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(72) Inventor: **SUGAHARA, Masayuki**
Tokyo 100-8310 (JP)

(71) Applicant: **Mitsubishi Electric Corporation**
Tokyo 100-8310 (JP)

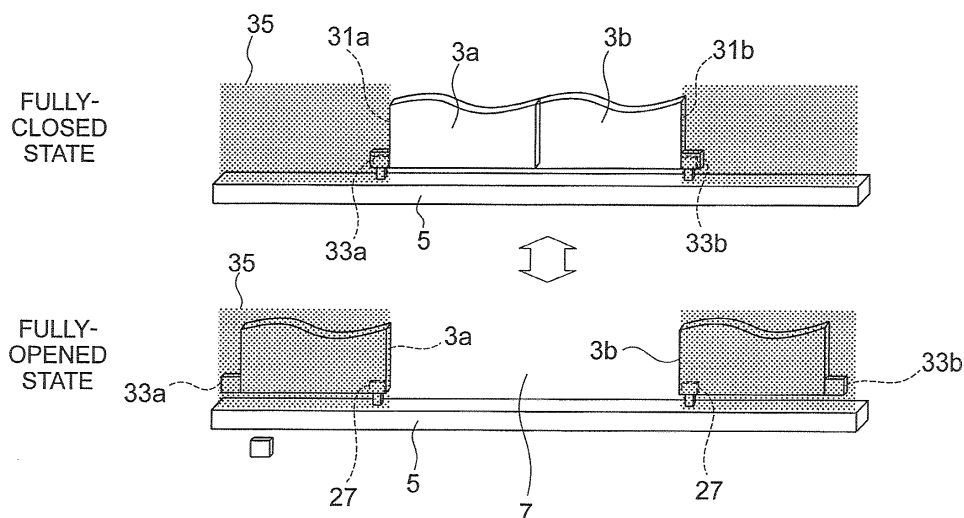
(74) Representative: **HOFFMANN EITLE**
Patent- und Rechtsanwälte
Arabellastrasse 4
81925 München (DE)

(54) **ELEVATOR DOOR ASSEMBLY**

(57) Provided is a door device for an elevator, which allows avoidance of trouble relating to a running resistance of a door without increasing a clearance between a sill and a car. A door device (1) for an elevator includes: at least one door panel (3a, 3b) provided slidably, for opening and closing a doorway (7) to a cage; and a sill (5) provided below the at least one door panel, the sill extending in a sliding direction of the at least one door

panel. The at least one door panel includes, on a lower surface thereof, a guiding groove (29) extending in the sliding direction. The sill includes, on an upper surface thereof, at least one guiding member (27) provided so as to project upward. The at least one guiding member is inserted into the corresponding guiding groove so that the at least one guiding member relatively moves along the corresponding guiding groove when the at least one door panel slides.

FIG. 2



Description

Technical Field

5 **[0001]** The present invention relates to a door device for an elevator.

Background Art

10 **[0002]** A door panel of an elevator door is suspended from a rail provided thereabove. A leg portion is provided to a bottom of the door panel. The leg portion is inserted into a groove formed on an upper surface of a sill provided below the door panel. In this manner, upper and lower parts of the door panel are supported so as to be guided in an opening/closing direction.

15 **[0003]** However, a space, in which the opening/closing of the door panel is performed, corresponds to a traveling path for passengers. Therefore, when the groove is formed on the upper surface of the sill, not only tiny dirt such as soil or dust enters the groove to be deposited therein but also relatively large dirt such as a pebble is sometimes caught in the groove. When the door panel is opened and closed, a loss in driving for opening/closing due to a running resistance is sometimes generated by the contact between the leg portion and the groove or the like, which becomes a factor of bringing about the degradation of each section with time. Moreover, when the relatively large dirt present on the groove is stepped on by a passenger(s), the dirt sometimes firmly adheres to the groove.

20 **[0004]** By the way, as a door panel for coping with the problem described above, there are door panels described in, for example, the following literatures. First, Patent Literature 1 discloses a configuration in which a clearance is provided between a car and a sill of a landing so that a leg portion of each door is led below the sill through the clearance to engage a guiding groove formed on a lower surface of the sill and the leg portion with each other.

25 **[0005]** Moreover, Patent Literature 2 discloses a structure in which an engagement body is provided in a vertically movable manner in a guiding groove formed on the upper surface of the sill so that a lower end portion of the door panel moves while gripping and lifting up the engagement body when the door panel moves in the opening/closing direction. In the above-mentioned configuration, the lower end portion of the door panel is supported through an intermediation of the engagement body. In addition, a portion of the groove, above which the door panel is not located, is closed by the engagement body during the opening/closing operation. In this manner, a foreign substance is prevented from entering the groove.

30 **[0006]** Further, Patent Literature 3 discloses a configuration in which a clearance passing through each sill from an upper surface to a lower surface is provided to the sill so that the leg portion of the door is led below the sill through the clearance to engage a guiding portion formed on the lower surface of the sill and the leg portion with each other.

35 **[0007]** With the configuration disclosed in Patent Literature 1 described above, however, the leg portion of the door is required to pass through the clearance between the car and the sill. Therefore, there arises a new problem in that an extremely large clearance is required to be ensured between the car and the sill. With the configuration disclosed in Patent Literature 2, the door panel moves while gripping and lifting up the engagement body. Therefore, even before the clogging of dirt in the guiding groove increases the running resistance, there arises a problem of an increased running resistance after all. Further, the passenger may stumble on an area in which a height of an upper surface of the engagement body is not equal to that of an upper surface of the sill. Moreover, with the configuration disclosed in Patent Literature 40 3, there still remains a fear of the clogging of dirt or the like in the clearance passing through the sill. Thus, a fundamental solution to the above-mentioned problem of the clogging of foreign substance cannot be expected.

Citation List

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Patent Literature

[0008] [PTL 1] JP 60-80672 A

[PTL 2] JP 2009-242039 A

50 [PTL 3] JP 10-203764 A

Summary of Invention

Technical Problem

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[0009] The present invention has been made in view of the problem described above, and therefore has an object to provide a door device for an elevator, which allows avoidance of trouble relating to a running resistance of a door without increasing a clearance between a sill and a car.

Solution to Problem

[0010] In order to achieve the above-mentioned object, according to the present invention, there is provided a door device for an elevator, including: at least one door panel provided slidably, for opening and closing a doorway to a cage; and a sill provided below the at least one door panel, the sill extending in a sliding direction of the at least one door panel. The at least one door panel includes, on a lower surface thereof, a guiding groove extending in the sliding direction. The sill includes, on an upper surface thereof, at least one guiding member provided so as to project upward. The at least one guiding member is inserted into the corresponding guiding groove so that the at least one guiding member relatively moves along the corresponding guiding groove when the at least one door panel slides.

Advantageous Effects of Invention

[0011] According to the door device for an elevator of the present invention, it is possible to avoid the trouble relating to the running resistance of the door without increasing the clearance between the sill and the car.

