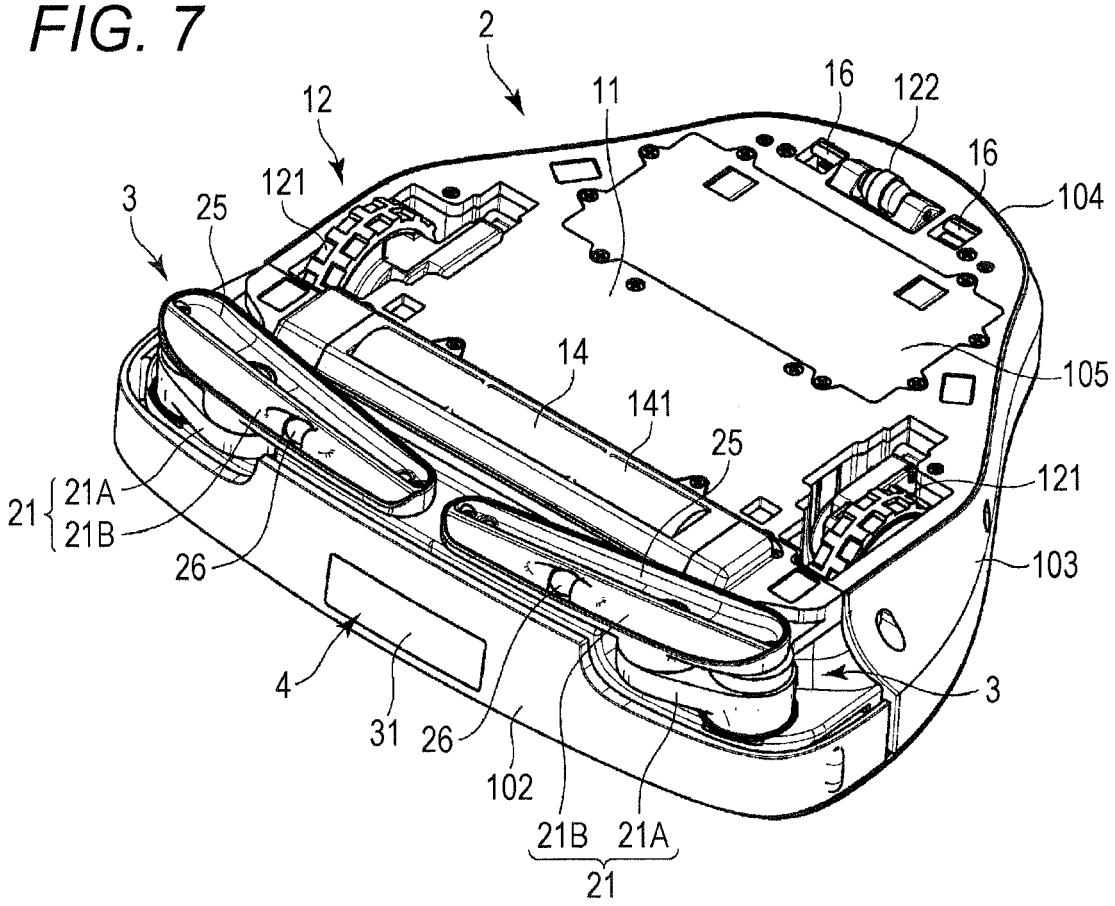
101
104
3
21
21A
21B
102
26
4
31
103
26
3
21B
21A
21

FIG. 7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26
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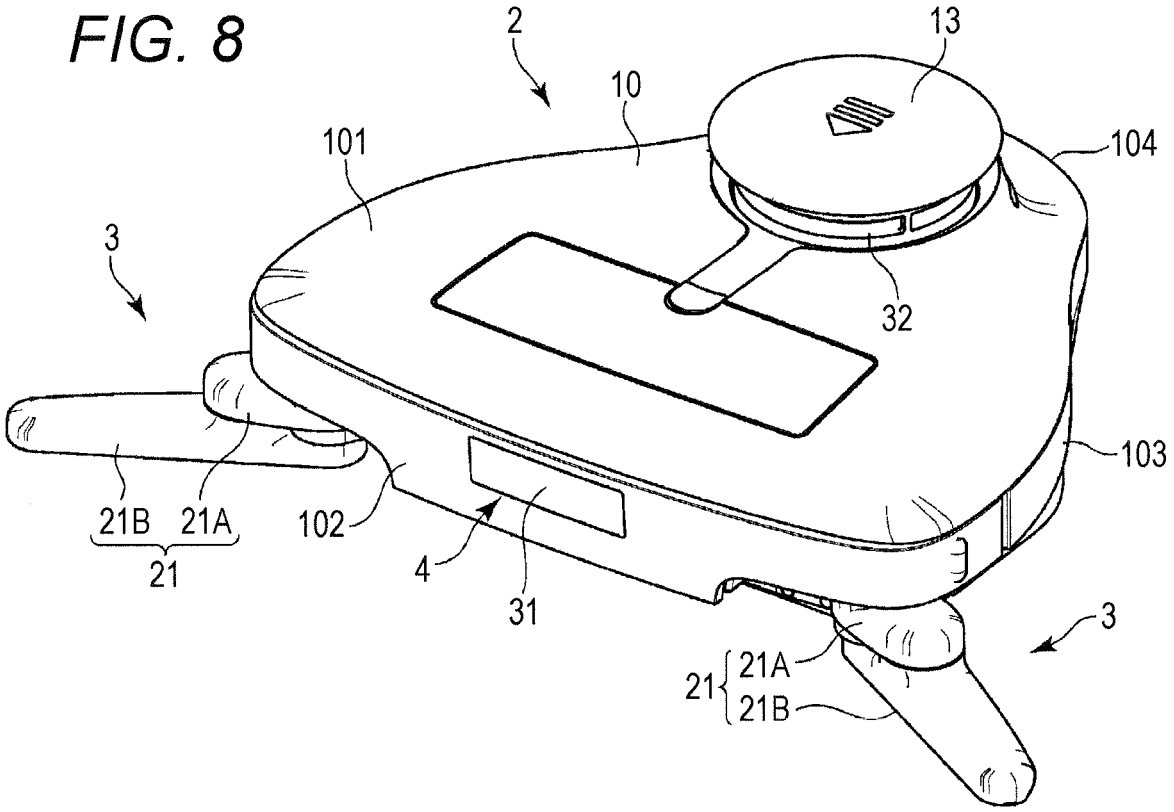
21B
21A
21

FIG. 8


2
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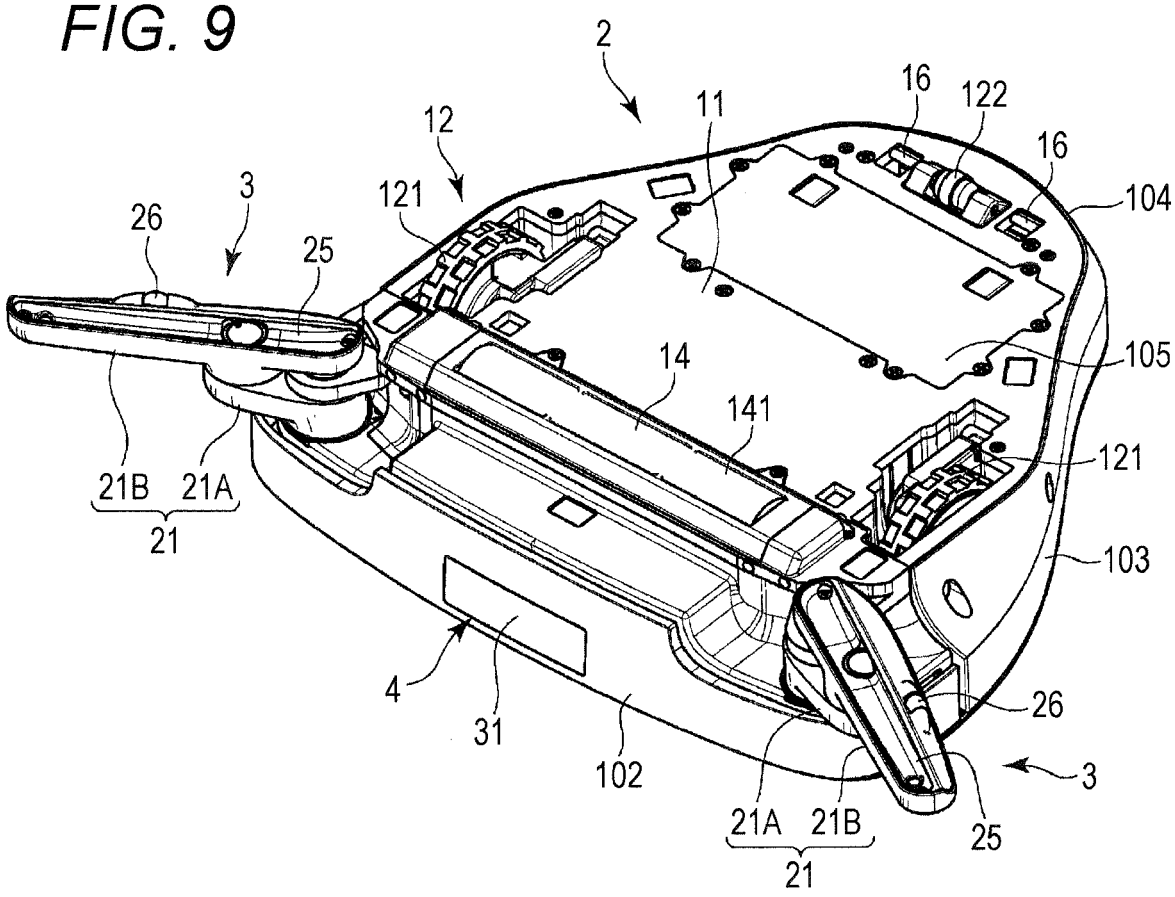
21A
21B

