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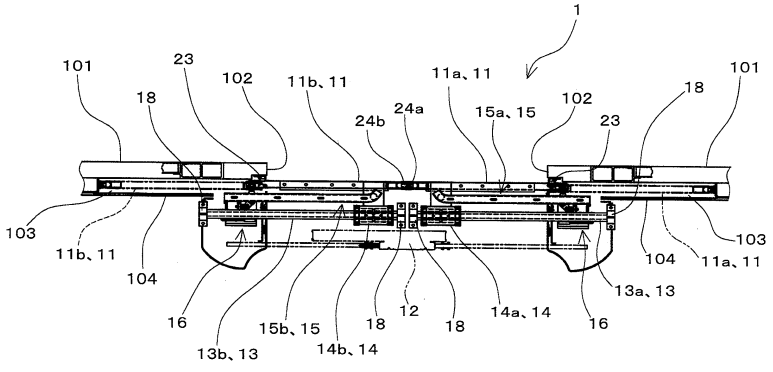
(54) VEHICLE DOOR DEVICE

(57) A vehicle door device that is provided has double sliding doors and can ensure an airtight state that is applicable to high-speed vehicles. A door open-close drive mechanism 12 is installed at the top of double sliding doors 11, and drives doors 11 to be opened and closed. Vehicle width direction guiding mechanisms 15 guide the doors 11 so as to move in the vehicle width direction along with the operation of the door open-close drive mechanism 12. First pressing mechanisms 16 press the doors 11 toward the vehicle body by pressing the doors 11 outward in the vehicle width direction on the door trailing end sides when the doors 11 are in the fully-closed position. Second pressing mechanisms 17 are installed at the bottom of the doors 11, and press the doors 11 toward the vehicle body by pressing the doors 11 outward in the vehicle width direction on the door leading end sides when the doors 11 are in the fully-closed position.

FIG. 2



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Description

Technical Field

[0001] The present invention relates to a vehicle door device for installation in the doorway of a vehicle.

Background Art

[0002] A plug type of door device and a door pocket type of door device are conventionally known as vehicle door devices for installation in the doorway of a vehicle. A plug type of door device is configured as a door device that performs a door open/close operation and a plug operation for moving the door in the vehicle width direction. A door pocket type of door device is configured as a door device in which the door is accommodated in a door pocket when in the fully-opened position.

[0003] There are cases where the above-described plug type or door pocket type of door device is used in a high-speed vehicle. In such cases, the door device is configured as a door device that includes an airtight door structure in which the door is pressed or pulled toward the body of the vehicle in order to suppress sudden changes in air pressure when entering a tunnel, for example. Note that Patent Document 1 discloses a door pocket type of door device for a high-speed vehicle.

[0004] The door device disclosed in Patent Document 1 is provided with an airtight door structure that has one single sliding door and four door pressing devices for pressing the single sliding door toward the peripheral portion of the doorway. This door pressing device is installed in the frame of the vehicle body, and is configured such that the single sliding door is pressed against the peripheral portion of the doorway by pressure from a cylinder.

[0005] Patent Document 2, however, discloses a vehicle door device for use in a general vehicle such as a subway vehicle. This vehicle door device is not provided with an airtight door structure, but rather includes double sliding doors that are provided as a pair and can open and close the doorway. Using this kind of vehicle door device provided with double sliding doors enables a large number of passengers to board and get off smoothly in a short amount of time.

Citation List

Patent Document

[0006]

Patent Document 1: JP 2005-132353A
Patent Document 2: JP 2008-121244A

Disclosure of the Invention

Problem to be Solved by the Invention

[0007] If a vehicle door device provided with double sliding doors can be used in a high-speed vehicle, a large number of passengers will be able to board and get off smoothly in a short amount of time. However, high-speed vehicles require a vehicle door device provided with an airtight door structure such as that disclosed in Patent Document 1. Since the vehicle door device disclosed in Patent Document 1 is a door device for driving one single sliding door to be opened and closed, it is difficult for this door device to be employed as an airtight door structure for a door device that has double sliding doors. Also, even if the airtight door structure disclosed in Patent Document 1 is applied to a door device that has double sliding doors, it is difficult to ensure an airtight state on the door leading end sides, which are the end portion sides of the doors in the closing direction.