Brief Description of Drawings

[0012]

[FIG. 1] A view illustrating a front and a side of a door device for an elevator according to an embodiment of the present invention.

[FIG. 2] A view illustrating a fully-closed state and a full-opened state of door panels.

[FIG. 3] A view for illustrating the balancing of principal forces acting on one of the door panels.

[FIG. 4] A view illustrating the vicinity of a guiding member in an enlarged manner.

[FIG. 5] A view for illustrating a configuration and an operation of a panel-supporting device.

Description of Embodiment

[0013] Hereinafter, a door device for an elevator according to an embodiment of the present invention is described referring to the accompanying drawings. In the figures, the same reference symbols denote the same or corresponding parts.

[0014] FIG. 1 is a view illustrating a front and a side of the door device for an elevator according to the embodiment of the present invention. FIG. 2 is a view illustrating a fully-closed state and a fully-opened state of door panels. A door device 1 for an elevator includes at least one door panel (in this embodiment, a pair of right and left door panels 3a and 3b), and a sill 5. The pair of right and left door panels 3a and 3b is slidably provided, and opens and closes a doorway 7 to a cage. The sill 5 is provided below the door panels 3a and 3b, and extends in a direction in which the door panels 3a and 3b slide.

[0015] A hunger 9 is provided to an upper end of each of the door panels 3a and 3b. A beam 11, which is arranged in a longitudinal direction (horizontal direction), is provided to an upper edge portion of the doorway 7. A rail 13 is provided to the beam 11 so as to be arranged in the longitudinal direction (horizontal direction). A plurality of hunger rollers 15 are provided to each of the hungers 9. Through the movement of the hunger rollers 15 along the rail 13, the horizontal movement of the hungers 9, that is, the movement of the door panels 3a and 3b to open and close the door panels is guided.

[0016] Further, a plurality of upthrust rollers 17 are provided to each of the hungers 9. The plurality of upthrust rollers 17 prevent the hunger rollers 15 from being removed from the corresponding rail 13. A pair of pulleys 19a and 19b for looping is provided to the beam 11 so as to be rotatable. The pair of pulleys 19a and 19b for looping is provided so as to be separated away from each other. A circulating member 21, which may be an endless belt or the like, is looped around the pulleys so as to be provided between the pulleys in a tense state.

[0017] A pair of connectors 23a and 23b is provided to the circulating member 21. An upper end of the one connector 23a is connected to a portion of the circulating member 21, which runs as an upper line, whereas a lower end thereof is connected to the one door panel 3a. The another connector 23b is connected to a portion of the circulating member 21, which runs as a lower line, whereas a lower end thereof is connected to the another door panel 3b.

[0018] When the circulating member 21 is driven by a motor 25, the pair of connectors 23a and 23b moves in the directions opposite to each other. As a result, the pair of right and left door panels 3a and 3b also moves in the directions opposite to each other. Specifically, an opening/closing operation for the doorway 7 is performed.

[0019] The door panels 3a and 3b are guided not only by the rail 13 on the upper side thereof but also by the sill 5 on the lower side thereof. At least one guiding member (at least as many guiding members as the door panels and, in this embodiment, a pair of guiding members 27) is provided on an upper surface of the sill 5 so as to project upward therefrom.

[0020] On the other hand, guiding grooves 29 respectively for housing the guiding members 27 therein are formed in

lower parts of the door panels 3a and 3b, respectively. Regarding the guiding grooves, the door panels 3a and 3b respectively include guiding-groove extension members 33a and 33b on rear end surfaces 31a and 31b oriented in a direction of a closing operation of the door panels. The guiding-groove extension members 33a and 33b project backward in the direction of the closing operation of the door panels from the rear end surfaces 31a and 31b. The guiding grooves 29 include grooves formed on the respective lower surfaces of the door panels 3a and 3b, and grooves formed on lower surfaces of the guiding-groove extension members 33a and 33b which correspond to the grooves so as to be continuous from the grooves. Specifically, a major part of each of the guiding grooves 29 is formed from a corresponding one of the grooves formed on the lower surfaces of the door panels 3a and 3b, whereas a minor part thereof is formed from a corresponding one of the grooves formed on the lower surfaces of the guiding-groove extension members 33a and 33b. In other words, the guiding grooves 29 are formed so that the grooves formed on the lower surfaces of the door panels 3a and 3b are extended with the grooves formed on the lower surfaces of the guiding-groove extension members 33a and 33b. The size of each of the guiding-groove extension members 33a and 33b may be set so that the range of extension of the groove, in which a corresponding one of the guiding members 27 is allowed to be housed therein even when the door panels 3a and 3b are fully closed, is at least added.

[0021] Each of the guiding members 27 is housed in a corresponding one of the guiding grooves 29. When the door panels 3a and 3b perform an opening/closing operation, there is brought about a state in which the guiding members 27 move along the guiding grooves 29 in terms of the relative relationship between the guiding members 27 and the guiding grooves 29.

[0022] As can be seen from FIG. 2, each of the guiding members 27 is provided at a position on the upper surface of the sill 5, which is covered by a part including a corresponding one of the guiding grooves 29 (in this embodiment, a corresponding one of the door panels or the guiding-groove extension members) from the time at which a corresponding one of the door panels 3a and 3b is fully closed to the time at which the corresponding one of the door panels is fully opened. The guiding members 27 are provided to portions of the upper surface of the sill 5, which are located outside the doorway 7, that is, in a region other than a passage path for passengers. In other words, each of the guiding members 27 is provided in a door-pocket region 35 illustrated in FIG. 2 as a hatched area, in particular, in an end portion of the door-pocket region 35, which is closer to the doorway. In order to realize the arrangement of the guiding members 27 described above, the guiding-groove extension members 33a and 33b are also located in the end portions of the door-pocket regions 35, which are close to the doorway, so as not to be located outside the door-pocket regions 35 even when the door panels 3a and 3b are fully closed.

[0023] With the configuration described above, the door panels 3a and 3b are supported and guided by the guiding members 27 on the lower side thereof. For this reason, a groove for supporting and guiding the door panels 3a and 3b is not provided on a part of the upper surface of the sill 5, which corresponds to the doorway.

[0024] Next, the significance of the support of the lower ends of the door panels is described. For example, in a conventional door device, a groove is provided on an upper surface of a sill. A leg portion extending downward from a lower surface of a door panel is inserted into the groove so as to be held in contact with an inner surface of the groove. As functions provided by the contact, there are three functions, that is, guiding of the lower end portion of the door panel for the horizontal movement of the door panel, suppression of inclination of the door panel in a passenger-passage direction, and prevention of removal of the door panel when a shock is applied in the passenger-passage direction when the door panel is fully closed.