FIG. 9


2
16
122
11
12
16
3
121
104
26
25
105
14
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21B
21A
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31
102
3
21A
21B
25
21

FIG. 10

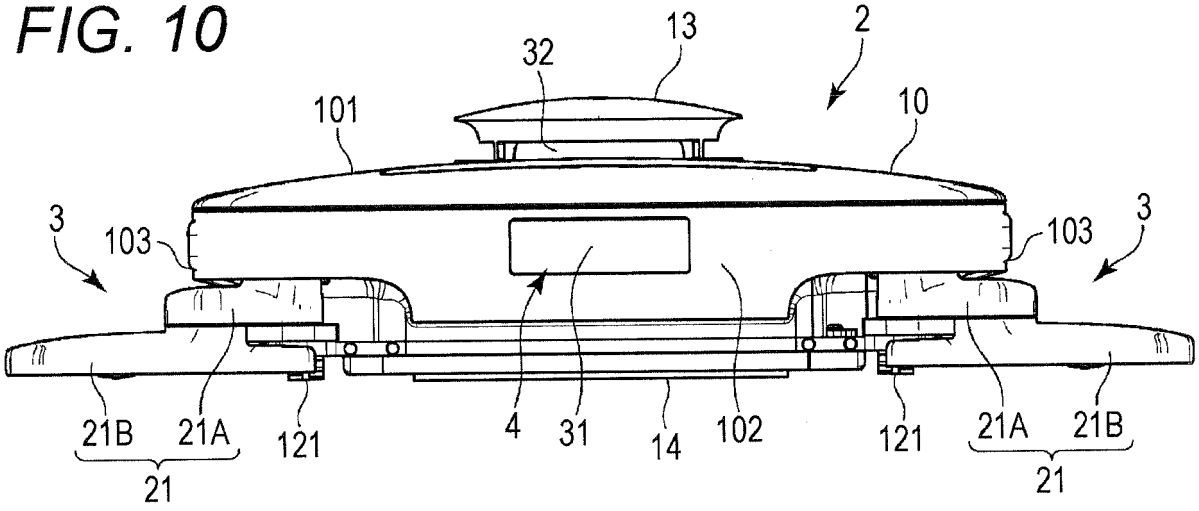