[0008] In light of the above-described circumstances, an object of the present invention is to provide a vehicle door device that has double sliding doors and can also ensure an airtight state that is applicable to a high-speed vehicle.

Means for Solving the Problem

[0009] A vehicle door device according to a first aspect for achieving the aforementioned object is a vehicle door device for installation in a doorway of a vehicle, including: double sliding doors that are provided as a pair and are able to open and close the doorway by moving along a side wall of the vehicle in a forward-rearward direction of the vehicle; a door open-close drive mechanism that is installed at one of the top and the bottom of the doors and drives the doors to be opened and closed; a vehicle width direction guiding mechanism that guides the doors so as to move in a vehicle width direction along with operation of the door open-close drive mechanism, the vehicle width direction being the width direction of the vehicle; first pressing mechanisms that, when the doors are in a fully-closed position, press the doors toward a vehicle body of the vehicle by pressing the doors outward in the vehicle width direction on door trailing end sides that are end portion sides in an opening direction of the doors; and second pressing mechanisms that are installed at the other of the top and the bottom of the doors and, when the doors are in the fully-closed position, press the doors toward the vehicle body by pressing the doors outward in the vehicle width direction on door leading end sides that are end portion sides in a closing direction of the doors.

[0010] According to this configuration, the double sliding doors provided as a pair are driven to be opened and closed by the operation of the door open-close drive mechanism. This enables a large number of passengers to board and get off smoothly in a short amount of time.

Also, according to this configuration, when in the fully-closed position, the door trailing end sides of the doors are pressed outward in the vehicle width direction against the vehicle body by the first pressing mechanisms. Also, at one of the top and the bottom of the doors, specifically on the side on which the door open-close drive mechanism is installed, the doors are pressed toward the vehicle body in the fully-closed position by the vehicle width direction guiding mechanism that moves the doors in the vehicle width direction along with the operation of the door open-close drive mechanism. Furthermore, at the other of the top and the bottom of the doors, specifically the side opposite to the side on which the door open-close drive mechanism is installed, the door leading end sides of the doors are pressed outward in the vehicle width direction against the vehicle body by the second pressing mechanisms when in the fully-closed position. Accordingly, the periphery of the double sliding doors is pressed closely against the vehicle body, thus making it possible to obtain an airtight door structure in which an airtight state applicable to high-speed vehicles is ensured.

[0011] Accordingly, this configuration enables providing a vehicle door device that has double sliding doors and can also ensure an airtight state that is applicable to a high-speed vehicle.

[0012] A vehicle door device according to a second aspect of the invention is the vehicle door device of the first aspect of the invention, including: a close-contact member that is installed on at least one of the door and the vehicle body and is able to come into close contact with the door and the vehicle body, wherein the close-contact member is installed so as to be interposed between the door and a portion of the vehicle body that is located outward of the door in the vehicle width direction.

[0013] According to this configuration, the close-contact member is provided, and this close-contact member is configured as a packing, and is able to come into close contact with the doors and the vehicle body at a position interposed between the doors and a portion of the vehicle body that is outward of the doors in the vehicle width direction. This enables further improving the airtightness of the double sliding door type of airtight door structure.

[0014] A vehicle door device according to a third aspect of the invention is the vehicle door device of the first or second aspect of the invention, wherein the first pressing mechanisms are installed at at least the other of the top and the bottom of the doors, and are able to press the doors in the closing direction of the doors as well.

[0015] According to this configuration, the first pressing mechanisms press the doors at at least one of the top and the bottom of the doors, specifically on the side opposite to the side on which the door open-close drive mechanism is installed. This enables the periphery of the doors to be efficiently pressed against the vehicle body by the vehicle width direction guiding mechanism and the first pressing mechanisms. Also, since the first pressing mechanisms can press the doors in the closing direction as well, the pair of door leading end sides of the doors can be pressed against each other in the closing direction, thus enabling further improving the airtightness of the double sliding door type of airtight door structure.