[0025] By theoretically demonstrating forces acting on the door panel in the opening/closing operation of the door panel, a structure necessary for the realization of the above-mentioned functions is demonstrated. When a driving force is generated by the motor 25 to open and close the door panels 3a and 3b, the balancing of principal forces acting on each of the door panels can be individually described for an X-axis direction, a Y-axis direction, a Z-axis direction, a direction of a rotational angle θ on an X-Y plane, and a direction of a rotational angle ω on a Z-Y plane as illustrated in FIG. 3.

[0026] Specifically, the balancing of the principal forces is expressed by the following equations of motion (1) to (5) in the stated order of the directions.

[Math. 1]

$$M\ddot{X} = F_m - 2F_{hx} - F_{ux} \quad (1)$$

[Math. 2]

$$M\ddot{y} + 2Ky = Mg \quad (2)$$

[Math. 3]

$$M\ddot{z} = F_{hz} + F_{uz} \quad (3)$$

[Math. 4]

$$J_{xy} \ddot{\theta} + Kd_x^2 \theta = F_m (L_1 + L_2) + F_{ux} L_3 - 2F_{hx} L_2 \quad (4)$$

[Math. 5]

$$J_{zy} \ddot{\omega} + Kd_z^2 \omega = F_{uz} L_3 - 2Ky d_z \quad (5)$$

When i=x, y, z, each of the symbols means as follows.

i: position of a gravity center G of each of the door panels in an i-axis direction,

θ : rotational angle in the z-axis about the gravity center G of each of the door panels,

ω : rotational angle in the x-axis about the gravity center G of each of the door panels,

M: total weight of one door panel including the hunger rollers and the hunger,

J_{iy} : i-axis inertia about the gravity center G of each of the door panels,

F_m : driving force transmitted to the belt, which is generated by driving the door motor,

F_{ui} : frictional force in the i-axis direction, which is generated by the contact between each of the door panels and the guiding device,

F_{hi} : frictional force in the i-axis direction, which is generated by the contact between the hunger rollers 5 and the rail 4,

d_i : distance in the i-axis direction between the hunger rollers 5 and the gravity center G of each of the door panels,

L_1 : vertical distance between the connecting portion 9 and the rail 4,

L_2 : vertical distance between the rail 4 and the gravity center G of each of the door panels,

L_3 : vertical distance between the guiding device 12 and the gravity center G of each of the door panels,

K: equivalent rotational-spring stiffness of each of the hunger rollers, and

g: gravity acceleration.

[0027] For opening and closing the door panel 3a, the belt-transmitted force F_m generated by the driving force of the motor 25 acts only in the X-axis direction in Equation (1) and in the direction of the rotational angle θ in Equation (4). A dynamic force generated during a normal opening/closing operation is the belt-transmitted force F_m alone. At the time other than the normal opening/closing operation, a static force which does not vary with elapse of time acts. Therefore, an acceleration in each of the axial directions does not change. Specifically,

$$\ddot{y} = \ddot{z} = \ddot{\omega} = 0 \quad (6)$$

is established. This state is, in other words, in the Y-axis direction, a state in which a weight of each door panel is

supported by portions, in which the hunger rollers 15 and the rail 13 are held in contact with each other, and in the Z-axis direction, a stationary state archived when the force F_{hz} acting on the contact portions and the force F_{uz} acting on the lower end portion of the door panel 3a equilibrate each other. Moreover, according to Equation (5), when there is a shift corresponding to the distance d_z in the z-axis direction between the hunger rollers 15 and the door-panel gravity center G in the direction of the rotational angle ω , the drag F_{uz} only needs to be exerted on the lower end portion of the door panel in the Z-axis direction as a force against a moment generated by the total weight of the door panel and the above-mentioned distance d_z .

[0028] If only the at least one guiding member 27 is provided to the lower end portion of one door panel, the above-mentioned force F_{uz} in the z-axis direction can be generated. If the door panel is mounted after the door panel is adjusted so that the above-mentioned distance d_z becomes zero, specifically, the positions of the hunger rollers 15 and the door-panel gravity center G are aligned with each other, the above-mentioned force F_{uz} in the Z-axis direction acting on the lower end portion is not required any more.

[0029] In the X-axis direction and the direction of the rotational angle θ , the frictional force in the X-axis direction, which is generated by a corresponding one of the guiding members 27, acts. Providing a plurality of the guiding members 27 has the same significance as changing a magnitude of terms including the frictional force F_{ux} in Equations (1) and (4). Specifically, the effect provided by setting one guiding member 27 is equivalent to a mere question of the magnitude of the friction.

[0030] Based on the knowledge obtained by the equations of motion acting during the door-opening/closing operation described above, a configuration of this embodiment is further described in terms of the structure having the above-mentioned three functions without providing a concave groove on the upper surface of the sill as in the conventional cases.

[0031] The guiding of the movement of the door panels 3a and 3b to open and close the door panels is performed by the movement of the hunger rollers 15 along the rail 13 on the side of the upper ends of the door panels 3a and 3b and by the contact of the guiding members 27 with the guiding grooves 29 of the door panels 3a and 3b on the side of the lower ends thereof. When a distance between the portions in which the rail 13 and the hunger rollers 15 are held in contact (which support the total weight of each of the door panels) and the gravity center portion G of each of the door panels 3a and 3b is large in the passenger-passage direction, a force for inclining each of the door panels 3a and 3b with respect to the passenger-passage direction acts on each of the door panels 3a and 3b. In other words, when the above-mentioned distance can be adjusted to be zero, the door panels 3a and 3b can be opened and closed without being inclined in the passenger-passage direction even without the guiding on the side of the lower end portions if only with the guiding on the side of the upper ends. Therefore, the hunger rollers 15 only need to be adjusted and suspended on the rail 13 so that the above-mentioned distance becomes zero. In this manner, the prevention of inclination of the door panels 3a and 3b in the passenger-passage direction can be realized.

[0032] The upthrust rollers 17 are provided below the rail 13 so as to prevent a shift of the contact points between the hunger rollers 15 and the rail 13, that is, the removal of the door panels, due to the application of an external force in the passenger-passage direction and the opening/closing direction when the door panels are normally opened and closed or fully opened and closed. However, if the upthrust rollers 17 and the rail 13 are constantly held in contact with each other, a loss in running resistance, which is generated when the door panels are opened and closed, is increased. Therefore, it is desirable that the adjustment be performed without pressing the upthrust rollers against the rail 13 during the normal opening/closing operation. Moreover, as mechanical measures against the removal of the doors, a plate (not shown) is fixed to each of the hungers 9 so as to cover an upper portion or a lower portion of the rail 13. In this manner, when the degree of inclination of the door panels exceeds a certain degree, the contact between the plate and the rail can prevent the removal of the doors. Such a plate can be provided in an area of each of the hungers 9, which avoids the hunger rollers 15, and only needs to be provided so as not to be in contact with the rail during a normal operation.