FIG. 11

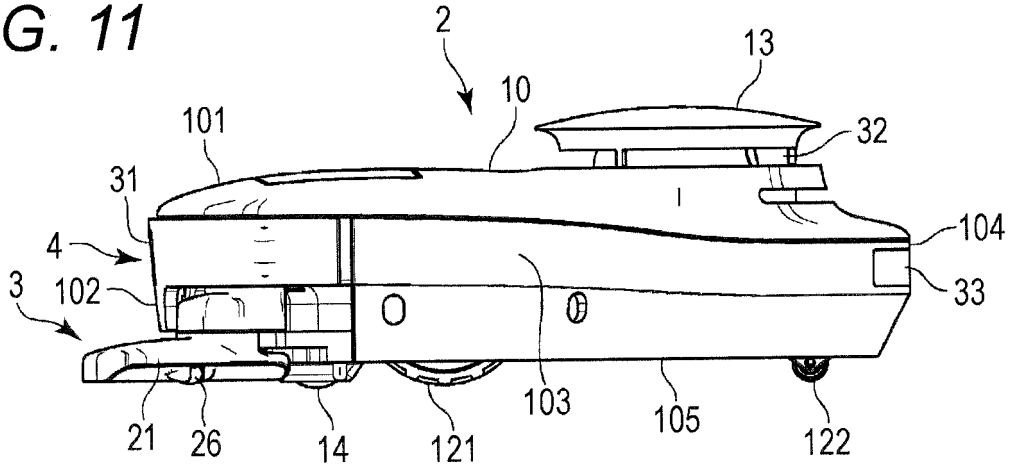


FIG. 12

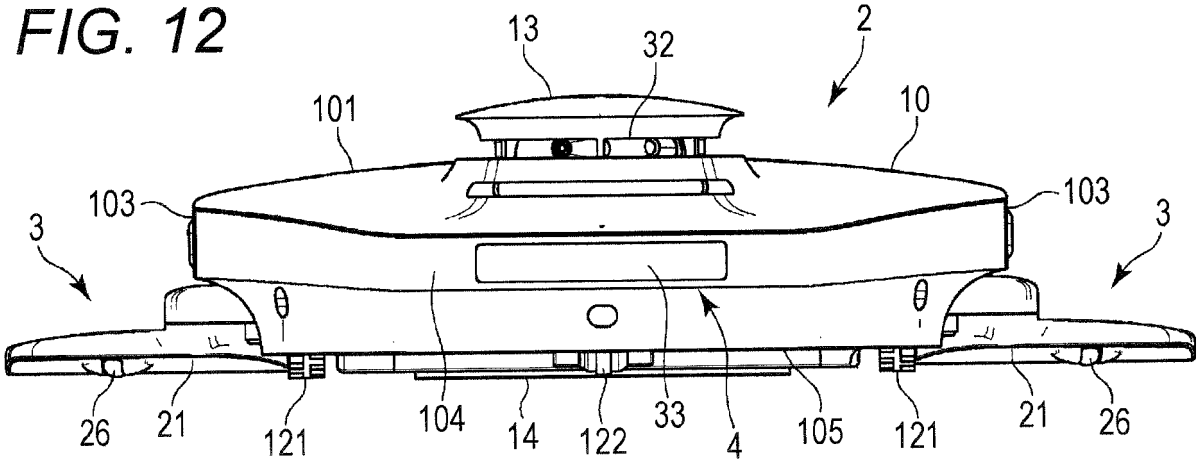


FIG. 13

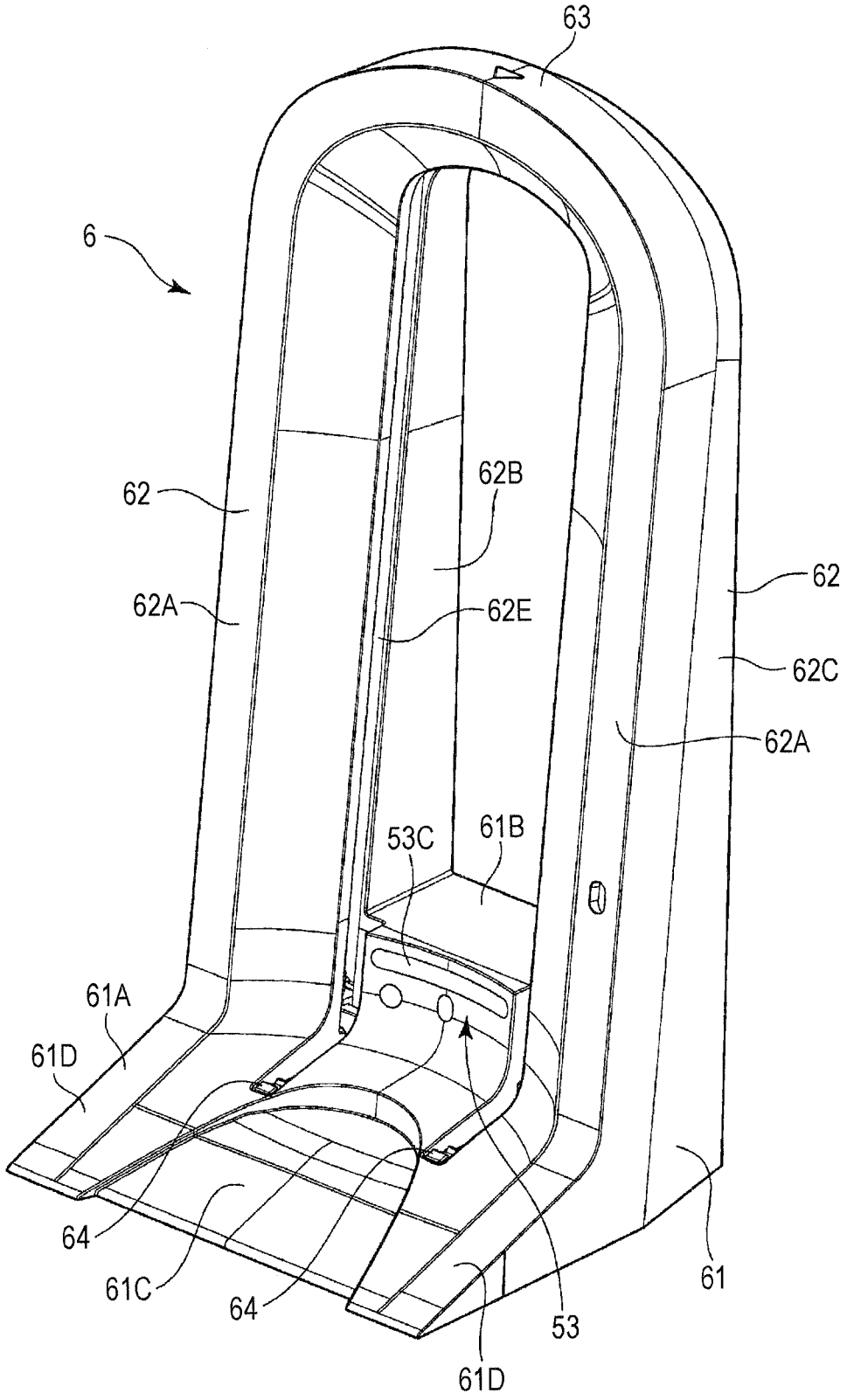


FIG. 14

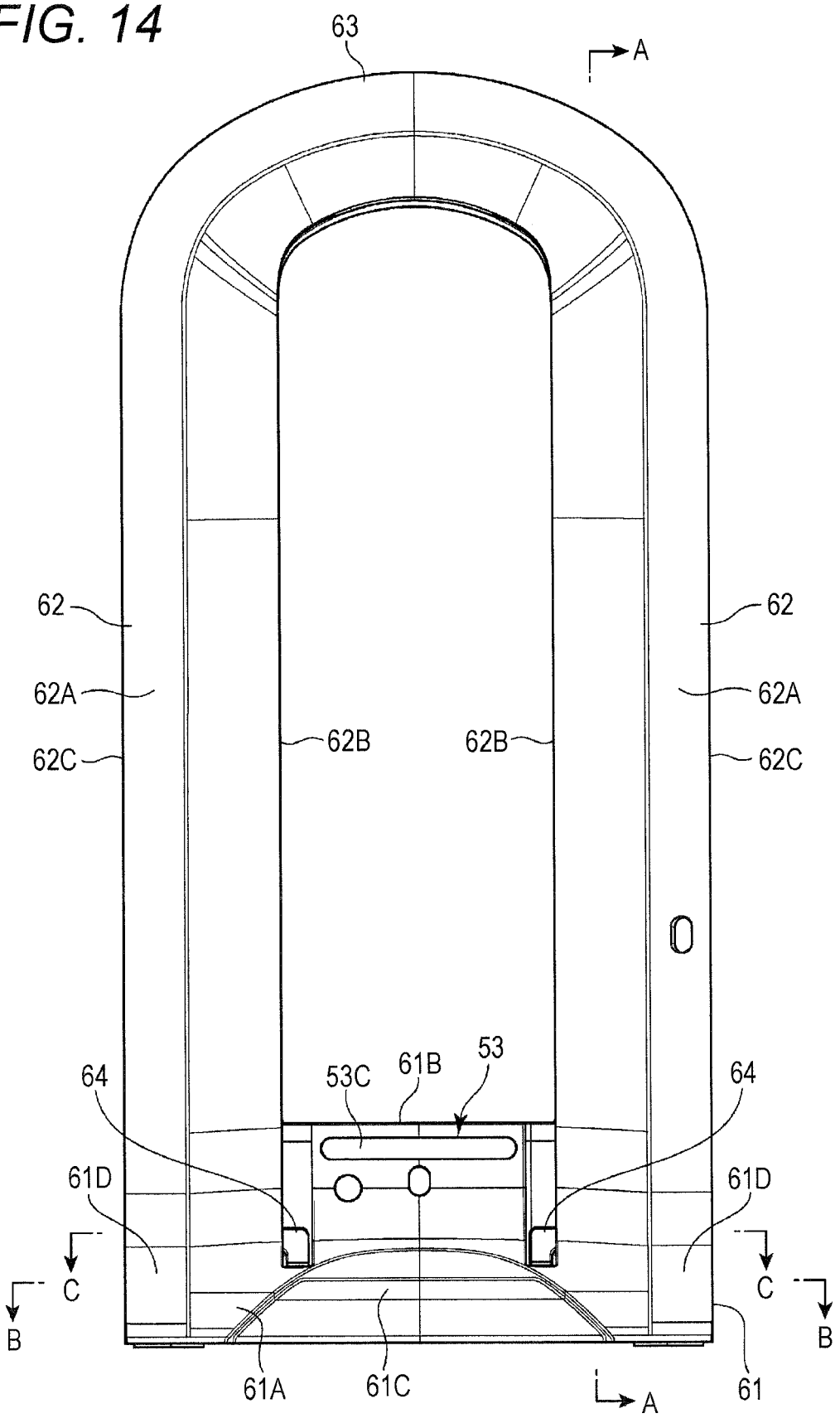

63