[0016] A vehicle door device according to a fourth aspect of the invention is the vehicle door device of the third aspect of the invention, wherein each of the first pressing mechanisms has an actuator and a link member that is installed so as to be able to swing about a shaft that extends in a vertical direction, the actuator having a cylinder mechanism, a solenoid mechanism, or a ball screw mechanism, and due to operation of the actuators, the link members swing about the shafts, press the doors outward in the vehicle width direction, and press the door trailing end sides of the doors in the closing direction of the doors.

[0017] According to this configuration, the first pressing mechanisms, which press the doors outward in the vehicle width direction against the vehicle body and also press the pair of door leading end sides of the doors against each other in the closing direction, are realized with a simple structure in which link members swing about shafts, which extend in the vertical direction, due to the operation of actuators. Also, the function of pressing the doors outward in the vehicle width direction against the vehicle body and the function of pressing the pair of door leading end sides of the doors against each other are realized by a single mechanism.

[0018] A vehicle door device according to a fifth aspect of the invention is the vehicle door device of any one of the first to fourth aspects of the invention, wherein each of the second pressing mechanisms has a cam portion that has an inclined face, and a guide roller that presses the door outward in the vehicle width direction upon coming into contact with the cam portion when the doors are in the fully-closed position, either the cam portions or the guide rollers are provided on the door leading end sides of the doors, and the other of the cam portions and the guide rollers are provided on portions of the vehicle body that oppose the door leading end sides of the doors when the doors are in the fully-closed position.

[0019] According to this configuration, the second pressing mechanisms are each configured by a cam portion and a guide roller that comes into contact with the cam portion, and therefore the doors can be pressed outward in the vehicle width direction using drive force from the door open-close drive mechanism. Also, the second pressing mechanisms, which press the doors outward in the vehicle width direction at the door leading end sides of the doors when in the fully-closed position, are realized with a simple structure in which the cam portion and the guide roller are provided on the doors and the vehicle body.

[0020] A vehicle door device according to a sixth aspect of the invention is the vehicle door device of any one of the first to fifth aspects of the invention, further including: a guiding member that is provided on the vehicle body at the top of the doors; and hanger members that

are joined to the doors so as to suspend the doors, a movement direction of the hanger members being guided by the guiding member, wherein the hanger members are installed on the guiding member so as to be able to swing along the vehicle width direction.

[0021] According to this configuration, when the doors are driven to be opened and closed by the door open-close drive mechanism, the movement of the hanger members, which suspend the doors, is guided by the guiding member while the doors are opened and closed. At this time, the hanger member can swing in the vehicle width direction relative to the guiding member, thus making it possible to suppress the extent to which momentum from the doors acts on the door open-close drive mechanism. This enables realizing a vehicle door device in which the door open-close drive mechanism is not readily damaged.

Effects of the Invention

[0022] The present invention enables providing a vehicle door device that has double sliding doors and can also ensure an airtight state that is applicable to a high-speed vehicle.

Brief Description of the Drawings

[0023]

FIG. 1 is a schematic diagram showing the entirety of a vehicle door device according to an embodiment of the present invention.
FIG. 2 is a plan view of the vehicle door device shown in FIG. 1, the vehicle door device being shown schematically as viewed from above.
FIG. 3 is an enlarged view of a portion of FIG. 2.
FIG. 4 is a diagram schematically showing the vehicle door device as viewed from the position of arrows B-B in FIG. 3.
FIG. 5 is an enlarged view of the upper portion of FIG. 4.
FIG. 6 is a plan view schematically showing a first pressing mechanism of the vehicle door device shown in FIG. 2, as well as a portion of a door.
FIG. 7 is a side view of the first pressing mechanism as viewed from the position of arrows C-C in FIG. 6.
FIG. 8 is a plan view schematically showing the first pressing mechanism of the vehicle door device shown in FIG. 2, as well as a portion of a door, the first pressing mechanism being in a state of pressing the door.
FIG. 9 is a plan view schematically showing the structure of a lower portion of the vehicle door device shown in FIG. 1, the doors being in the fully-closed position.
FIG. 10 is an enlarged view of a portion of FIG. 9.
FIG. 11 is a view corresponding to FIG. 10, and shows the doors in the state of being partially opened so as to open a portion of the doorway.
FIG. 12 is an enlarged schematic view of the state in FIG. 10 as viewed from the position of arrows E-E.
FIG. 13 is an enlarged schematic view of the state in FIG. 11 as viewed from the position of arrows F-F.