[0033] The sill 5 has a feature in that the concave groove for supporting the door panels is not provided in a region over which the passengers pass so that a foreign substance such as dirt or dust does not enter. It is most desirable that the region of the sill 5, over which the passengers pass, have a flat shape in view of the prevention of the foreign substance from entering and the improvement of facility in passage. However, even with a convex shape, the effects of preventing the foreign substance from entering can be ensured. In the case where the convex shape is used, however, a height of the convex portion is reduced as much as possible so that the passengers do not stumble on the convex portion as passing. Further, the concave portion is suitably provided with a smooth curve surface so that a height between the sill and a floor surface does not abruptly change.

[0034] If the door panels 3a and 3b are suspended from the rail 13 so that the portions, in which the rail 13 and the hunger rollers 15 are held in contact with each other, and the door-panel gravity center G are aligned in the passenger-passage direction, a state, in which the guiding members 27 are not in contact with the guiding grooves 29, can be steadily obtained, as illustrated in FIG. 4. On the other hand, when the force in the passenger-passage direction acts on the door panels 3a and 3b, the guiding grooves 29 and the guiding members 27 come into contact with each other. As a result, an excessive inclination of the door panels 3a and 3b in the passenger-passage direction can be suppressed while the function of guiding the door panels 3a and 3b in the horizontal direction is ensured. The present invention

encompasses a mode in which the door panels 3a and 3b are suspended while the guiding grooves 29 and the guiding members 27 are initially held in contact with each other.

[0035] At least an upper end of each of the guiding members 27 is suitably formed of a resin or from a brush. As an example, in this embodiment, each of the guiding members 27 includes a metal portion 27a mounted onto the upper surface of the sill 5, and a resin portion 27b made of a rubber or the like, which is provided to an upper end portion of the metal portion 27a and can come into contact with side surfaces which define a corresponding one of the guiding grooves 29. By providing one or more guiding member(s) 27 to each door panel, the function of guiding the door panels 3a and 3b in the opening/closing direction can be realized.

[0036] The door device 1 for an elevator further includes a panel-supporting device. The panel-supporting device is described referring to FIG. 5. FIG. 5 is a view illustrating configurations and operations of two types of panel-supporting devices 135 and 235 as examples.

[0037] First, an outline is described. Each of the panel-supporting devices 135 and 235 supports one or more door panels against a force in the passenger-passage direction when the door panels are fully closed. When the one or more door panels are fully closed, one door panel is connected to a facing body (pair of the door panels are connected to each other). In this manner, stiffness against a shock applied in the passenger-passage direction can be increased. The panel-supporting device 135 includes support members 137 and the panel-supporting device 235 includes a support member 237, which are located in support positions when the door panels are fully closed. In the support position, each of the support members 137 and 237 overlaps both a lower portion of a front end of the door panel in the direction of the closing operation and the facing body which abuts against the lower portion of the front end as viewed from the passenger-passage direction. The panel-supporting devices 135 and 235 respectively include driving mechanisms 139 and 239 for driving the support members 137 and 237 between the support position and a non-support position. Each of the driving mechanisms 139 and 239 includes at least a pair of magnets provided separately to the door panel and the facing body. Each of the support members 137 and 237 is driven by magnetic forces of the magnets.

[0038] Specifically, the panel-supporting device 135 of attraction type, which is illustrated on the left in FIG. 5, is described. The panel-supporting device 135 includes the support members 137 and the driving mechanism 139. The driving mechanism 139 includes at least a pair of magnets 141 and 143 having different polarities and a spring 145. The magnet 141 having one of an N-magnetic pole and an S-magnetic pole is fixed to a lower portion of a front end of the one door panel 3a in the direction of the closing operation. The magnet 143 having another of the N-magnetic pole and the S-magnetic pole is movably mounted through the spring 145 to a lower portion of a front end of the door panel 3b in the direction of the closing operation, which serves as the facing body for the door panel 3a. The pair of upper and lower support members 137 is provided. The pair of support members 137 is mounted onto the top and the bottom of the magnet 143. The spring 145 is provided between the pair of support members 137 and biases the magnet 143 and the pair of support members 137 in a direction away from the one door panel 3a.

[0039] In the configuration described above, in a state other than a state in which the door panels 3a and 3b are fully closed, the support members 137 are in non-support positions, specifically, are subjected to an elastic force by the spring 145 to be located in positions so as not to protrude from the door panel 3b as viewed from the passenger-passage direction. On the other hand, when the door panels 3a and 3b come into a fully-closed state, the magnet 143 comes closer to the magnet 141 against the spring 145 by attracting magnetic forces which are generated between the magnets 141 and 143. As a result, the support members 137 move toward the door panel 3a, specifically, are located in the support positions. In the support positions, the support members 137 overlap both the door panels 3a and 3b as viewed from the passenger-passage direction. More specifically, the support members 137 are inserted into the door panel 3a on the opposed side through passage holes provided on the end surface of the door panel 3b. As a result, the door panels 3a and 3b are connected to each other by the support members 137 to improve the stiffness against an impulsive force in the passenger-passage direction.

[0040] Further, as another mode, the panel-supporting device 235 of repelling type, which is illustrated on the right in FIG. 5, is described. The panel-supporting device 235 includes the support member 237 and the driving mechanism 239. The driving mechanism 239 includes at least a pair of magnets 241 and 243 having the same polarity. The magnet 241 having one of the N-magnetic pole and the S-magnetic pole is fixed to the lower portion of the front end of the one door panel 3a in the direction of the closing operation. The magnet 243 having the same magnetic pole as that of the magnet 241 is mounted movably to the lower portion of the front end of the door panel 3b in the direction of the closing operation, which serves as the facing body for the door panel 3a. The magnet 243 is fixed to a lower end of the support member 237 mounted turnably to the door panel 3b.

[0041] In the configuration described above, in a state other than a state in which the door panels 3a and 3b are fully closed, the support member 237 is in a non-support position, specifically, extends in a vertical direction as viewed from the passenger-passage direction to take an attitude so as not to protrude from the door panel 3b by a self-weight of the magnet 243. On the other hand, when the door panels 3a and 3b come into the fully-closed state, the magnet 243 and the lower end of the support member 237 move in a direction away from the door panel 3a by repelling magnetic forces generated between the magnets 241 and 243. The above-mentioned movement of the lower end of the support member

237 means the rotation of the support member 237. An upper end of the support member 237 is inserted into the door panel 3a on the side opposed thereto through a passage hole provided on the end surface of the door panel 3b. Specifically, the support member 237 is located in the support position. As a result, the door panels 3a and 3b are connected to each other by the support member 237 to improve the stiffness against the impulsive force in the passenger-passage direction.

[0042] When the door panels 3a and 3b in the fully-closed state start an opening operation, the repelling forces between the magnets 241 and 243 are reduced. The support member 237 is subjected to the action of the self-weight of the magnet 243 to rotate to return to the initial non-support position. At this time, in order to stop the movement by the self-weight of the magnet 243 and to reduce the shock when the support member is stationary, it is suitable to provide a stopper 247 at an appropriate location on the door panel 3b. The stopper 247 can be formed from a shock absorber or an elastic member such as a spring.