A
62
62A
62C
62B
62B
62
62A
62C
64
53C
61B
53
64
61D
61D
C
C
B
B
61A
61C
A
61

FIG. 15

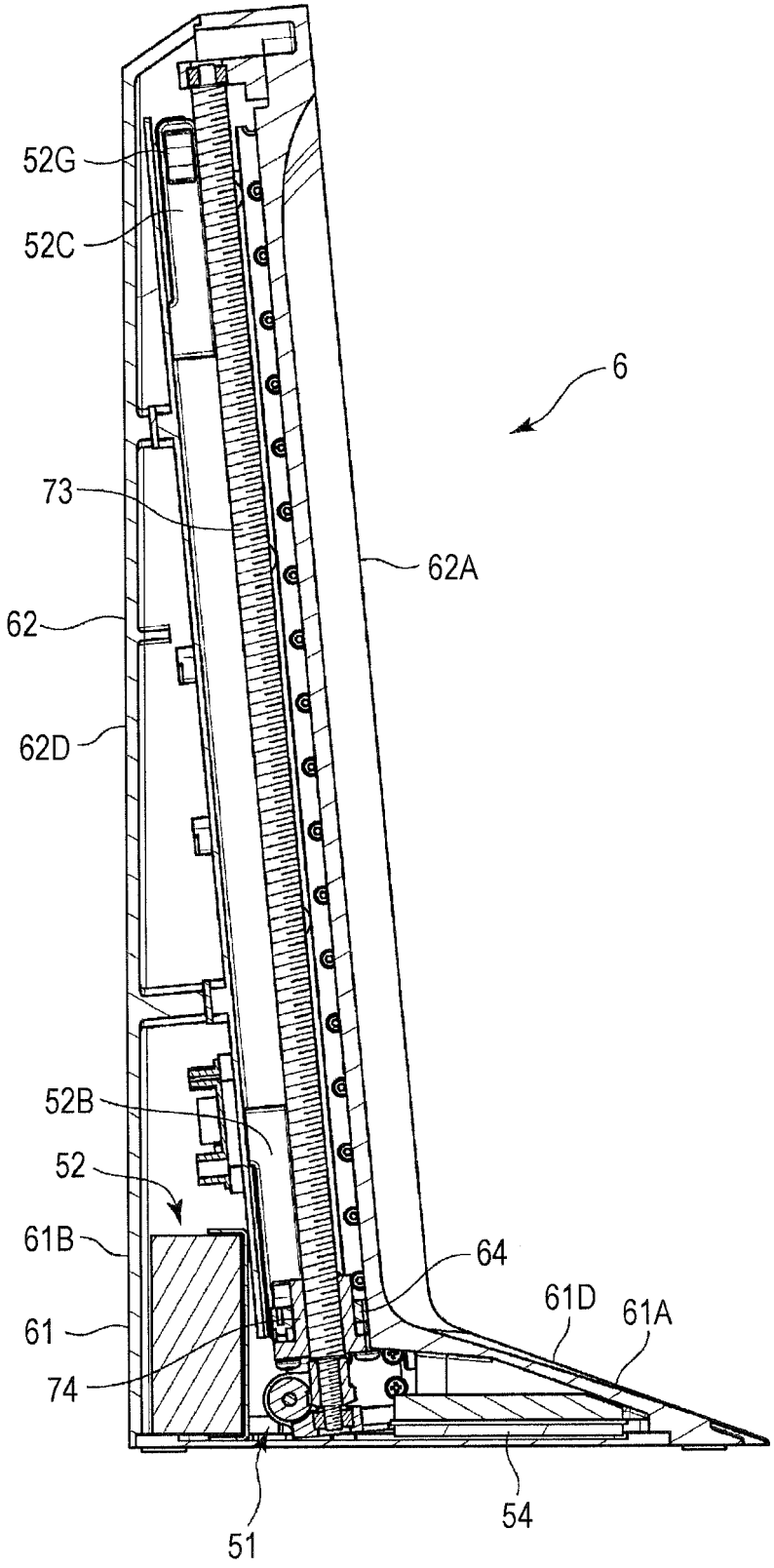


FIG. 16

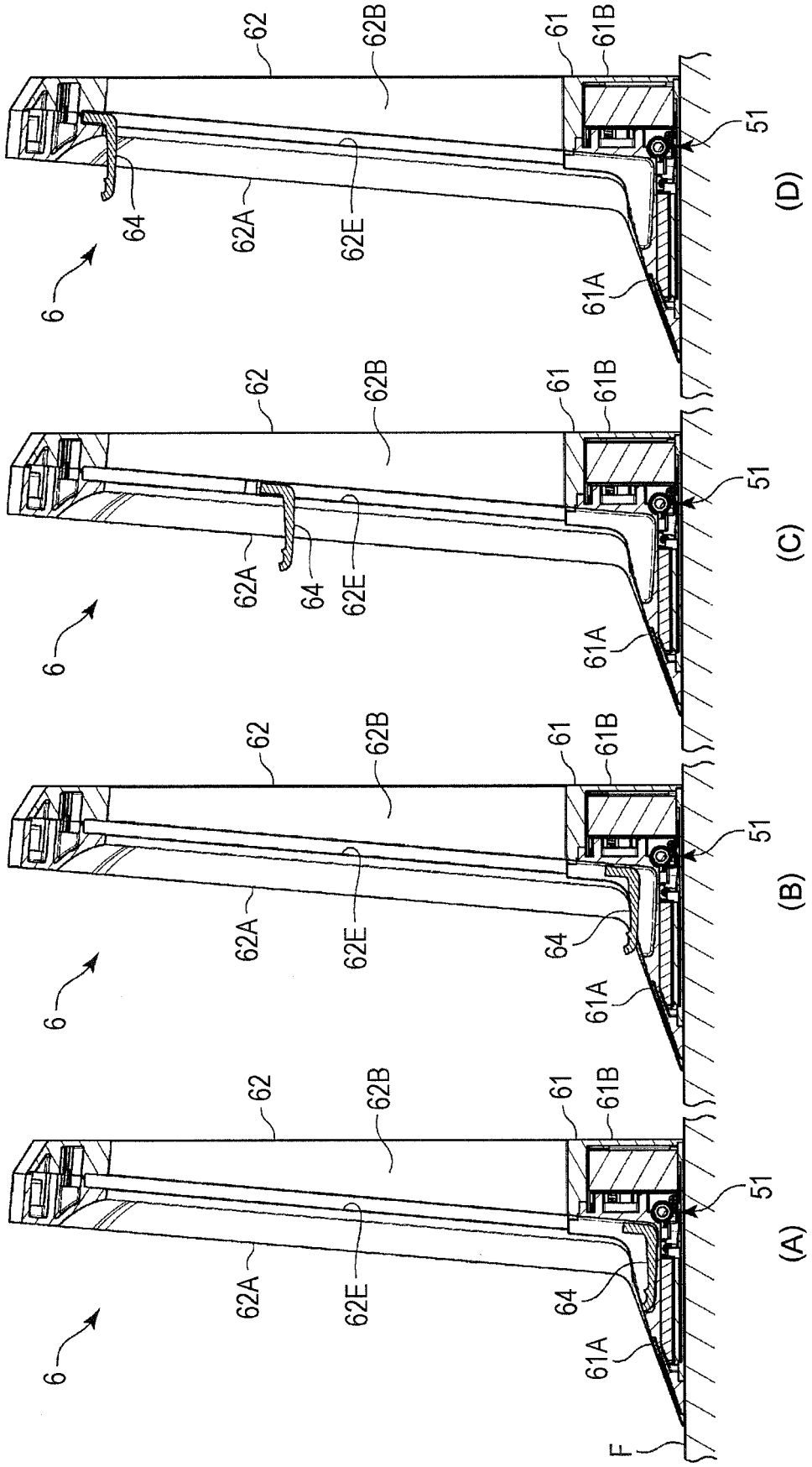
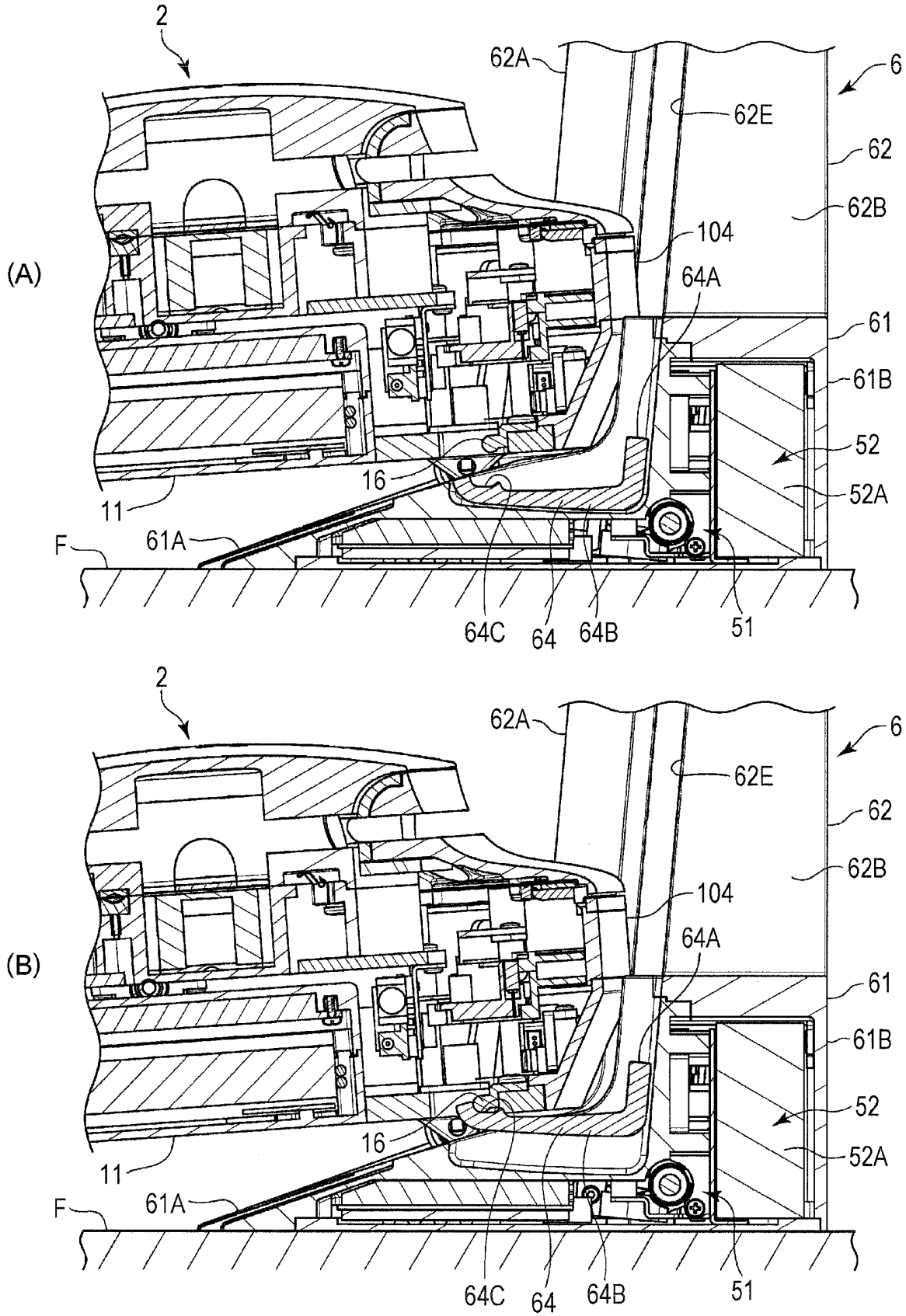