Description of Embodiments

[0024] Modes for carrying out the present invention will be described below with reference to the drawings. The present invention is applicable as a vehicle door device that is installed in the doorway of a vehicle and has double sliding doors. Note that the present embodiment is described taking the example of being applied to a door pocket type of vehicle door device in which the doors are accommodated in door pockets when in the fully-open position, but the present invention is not limited to this example, and may be applied to a plug type of door device in which a plug operation is performed.

[0025] FIG. 1 is a schematic diagram showing the entirety of a vehicle door device 1 according to an embodiment of the present invention. The vehicle door device 1 (also simply referred to hereinafter as the "door device 1") shown in FIG. 1 includes double sliding doors 11 (11a, 11b) that are provided as a pair and can open and close a doorway 102 of a vehicle by moving in the forward-rearward direction (direction indicated by a double-ended arrow A in FIG. 1) of the vehicle along a side wall 101 of the vehicle. Note that FIG. 1 is a schematic view from the interior of the vehicle, and shows the state in which the doors 11 (11a, 11b) are in the fully-closed position, that is to say, the state in which the doorway 102 of the vehicle is closed by the doors 11 (11a, 11b).

[0026] FIG. 2 is a plan view of the door device 1 and schematically shows the state of the door device 1 shown in FIG. 1 as viewed from above. Note that illustrations of the vehicle body and the like have been omitted from FIG. 2 as appropriate. The double sliding doors 11 (11a, 11b) shown in FIGS. 1 and 2 are provided as a pair, and open and close the doorway 102 by moving in the direction of separating from each other and the direction of approaching each other in the forward-rearward direction of the vehicle. In FIGS. 1 and 2, the doors 11 (11a, 11b) are depicted using solid lines when they are in the fully-closed position and have closed the doorway 102, and in FIG. 2, the doors 11 (11a, 11b) are depicted using dashed double-dotted lines when they are in the fully-open position and have opened the doorway 102. Note that as shown in FIG. 2, when the doors 11 (11a, 11b) are in the fully-open position, they are accommodated in door pockets 103 that are provided as accommodating spaces inside the side wall 101.

[0027] FIG. 3 is an enlarged view of a portion of FIG. 2. FIG. 4 is a diagram schematically showing the door device 1 as viewed from the position of arrows B-B in FIG. 3. FIG. 5 is an enlarged view of the upper portion of FIG. 4. Note that hatching indicating cross-sections has been omitted from FIGS. 4 and 5 in order to more

clearly show the structure. As shown in FIGS. 1 to 5, in addition to the doors 11 (11a, 11b), the door device 1 is configured so as to include a door open-close drive mechanism 12, guiding members 13, hanger members 14, vehicle width direction guiding mechanisms 15, pressing mechanisms 16, pressing mechanisms 17, and the like. Note that the door open-close drive mechanism 12 has been omitted from FIG. 1, is partially shown by dashed double-dotted lines in FIGS. 2 and 3, and is shown in an external view rather than a cross-sectional view in FIGS. 4 and 5. Also, FIGS. 4 and 5 show the state in which the door 11 is in the fully-open position.

[0028] The door open-close drive mechanism 12 is installed at one of the top and the bottom of the doors 11, and is provided as a mechanism for driving the doors 11 to be opened and closed. In the present embodiment, the door open-close drive mechanism 12 is installed at the top of the doors 11.

[0029] The door open-close drive mechanism 12 is configured so as to include an electric motor, a planetary gear mechanism that operates using the operation of the electric motor, a pinion to which drive force is input from the planetary gear mechanism, and a pair of racks that mesh with the pinion, for example. In the case where the door open-close drive mechanism 12 is configured as described above, the door 11a is joined to one of the racks via one joining member 19 and one hanger member 14 (see FIG. 5), and the door 11b is joined to the other rack via another joining member 19 and another hanger member 14.