[0043] According to the above-mentioned door device for an elevator according to this embodiment, the following effects are obtained. The guiding grooves for guiding the door panels are provided not to the sill but on the lower surfaces of the door panels, and are grooves open downward, that is, in a direction of the gravity. Therefore, dirt is unlikely to be accumulated in the grooves by the action of the self-weight. As a result, an increase in running resistance of the doors due to the accumulation of dirt can be suppressed. Moreover, it is the guiding members projecting from the upper surface of the sill that are engaged with the guiding grooves. Therefore, it is not necessary to insert a member for guiding the door panel through a clearance between the sill and the car. Therefore, according to this embodiment, trouble relating to the running resistance of the doors can be avoided without increasing the clearance between the sill and the car.

[0044] Further, the guiding member is provided at the position on the upper surface of the sill, which is covered with the portion including the guiding groove, from the time at which the door panels are fully closed to the time at which the door panels are fully opened. Therefore, even when the downwardly-oriented open groove is used so as to prevent the dirt from being accumulated as described above, the doors can be guided while the passengers are more reliably prevented from stumbling. Moreover, not only for the fear in that a foreign substance enters the grooves as a natural phenomenon but also for the fear in that a relatively large foreign substance such as a pebble is pressed into the groove by the passage of the passenger, in this embodiment, the groove itself formed on the upper surface of the sill, which is open in the direction opposite to the direction of gravity, is eliminated. As a result, the phenomenon itself, that is, the foreign substance entering the sill, can be eliminated. Further, the guiding members are provided to the portions on the upper surface of the sill, which are located outside the doorway. Therefore, the doorway can be set wide.

[0045] Moreover, each of the door panels includes the guiding-groove extension member formed on the rear end surface of the door panel in the direction of the closing direction. The guiding-groove extension member projects backward from the rear end surface in the direction of the closing operation. The groove constituting a part of the guiding groove is provided on the lower surface of the guiding-groove extension member. Therefore, for ensuring the guiding grooves extending to have a necessary length, the above-mentioned effects can be obtained while the facility of use of existing door panels is improved and an increase in weight of each of the door panels is suppressed.

[0046] Further, at least an upper end of each of the guiding members is formed of a resin or formed from a brush. Therefore, two effects, that is, the effect of facilitating the removal of dirt and the effect of reducing noise generated when the door panels are opened and closed, can be simultaneously obtained. Specifically, even if a foreign substance enters any of the guiding grooves, the dirt collides against the guiding member to be pushed out. In addition, an effect of removing dirt outside the groove is also obtained by the gravity. Therefore, the removal of dirt can be remarkably facilitated. Further, when each of the guiding members relatively moves inside a corresponding one of the guiding grooves with the opening/closing of the door panels, not only noise which may be generated by the contact between the guiding member and the dirt when the guiding member excludes the dirt as described above, but also noise which may be generated by the direct contact of the guiding member with an inner surface of the guiding groove can be reduced.

[0047] Moreover, in this embodiment, the panel-supporting device is provided. Therefore, with the configuration in which the guiding members are provided outside the region over which the passengers pass for entrance and exit so as to suppress an increase in running resistance of the doors due to the accumulation of dirt and to more reliably prevent the passengers from stumbling on the guiding members, the support in the passenger-passage direction can be obtained in the lower portion of the front end of each of the door panels, which is far from the guiding members. Therefore, the strength in the passenger-passage direction for the door panels in the fully-closed state can be maintained high while both the effect of reducing the increase in running resistance and the effect of preventing stumbling are obtained. Moreover, the support member of the panel-supporting device is driven by the magnetic forces of the magnets. Therefore, a state in which the door panels in the fully-closed state are supported in the passenger-passage direction can be automatically brought about by using the opening/closing operation of the door panels.

[0048] Further, if the portions in which the plurality of hunger rollers and the rail are held in contact with each other and the gravity center of each of the door panels are aligned in the passenger-passage direction, a non-contact state of the guiding members and the guiding grooves can be ensured in a steady state. Thus, the running resistance can be further lowered when the door panels are opened and closed.

[0049] The contents of the present invention have been specifically described above referring to the preferred embodiment. However, it is apparent that various modified modes are possible by those skilled in the art based on the basic technical thought and teaching of the present invention.

[0050] For example, in the embodiment described above, the guiding grooves are extended by adding the guiding-groove extension members to the door panels. However, the present invention is not limited to the above-mentioned mode. A horizontal width of the entire door panel may be increased or a part of the door panel, which requires a large horizontal width, may be initially manufactured to have a large horizontal width.

[0051] The mode in which the driving mechanism of the panel-supporting device includes the magnets has been described as an example. However, the magnets are not limited to the permanent magnets, and electromagnets can also be used. Further, the driving mechanism is not limited to the mode in which the magnetic forces are used. The driving mechanism may include means other than the magnets as long as the means generates an attracting or repelling force.

[0052] In the embodiment described above, the configuration in which the pair of right and left door panels is provided is described as an example. However, the door device for an elevator according to the present invention is not limited thereto. It is only necessary to use a mode in which the doorway is opened and closed by one or more door panels. Therefore, the facing body for the door panel means the another door panel with respect to the one door panel in the configuration including the pair of right and left door panels. In a configuration in which the doorway is opened and closed by a single door panel, the facing body may mean an immovable column portion or wall portion which defines one side portion of the doorway. Further, as a mode using the single door panel, any of a normal door panel having a fixed panel area and a telescopic door panel having a varying panel area during the opening/closing operation may be used.

Reference Signs List

[0053] 1 door device for elevator; 3a, 3b door panel; 5 sill; 7 doorway; 13 rail; 15 hunger roller; 27 guiding member; 29 guiding groove; 31a, 31b rear end surface; 33a, 33b guiding-groove extension member; 135, 235 panel-supporting device; 137, 237 support member; 139, 239 driving mechanism; 141, 143 magnet; 241, 243, magnet

Claims

1. A door device for an elevator, comprising:

at least one door panel provided slidably, for opening and closing a doorway to a cage; and
a sill provided below the at least one door panel, the sill extending in a sliding direction of the at least one door panel, wherein:

the at least one door panel comprises, on a lower surface thereof, a guiding groove extending in the sliding direction;

the sill comprises, on an upper surface thereof, at least one guiding member provided so as to project upward; and

the at least one guiding member is inserted into the corresponding guiding groove so that the at least one guiding member relatively moves along the corresponding guiding groove when the at least one door panel slides.

2. A door device for an elevator according to claim 1, wherein the at least one guiding member is provided at a position on the upper surface of the sill, which is covered by a portion of the at least one door panel, including the guiding groove, from a time at which the at least one door panel is fully closed to a time at which the at least one door panel is fully opened.

3. A door device for an elevator according to claim 1 or 2, wherein the at least one guiding member is provided on a portion of the upper surface of the sill, which is located outside the doorway.