FIG. 17


(A)
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62A
6
62E
62
62B
104
64A
61
61B
52
52A
16
11
61A
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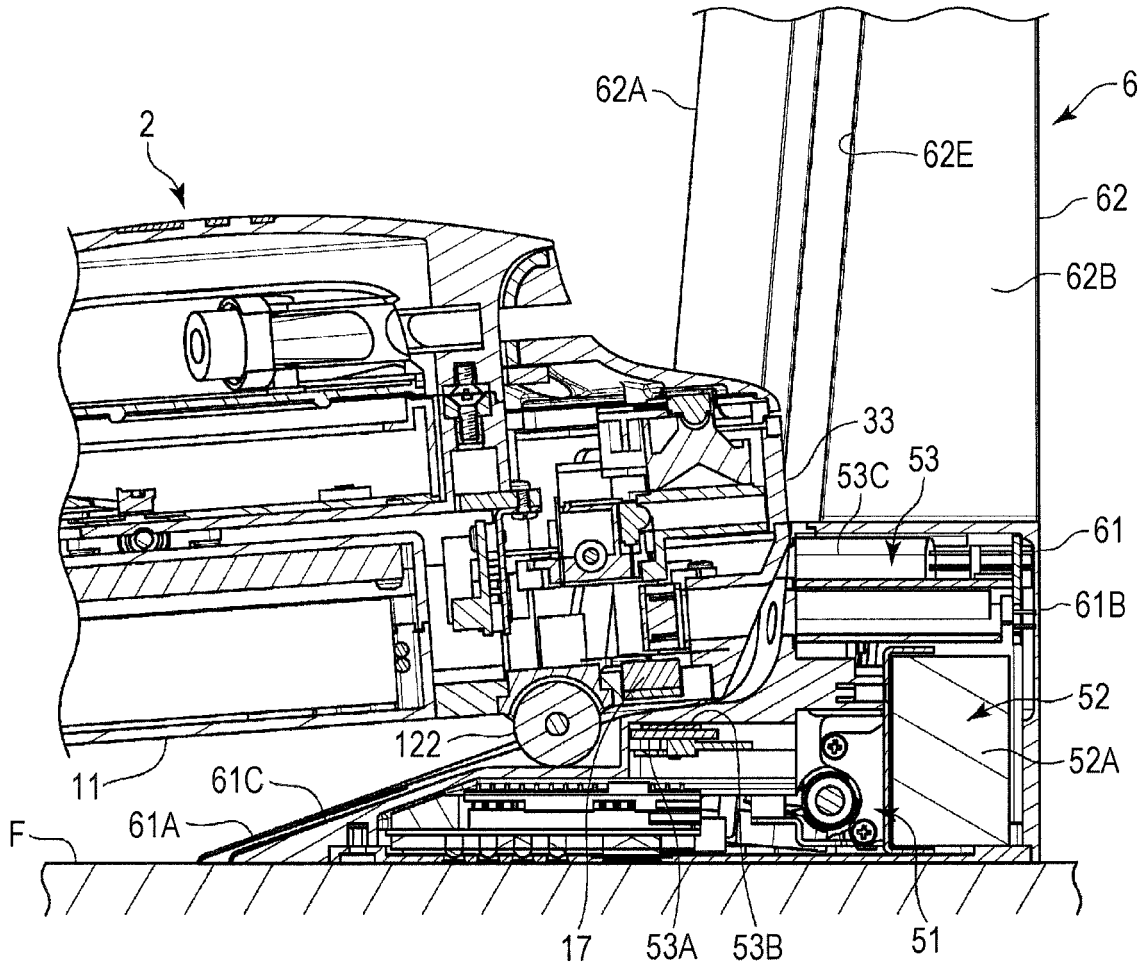
64C
64
64B
51
(B)
2
62A
6
62E
62
62B
104
64A
61
61B
52
52A
16
11
61A
F
64C
64
64B
51

FIG. 18


62A
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62E
62
62B
33
53C
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61
61B
52
52A
122
11
61C
61A
F
17
53A
53B
51

FIG. 19

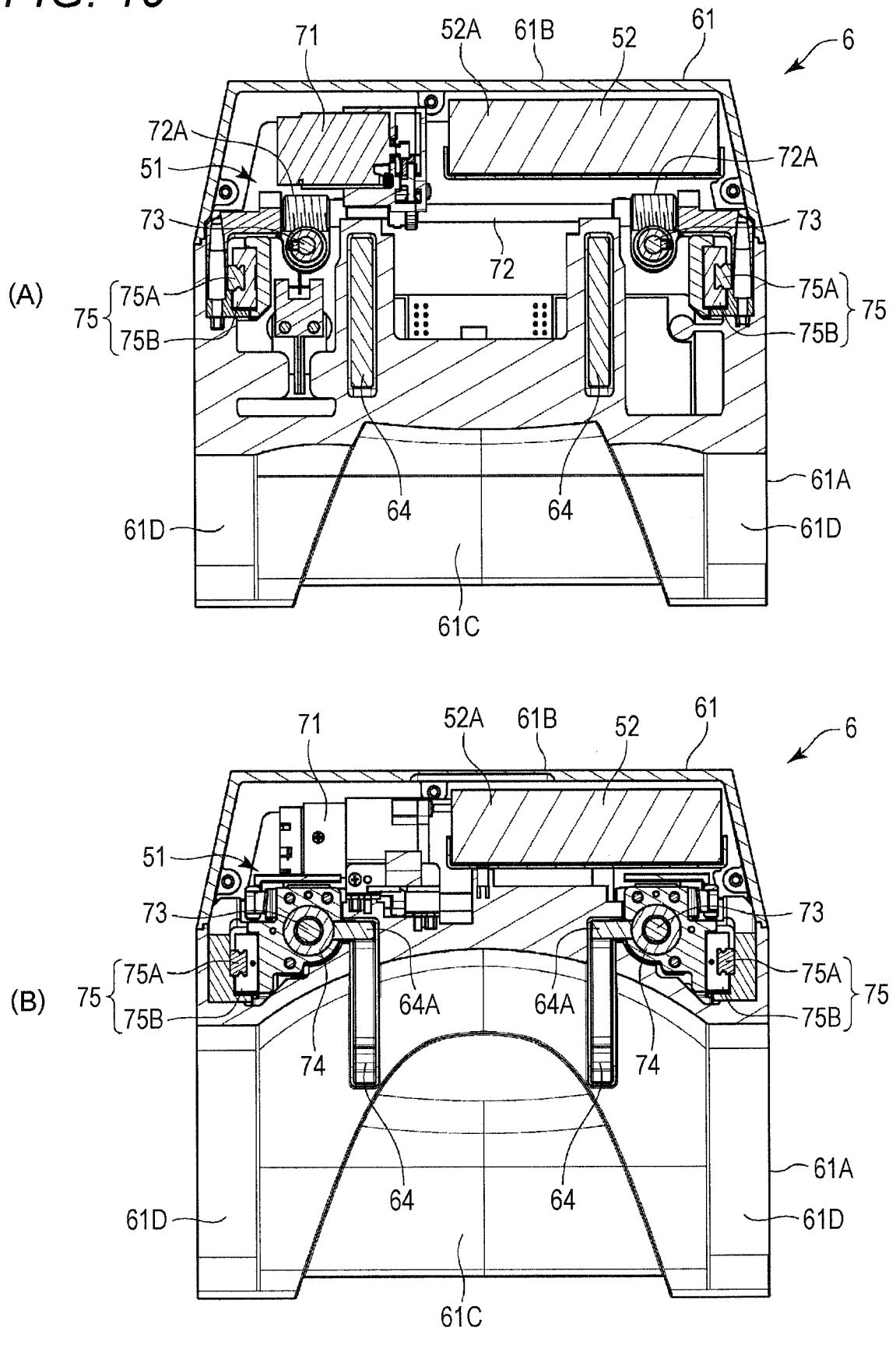
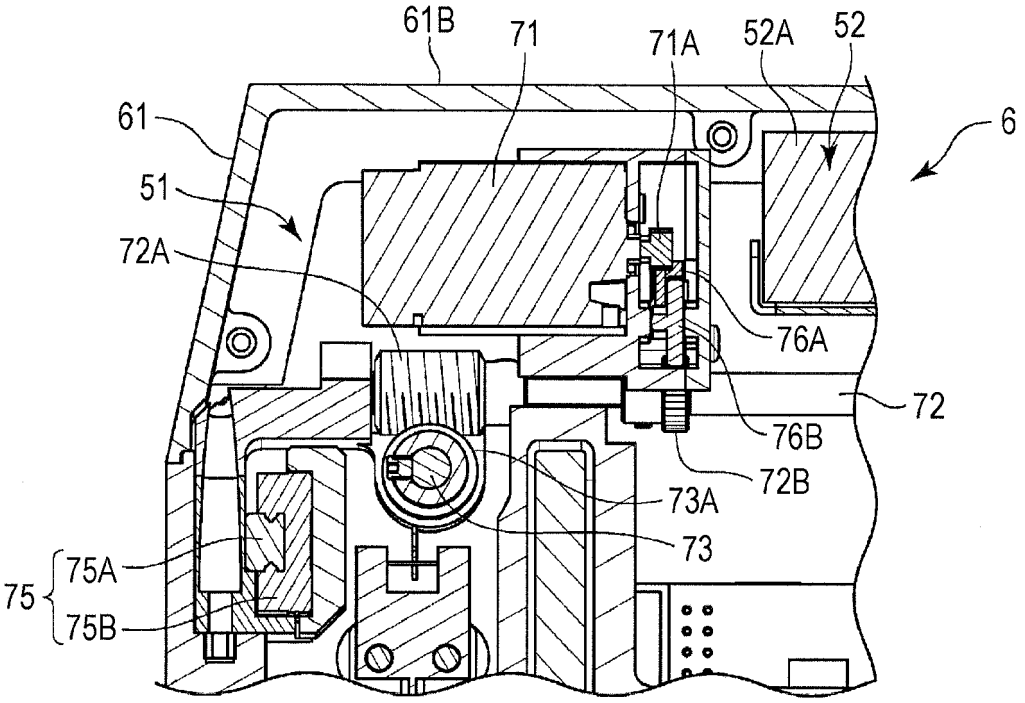