[0030] When the electric motor rotates in a predetermined direction, drive force is transmitted to the door 11a and the door 11b via the planetary gear mechanisms, the pinions, the racks, the joining members 19, and the hanger members 14. The door lla and the door 11b thus move in the direction of separating from each other, for example, and the doors 11 open the doorway 102. On the other hand, when the electric motor rotates in the direction opposite to the aforementioned predetermined direction, the drive force transmitted to the door 11a and the door 11b drives them in the opposite direction. Accordingly, the door 11a and the door 11b thus move in the direction of approaching each other, for example, and the doors 11 close the doorway 102. Note that the operation of the electric motor in the door open-close drive mechanism 12 is controlled by a door controller 25 (see FIG. 5). The door controller 25 controls the open-close operation of the doors 11 by operating the door open-close drive mechanism 12 based on a door open-close command transmitted from a higher controller (not shown).

[0031] More specifically, the door open-close drive mechanism 12 may be configured as a mechanism similar to the door open-close drive mechanism disclosed in JP 2008-121244A, for example. Also, the door open-close drive mechanism 12 may be configured so as to include an electric motor, a driving pulley that is driven by the electric motor, a driven pulley, and a drive belt is wound around the driving pulley and the driven pulley so as to be able to revolve.

[0032] In the above-described case, the door 11a and the door 11b are joined to the drive belt via the respective joining members so as to move in mutually opposite directions when the drive belt revolves. When the electric motor and the driving pulley rotate in a predetermined direction, the drive belt revolves in a predetermined direction, the door 11a and the door 11b move in the direction of separating from each other, and thus the doors 11 open. On the other hand, when the electric motor and the driving pulley rotate in the direction opposite to the aforementioned predetermined direction, the drive belt revolves in the opposite direction, the door 11a and the door 11b move in the direction of approaching each other, and thus the doors 11 close. Also, the door open-close drive mechanism 12 may use a pneumatic or hydraulic motor or a pneumatic or hydraulic cylinder instead of an electric motor.

[0033] The guiding members 13 (13a, 13b) are installed in order to guide the movement of the doors 11 in the forward-rearward direction of the vehicle, and in the present embodiment, they are provided as cylindrical pipe members. The guiding members 13 (13a, 13b) are provided at the top of the doors 11 (11a, 11b) on the vehicle body, and are installed such that their lengthwise direction extends along the forward-rearward direction of the vehicle. Note that the guiding members 13 are illustrated in FIGS. 1 to 3, whereas the depiction of the guiding members 13 has been omitted from FIGS. 4 and 5.

[0034] The guiding members 13, which are provided as pipe members, are a guiding member 13a that is installed in correspondence with the door 11a at a position at the top of the door 11a, and a guiding member 13b that is installed in correspondence with the door 11b at a position at the top of the door 11b. The two end portions of each guiding member (13a, 13b) are fixed to an inner frame 104 or an upper frame 105 via fixing members 18. Note that body of the vehicle is constituted by side walls 101, the inner frame 104 that constitutes the internal structure of the vehicle, the upper frame 105 that constitutes the ceiling structure and the upper structure of the vehicle, a floor frame 106 that constitutes the floor structure of the vehicle, and the like.

[0035] The hanger members 14 are provided as members that are joined to the doors 11 (11a, 11b) such that the doors 11 (11a, 11b) are suspended therefrom, and the direction of their movement is guided by the guiding members 13 (13a, 13b). The hanger members 14 (14a, 14b) are provided as a pair. The one hanger member 14a is joined to the door 11a such that the door 11a is suspended therefrom, and the direction of its movement is guided by the guiding member 13a. The other hanger member 14b is joined to the door 11b such that the door 11b is suspended therefrom, and the direction of its movement is guided by the guiding member 13b.

[0036] The hanger member 14a and the hanger mem-

ber 14b have a similar configuration. In view of this, the following describes the structure of the hanger member 14a, and a description will not be given for the structure of the hanger member 14b.