4. A door device for an elevator according to any one of claims 1 to 3, wherein:

the at least one door panel comprises a guiding-groove extension member formed on a rear end surface of the at least one door panel in a direction of a closing operation;

the guiding-groove extension member projects backward in the direction of the closing operation from the rear

end surface; and

the guiding-groove extension member comprises, on a lower surface thereof, a groove constituting a part of the guiding groove.

5 5. A door device for an elevator according to any one of claims 1 to 4, wherein at least an upper end of the at least one guiding member is formed of a resin or from a brush.

10 6. A door device for an elevator according to any one of claims 2 to 5, further comprising a panel-supporting device for supporting the at least one door panel in a fully-closed state against a force in a passenger-passage direction, wherein:

the panel-supporting device comprises a support member located in a support position when the at least one door panel is fully closed; and

15 the support member in the support position overlaps both a lower portion of a front end of the at least one door panel in a direction of a closing operation and a facing body abutting against the lower portion of the front end as viewed from the passenger-passage direction.

7. A door device for an elevator according to claim 6, wherein:

20 the panel-supporting device comprises a driving mechanism for driving the support member between the support position and a non-support position;

the driving mechanism comprises at least a pair of magnets provided separately to the at least one door panel and the facing body; and

25 the support member is driven by magnetic forces of at least the pair of magnets.

30 8. A door device for an elevator according to any one of claims 1 to 7, further comprising a plurality of hunger rollers provided above the at least one door panel, for suspending and supporting the at least one door panel, the plurality of hunger rollers being guided by a rail extending in the sliding direction of the at least one door panel, wherein portions in which the plurality of hunger rollers and the rail are held in contact with each other and a gravity center of the at least one door panel are aligned in a passenger-passage direction.

FIG. 1

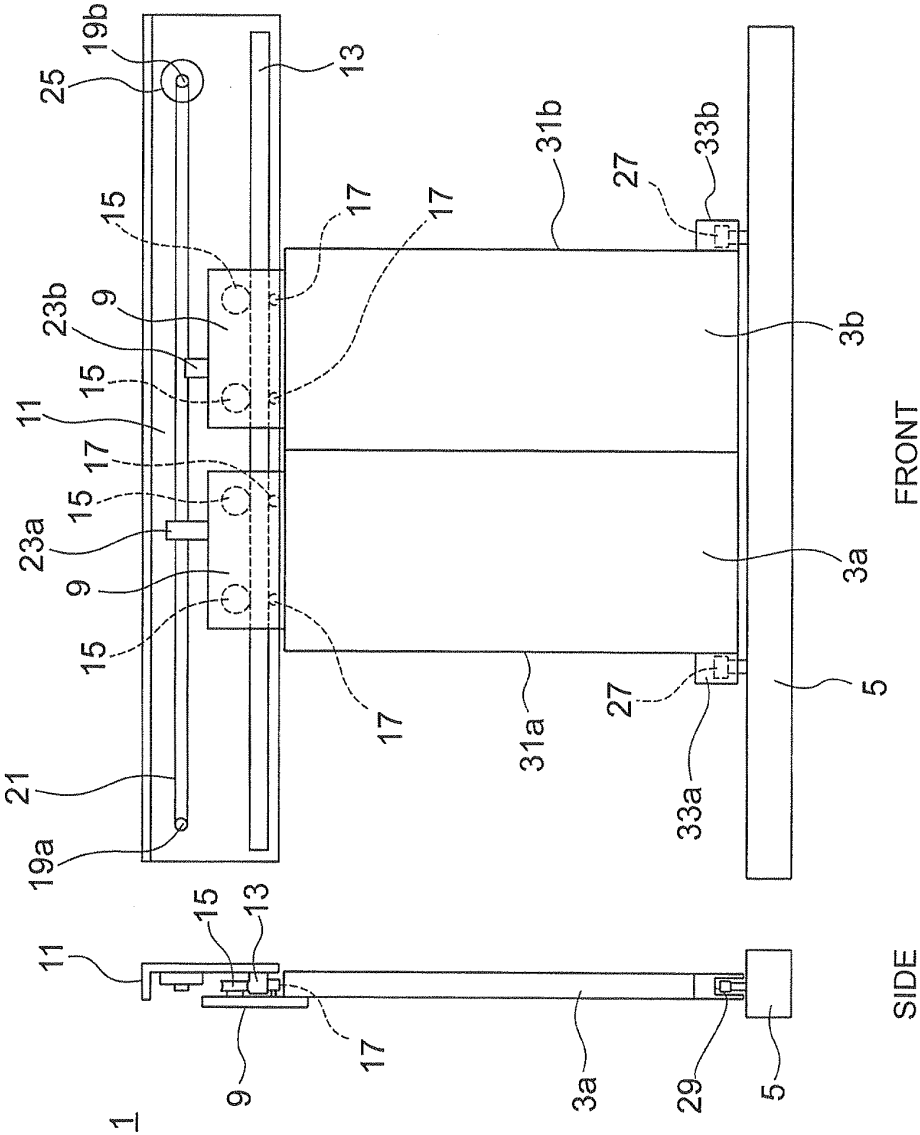
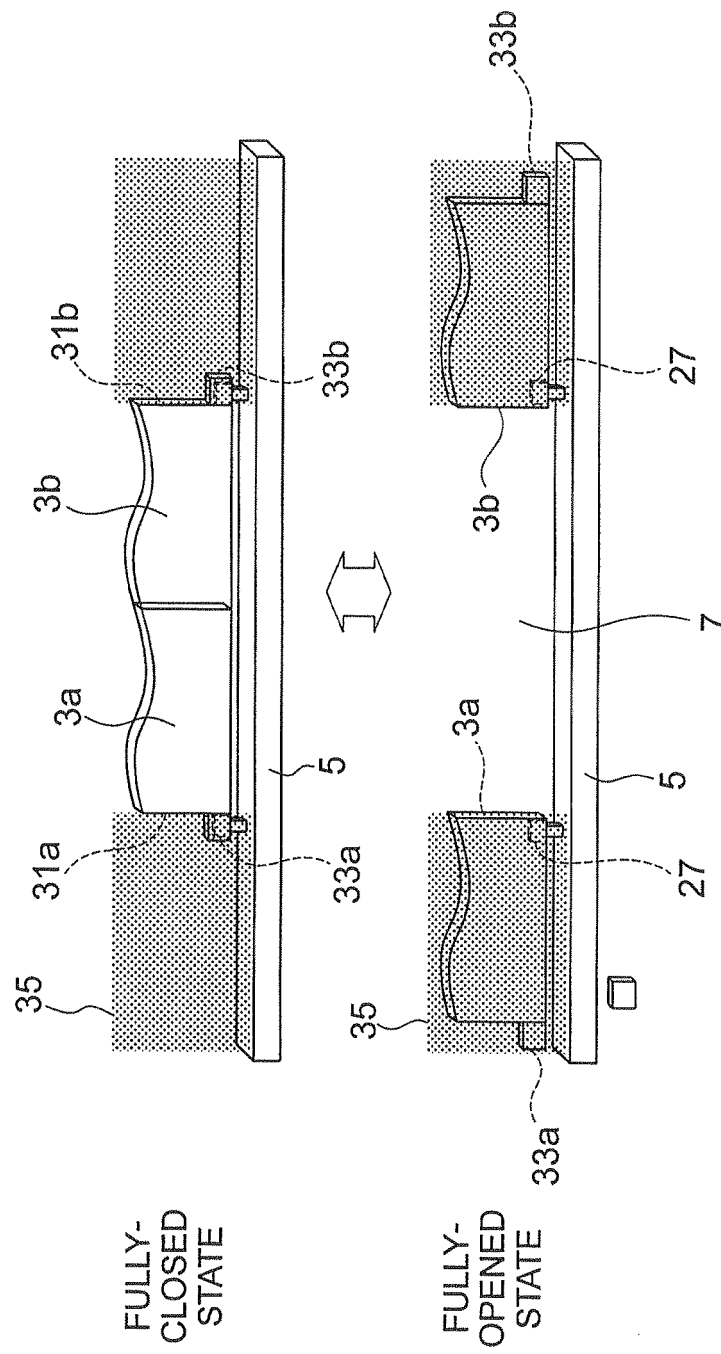