FIG. 20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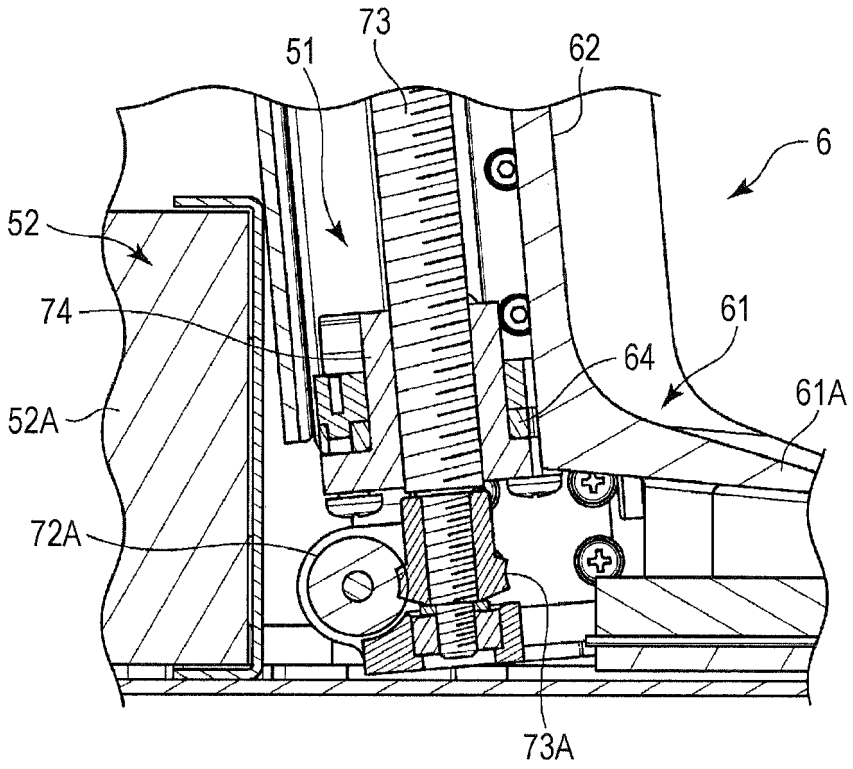
71
71A
52A
52
6
61
51
72A
76A
72
76B
72B
73A
73
75
75A
75B

FIG. 21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51
62
6
52
74
61
64
61A
52A
72A
73A

FIG. 22

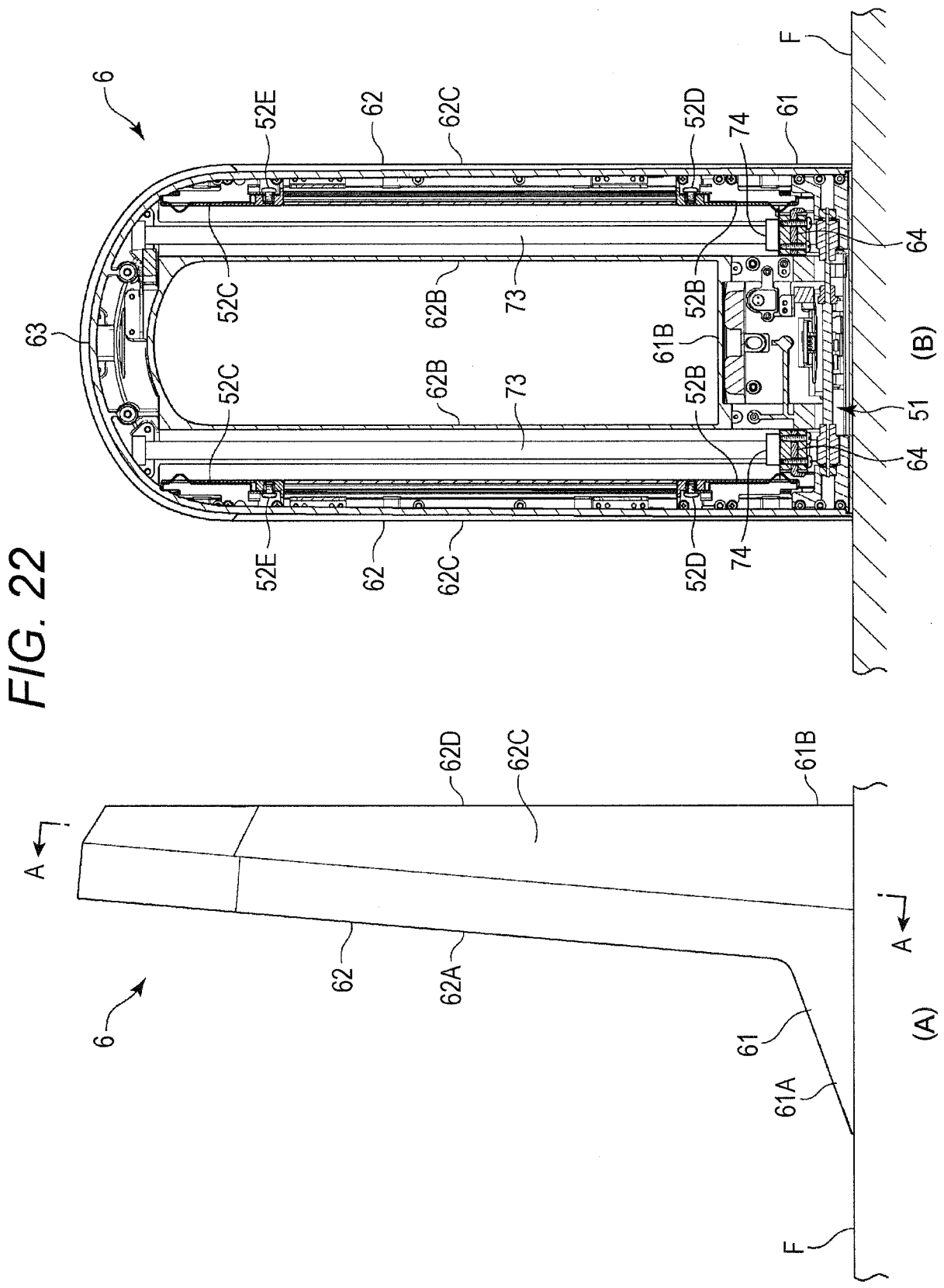

6
52E
62
62C
52D
74
61
F
64
63
52C
62B
73
61B
52B
51
(B)
62D
61B
A
62A
61
61A
(A)