[0037] The hanger member 14a is provided with a forward-rearward moving portion 20a that moves along the guiding member 13a in the forward-rearward direction of the vehicle, a swinging portion 20b capable of swinging relative to the forward-rearward moving portion 20a, and the like. The forward-rearward moving portion 20a is installed extending along the up-down direction, the one end thereof on the upper side being rotatably joined to the guiding member 13a, and the swinging portion 20b being rotatably joined to the other end on the lower side.

[0038] Note that a through-hole having a circular cross-section is formed in the end portion of the forward-rearward moving portion 20a on the one side, and the guiding member 13a is inserted into this through-hole in a loosely fitted state. Accordingly, the forward-rearward moving portion 20a is configured so as to be able to move along the guiding member 13a, and also be able to rotate so as to swing relative to the guiding member 13a at the end portion on the one side. Also, the end portion of the forward-rearward moving portion 20a on the one side is swingably joined to one of the racks of the door open-close drive mechanism 12 via one of the joining members 19. Accordingly the hanger member 14a is configured so as to be driven along the guiding member 13a in the forward-rearward direction when the door open-close drive mechanism 12 operates.

[0039] The swinging portion 20b is installed along the horizontal direction, and the one end side thereof on the inner side in the vehicle width direction, which is the width direction of the vehicle, is rotatably joined to the other end side of the forward-rearward moving portion 20a. The other end side of the swinging portion 20b on the outer side in the vehicle width direction is joined to the door 11a such that the door 11a is suspended therefrom. Accordingly, the hanger member 14a is installed so as to be able to swing relative to the guiding member 13a along the vehicle width direction.

[0040] The vehicle width direction guiding mechanisms 15 are provided as mechanisms that guide the doors 11 (11a, 11b) so as to move in the vehicle width direction, which is the width direction of the vehicle, along with the operation of the door open-close drive mechanism 12. The vehicle width direction guiding mechanisms 15 (15a, 15b) are provided as a pair. The one vehicle width direction guiding mechanism 15a is installed at the top of the door 11a, and is configured so as to guide the door 11a so as to move in the vehicle width direction. The other vehicle width direction guiding mechanism 15b is installed at the top of the door 11b, and is configured so as to guide the door 11b so as to move in the vehicle width direction.

[0041] The vehicle width direction guiding mechanism 15a and the vehicle width direction guiding mechanism 15b have a similar configuration. In view of this, the following describes the structure of the vehicle width direction guiding mechanism 15a, and a description will not be given for the structure of the vehicle width direction guiding mechanism 15b.

[0042] In the present embodiment, the vehicle width direction guiding mechanism 15a is configured so as to include a guiding rail 21 and a moving roller 22. The guiding rail 21 is provided as a rail member that extends along the forward-rearward direction of the vehicle parallel to the guiding member 13a, and is installed on the upper frame 105 at a position at the top of the door 11a. A groove is provided in the guiding rail 21 as a track along which the moving roller 22 rolls, and this groove is defined by a pair of wall portions installed parallel to each other along the vertical direction, is open downward, and extends along the lengthwise direction of the guiding rail 21. Also, the guiding rail 21 is provided with an inclined portion 21a in the end portion on the side toward the center of the doorway 102 in the forward-rearward direction of the vehicle, and the inclined portion 21 is formed with a curvature so as to be inclined relative to the forward-rearward direction of the vehicle.

[0043] The moving roller 22 is rotatably installed on the swinging portion 20b of the hanger member 14a. Note that this moving roller 22 is installed on the upper face side of the swinging portion 20b so as to rotate in a horizontal plane about a shaft extending in the vertical direction. Also, the moving roller 22 is installed so as to roll along the groove of the guiding rail 21 while coming into contact with the inner side of one of the wall portions that define the groove of the guiding rail 21. The moving roller 22 is configured so as to roll along the portion of the groove of the guiding rail 21 that extends in a straight line in the forward-rearward direction of the vehicle, and roll along the inclined portion 21a of the groove of the guiding rail 21 as well.