FIG. 2



மேல்

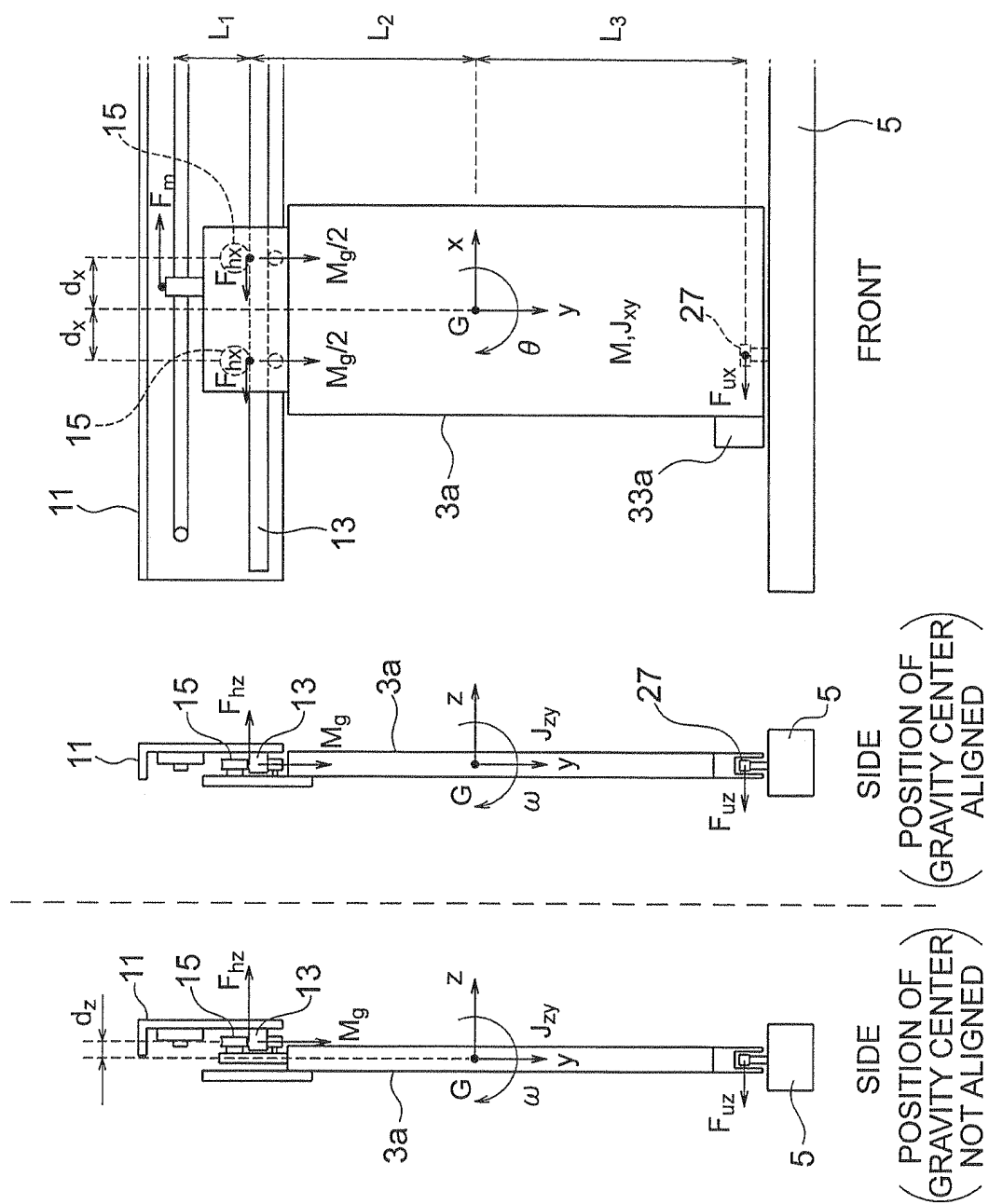


FIG. 4

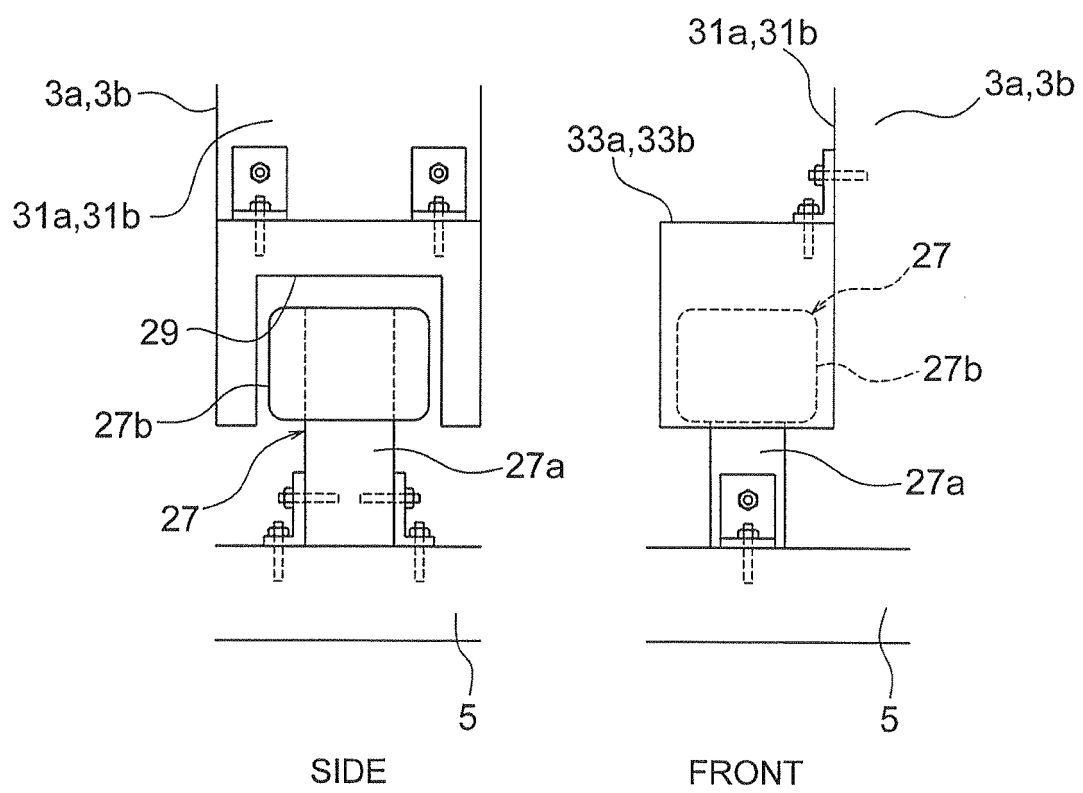
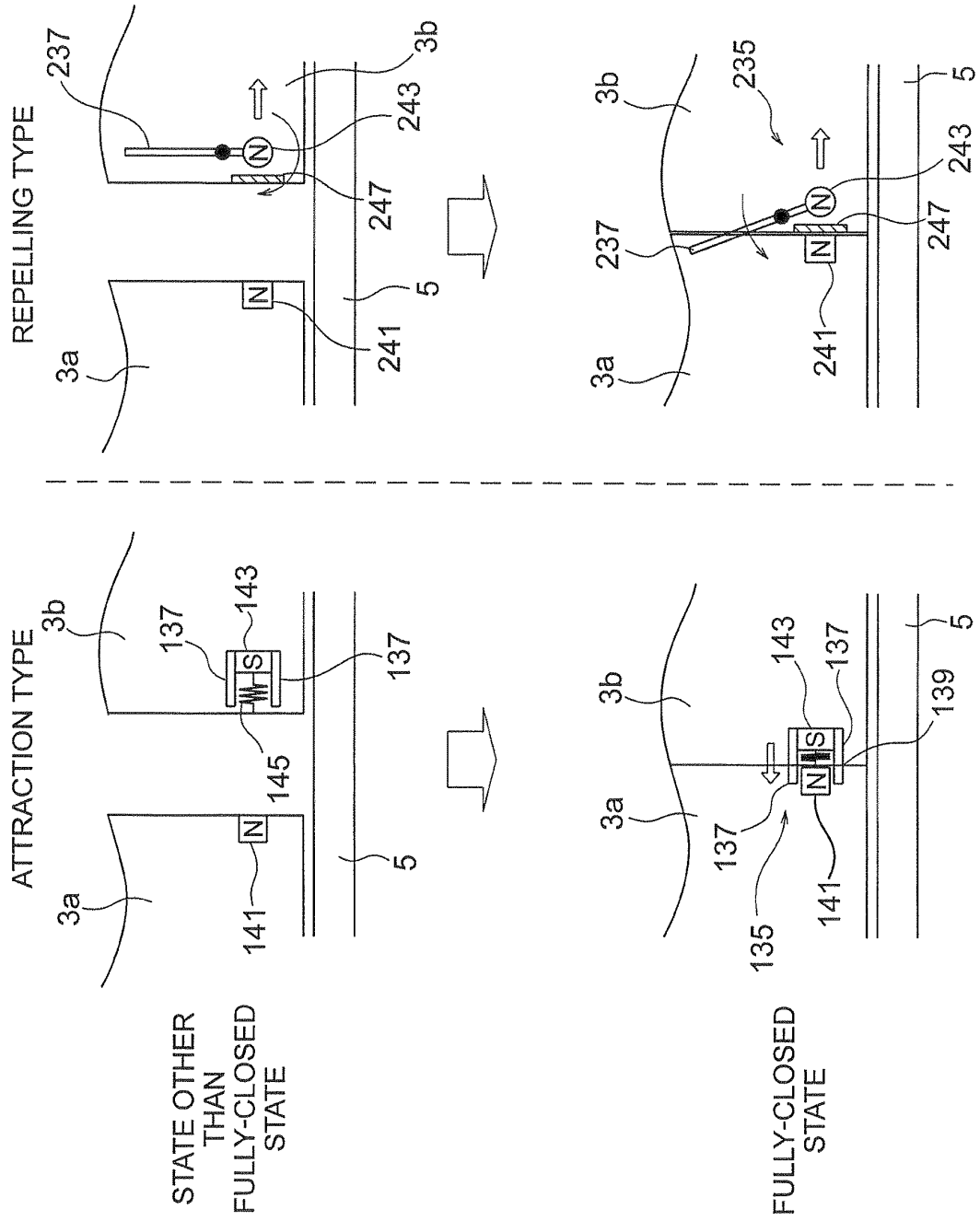


FIG. 5



INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2010/062064

A. CLASSIFICATION OF SUBJECT MATTER

B66B13/30 (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)

B66B13/30

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Jitsuyo Shinan Koho	1922-1996	Jitsuyo Shinan Toroku Koho	1996-2011
Kokai Jitsuyo Shinan Koho	1971-2011	Toroku Jitsuyo Shinan Koho	1994-2011

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 Y	JP 51-21480 Y1 (Hitachi, Ltd.), 04 June 1976 (04.06.1976), entire text; fig. 1 to 6 (Family: none)	1, 3-5, 8 2
X Y	JP 2-255488 A (Mitsubishi Electric Corp.), 16 October 1990 (16.10.1990), entire text; fig. 1 to 5 (Family: none)	1, 3, 8 2, 6-7
Y	JP 9-268834 A (Tostem Corp.), 14 October 1997 (14.10.1997), paragraphs [0014], [0021]; fig. 1 to 5 (Family: none)	2, 6-7

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

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"&" document member of the same patent family

Date of the actual completion of the international search
14 March, 2011 (14.03.11)Date of mailing of the international search report
22 March, 2011 (22.03.11)Name and mailing address of the ISA/
Japanese Patent Office

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INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2010/062064

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	JP 2-229382 A (Kabushiki Kaisha Nishi Seisakusho), 12 September 1990 (12.09.1990), page 2, lower right column, line 8 to page 3, upper left column, line 5; fig. 6 to 8 (Family: none)	7
A	Microfilm of the specification and drawings annexed to the request of Japanese Utility Model Application No. 17864/1981 (Laid-open No. 131984/1982) (The Nippon Aluminium Mfg. Co., Ltd.), 17 August 1982 (17.08.1982), entire text; fig. 1 to 5 (Family: none)	6-7

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REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- JP 60080672 A [0008]
- JP 2009242039 A [0008]
- JP 10203764 A [0008]