FIG. 23

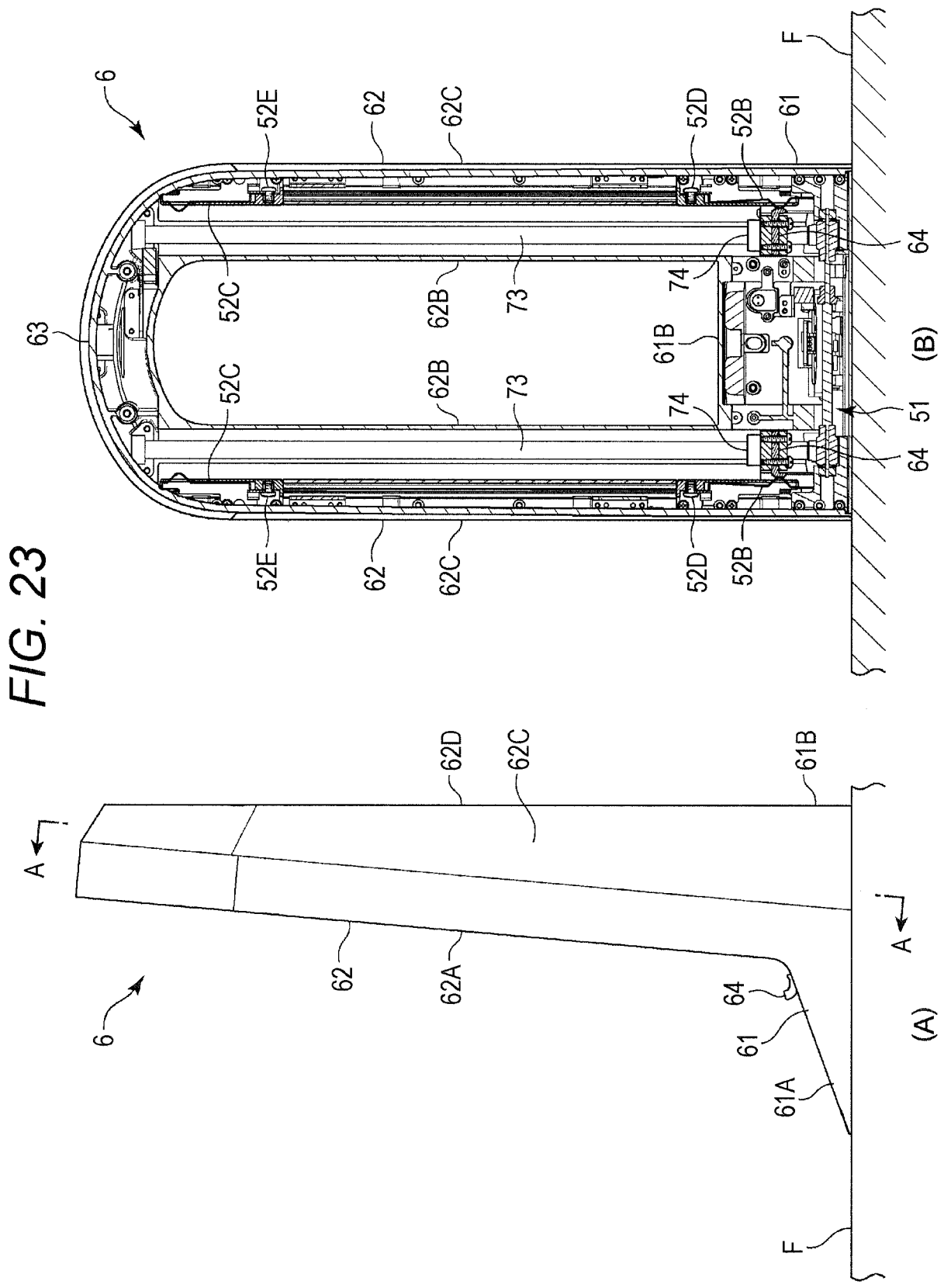

6
52E
62
62C
52D
52B
61
F
64
63
52C
62B
73
74
61B
51
(B)
62D
61B
A
62A
61
61A
(A)

FIG. 24

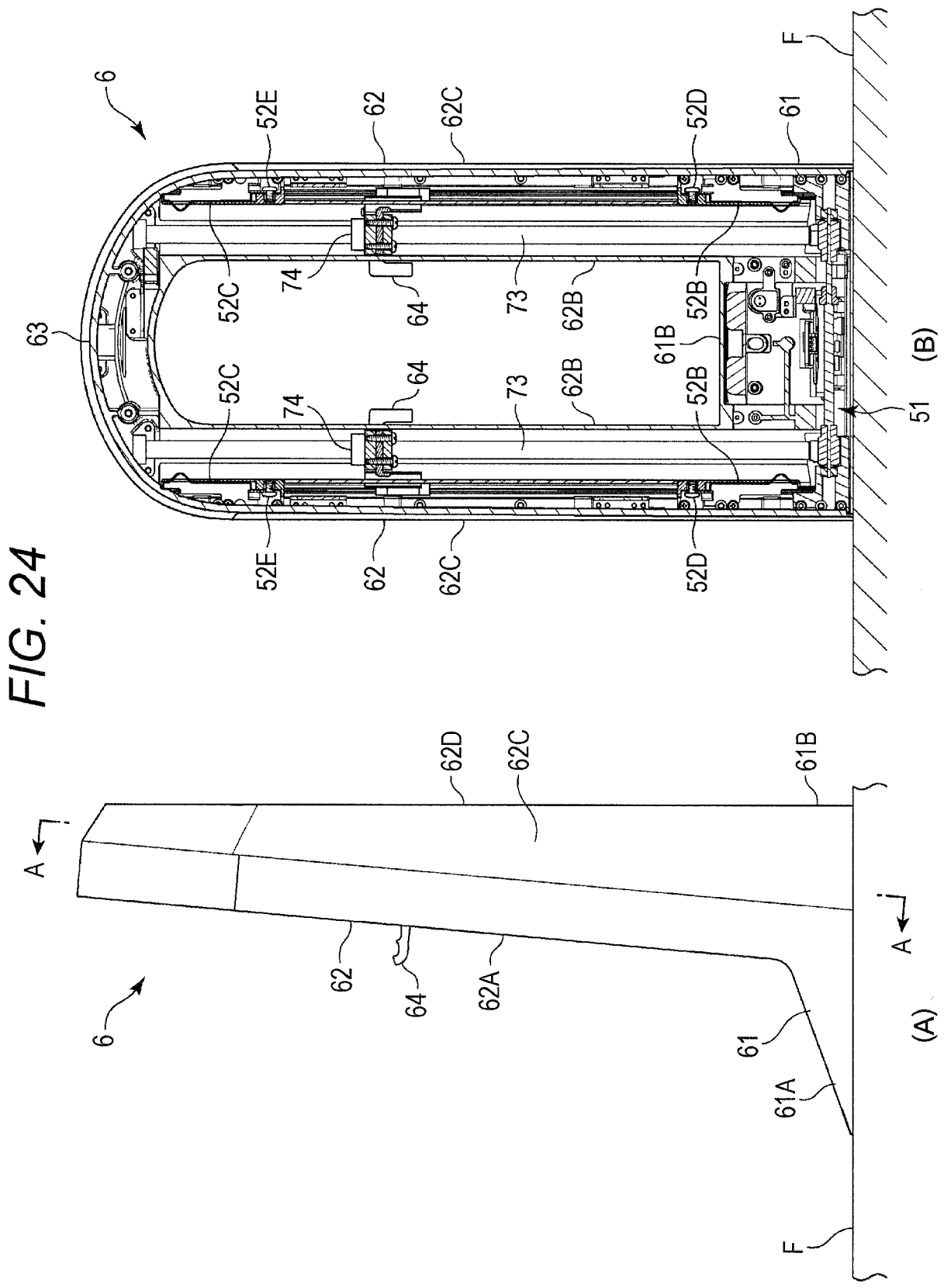

6
52E
62
62C
52D
61
F
63
52C
74
64
73
62B
61B
52B
51
(B)
62D
61B
A
62
64
62A
61
61A
(A)