[0044] Due to the moving roller 22 having the above-described configuration, when the door open-close drive mechanism 12 operates and the hanger member 14a moves along the guiding member 13a in the forward-rearward direction of the vehicle, the moving roller 22 moves along the groove of the guiding rail 21. When the moving roller 22 moves along the inclined portion 21a of the guiding rail 21, the moving roller 22 moves in the vehicle width direction as well. Accordingly, the swinging portion 20b moves in the vehicle width direction along with the moving roller 22, and the hanger member 14a swings relative to the guiding member 13a.

[0045] Note that in FIGS. 4 and 5, the door 11a and the hanger member 14a are depicted using solid lines when the door 11 is in the fully-open position, and the door 11a and the hanger member 14a are depicted using dashed double-dotted lines when the door 11 is in the fully-closed position. As shown in FIGS. 4 and 5, as the door 11 is closed, the hanger member 14a swings outward in the vehicle width direction due to the moving roller 22 moving along the inclined portion 21a of the guiding rail 21. The door 11a joined to the swinging portion 20b

thus also moves outward in the vehicle width direction.

[0046] The pressing mechanisms 16 configure the first pressing mechanisms of the present embodiment. These pressing mechanisms 16 are provided as mechanisms that, when the doors 11 are in the fully-closed position, press the doors 11 toward the vehicle body by pressing the doors 11 outward in the vehicle width direction on the door trailing end sides, which are the end portion sides of the doors 11 in the opening direction. Also, in the present embodiment, the pressing mechanisms 16 are provided so as to be able to press the doors 11 in the closing direction of the doors 11 as well, as will be described later.

[0047] Note that the door device 1 includes a doorway packing 23, which is made of rubber, as a close-contact member of the present embodiment that can come into close contact with the doors 11 and the vehicle body. In the present embodiment, the doorway packing 23 is installed on the inner side, in the vehicle width direction, of the peripheral portion of the doorway 102 on the side wall 101, which is part of the vehicle body. Also, this doorway packing 23 is installed so as to extend along the entire circumference of the peripheral portion of the doorway 102. Accordingly, the doorway packing 23 is installed so as to be interposed between the doors 11 and the portion of the vehicle body that is located outward of the doors 11 in the vehicle width direction.

[0048] Due to providing the doorway packing 23 as described above, when the doors 11 are in the fully-closed position and the pressing mechanisms 16 press the doors 11 outward in the vehicle width direction, the doors 11 are pressed against the peripheral portion of the doorway 102 via the doorway packing 23. Accordingly, the doors 11 and the side wall 101 of the vehicle body are in close contact via the doorway packing 23, and an airtight state is ensured between the doors 11 and the vehicle body in the doorway 102.

[0049] Also, the doors (11a, 11b) are respectively provided with door leading end side packings (24a, 24b), which are made of rubber, on the door leading end sides of the doors (11a, 11b), which are the end portion sides in the closing direction. The door leading end side packing 24a is provided on the door leading end side of the door 11a, and the door leading end side packing 24b is provided on the door leading end side of the door 11b. The door leading end side packings (24a, 24b) are installed so as to extend along the entire vertical length of the end portions of the doors (11a, 11b) on the door leading end side. Also, the door leading end side packing 24a and the door leading end side packing 24b are configured so as to come into close contact and fit with each other when the doors 11 (11a, 11b) are in the fully-closed position (see FIGS. 2 and 3).

[0050] When the doors 11 are in the fully-closed position and the pressing mechanisms 16 press the doors 11 in the closing direction of the doors 11 as well, the door 11a and the door 11b are pressed against each other via the door leading end side packings (24a, 24b). Accordingly, the door 11a and the door 11b are in close contact via the door leading end side packings (24a, 24b), and an airtight state is ensured between the door 11a and the door 11b in the doorway 102.

[0051] The configuration of the pressing mechanisms 16 will be described in more detail below Multiple pressing mechanisms 16 are installed, and in the present embodiment, four of them are installed. Two pressing mechanisms 16 are provided on the door trailing end side of the door 11a, and another two are provided on the door trailing end side of the door 11b.