FIG. 25

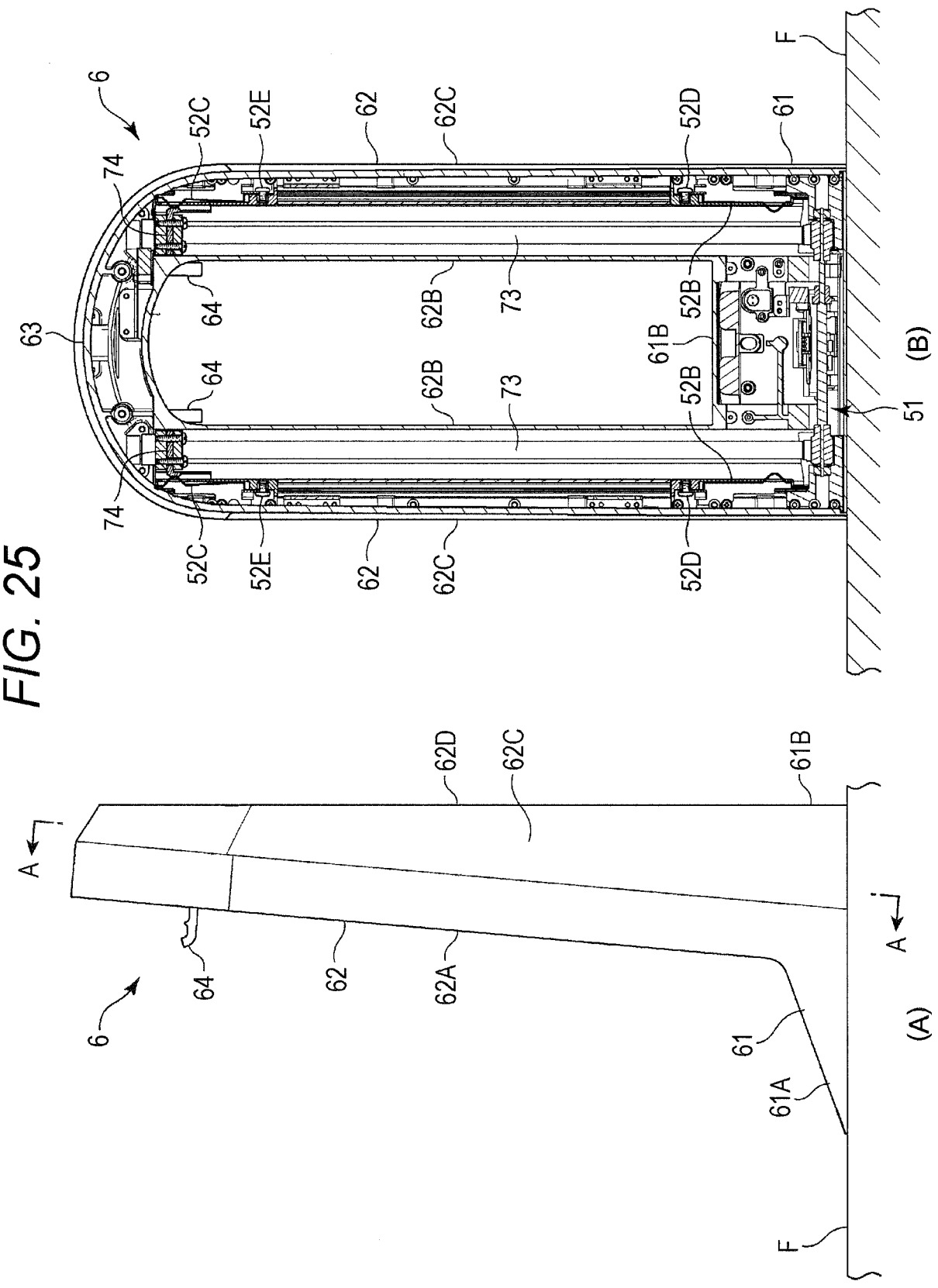
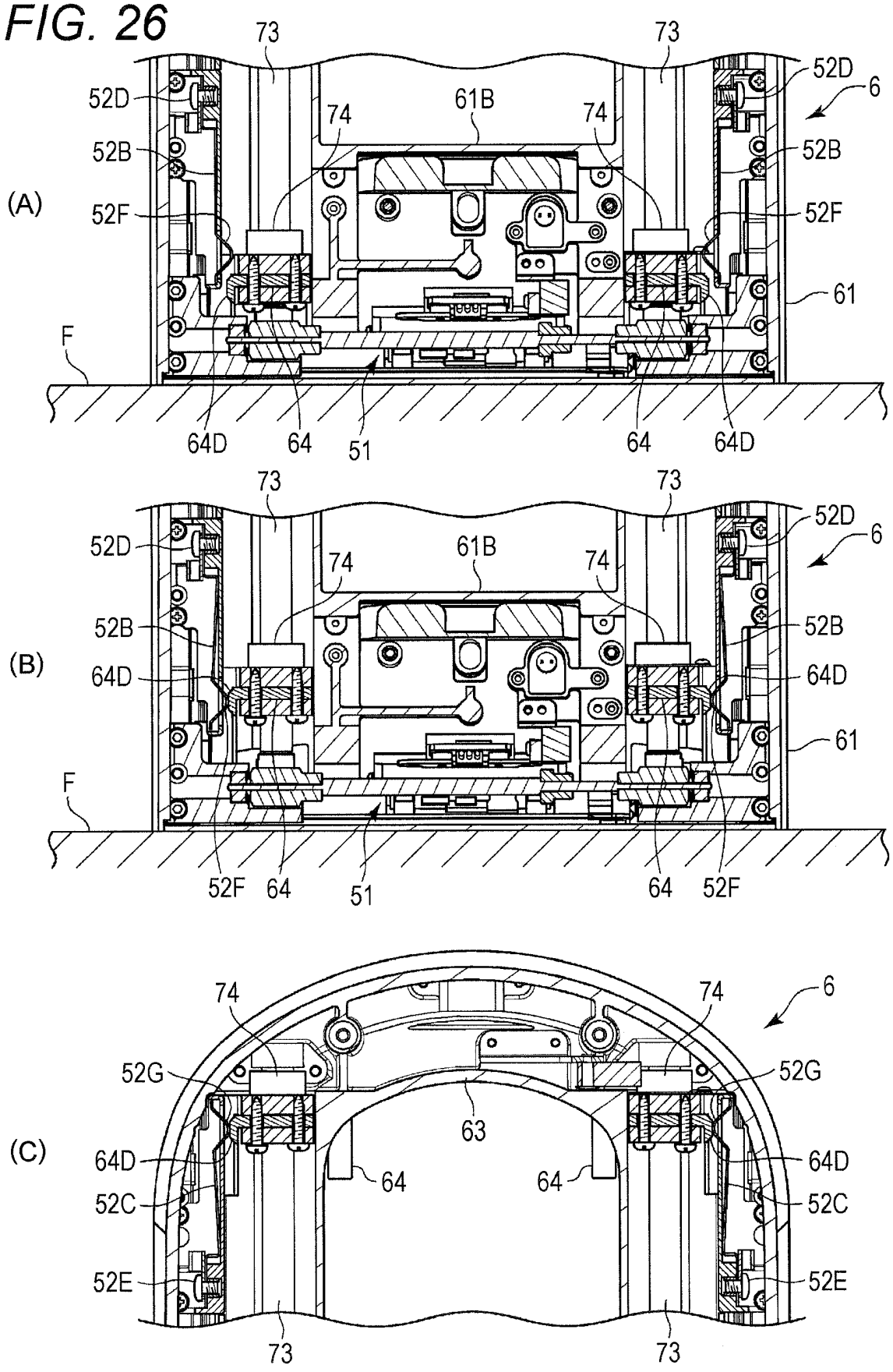

6
52C
52E
62
62C
52D
61
74
63
64
62B
73
61B
52B
F
51
(B)
62D
61B
A
64
62
62A
61
61A
(A)

FIG. 26


(A)
73
73
52D
52D
6
74
61B
74
52B
52B
52F
52F
61
F
64D
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64
64D
(B)
73
73
52D
52D
6
74
61B
74
52B
52B
64D
64D
61
F
52F
64
51
64
52F
(C)
74
74
6
52G
52G
63
64D
64
64
64D
52C
52C
52E
52E
73
73

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2017/033010

A. CLASSIFICATION OF SUBJECT MATTER
Int. Cl. A47L9/28(2006.01)i

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
Int. Cl. A47L9/28

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
Published examined utility model applications of Japan 1922-1996
Published unexamined utility model applications of Japan 1971-2017
Registered utility model specifications of Japan 1996-2017
Published registered utility model applications of Japan 1994-2017

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X A	JP 2007-319447 A (MATSUSHITA ELECTRIC INDUSTRIAL CO., LTD.) 13 December 2007, paragraphs [0027]-[0030], fig. 5 (Family: none)	1-2, 5 3-4, 6-8
A	JP 2016-108132 A (HITACHI BUILDING SYSTEMS CO., LTD.) 20 June 2016, entire text, all drawings (Family: none)	1-8

☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

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"P" document published prior to the international filing date but later than the priority date claimed
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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
28.11.2017	12.12.2017
Name and mailing address of the ISA/ Japan Patent Office 3-4-3, Kasumigaseki, Chiyoda-ku, Tokyo 100-8915, Japan	Authorized officer Telephone No.

Form PCT/ISA/210 (second sheet) (January 2015)

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Patent documents cited in the description

- JP 2014188062 A **[0003]**