[0052] Out of the two pressing mechanisms 16 installed on the door trailing end side of each of the doors (11a, 11b), one of them is installed at position that is on the upper half side of the corresponding door 11, and is a little higher than the central position of the door 11 in the vertical direction. Also, the other one of the two pressing mechanisms 16 installed on the door trailing end side of each of the doors (11a, 11b) is installed at a position at the bottom of the corresponding door 11. Accordingly, the pressing mechanisms 16 are installed at at least the other one of the top and the bottom of the doors 11, that is to say, at the bottom of the doors 11 in the present embodiment, which is the side on which the door open-close drive mechanism 12 is not installed.

[0053] Note that the pressing mechanism 16 installed on the upper half side of the door trailing end side of the door 11a and the pressing mechanism 16 installed on the upper half side of the door trailing end side of the door 11b are both installed at the same height in the vertical direction. Also, the pressing mechanism 16 installed at the position at the bottom of the door trailing end side of the door 11a and the pressing mechanism 16 installed at the position at the bottom of the door trailing end side of the door 11b are both installed at the same height in the vertical direction.

[0054] FIG. 6 is a plan view schematically showing the pressing mechanism 16 installed at the position at the bottom of the door trailing end side of the door 11a, as well as a portion of the door 11a. FIG. 7 is a side view of the pressing mechanism 16 as viewed from the position of arrows C-C in FIG. 6. Note that hatching indicating the cross-section of the door 11a has been omitted from FIG. 6 (the same follows for later-described FIG. 8). The pressing mechanisms 16 installed at the upper half side position and the bottom position of the door trailing end side of the door 11a have similar configurations. Also, the pressing mechanisms 16 installed at the upper half side position and the bottom position of the door trailing end side of the door 11b have similar configurations.

[0055] Also, with the pressing mechanism 16 installed on the door trailing end side of the door 11a and the pressing mechanism 16 installed on the door trailing end side of the door 11b, the respective arrangements of the constituent elements in the forward-rearward direction of the vehicle are set so as to be opposite from each other. Specifically, the arrangement of the constituent elements in the forward-rearward direction of the vehicle and the

vehicle width direction in the pressing mechanism 16 installed on the door trailing end side of the door 11b is set so as to be symmetrical to the arrangement of the constituent elements of the pressing mechanism 16 installed on the door trailing end side of the door 11a, the symmetry being about a central position in a virtual plane that passes through the central position of the doorway 102 in the forward-rearward direction of the vehicle and extends in the vehicle width direction.

[0056] As described above, the four pressing mechanisms 16 are configured so as to include similar constituent elements, and therefore the following describes the structure of the pressing mechanism 16 installed at the position at the bottom of the door trailing end side of the door 11a, and the structures of the other pressing mechanisms 16 will not be described.

[0057] The pressing mechanism 16 is installed on the vehicle body, that is to say, is installed on the inner frame 104, for example. The pressing mechanism 16 includes a base portion 26, an actuator 27, a link member 28, and the like. The base portion 26 is provided as a plate-shaped member, is fixed to the inner frame 104, and is installed such that the portion spreading out planarly spreads out along the horizontal direction. The actuator 27 and the link member 28 are installed on the base portion 26.

[0058] The actuator 27 is configured so as to include a cylinder mechanism that operates by a rod being displaced relative to the cylinder body due to compressed air being supplied and discharged, for example. Note that the actuator 27 may be configured so as to include a solenoid mechanism that operates by the position of a magnetic body being displaced relative to a coil due to the coil being switched between an excited state and a non-excited state, or may be configured so as to include a mechanism that uses a ball screw driven by an electric motor.

[0059] The present embodiment gives the example of an actuator 27 configured as a cylinder mechanism provided with a cylinder body 27a and a rod 27b. The actuator 27 operates in accordance with a command from the door controller 25. When an electromagnetic valve (not shown) is switched in accordance with a command signal from the door controller 25, compressed air is supplied from a compressed air source (not shown) to the cylinder body 27a, and the rod 27b moves into the cylinder body 27a so as to retract. Also, when the electromagnetic valve is switched in accordance with a command signal from the door controller 25, compressed air is discharged from the cylinder body 27a, and the rod 27b extends out of the cylinder body 27a so as to protrude.

[0060] The link member 28 is provided as a plate-shaped member that extends with a bend, and is configured as a member that has two end portions that extend from the central portion toward respective directions that form an obtuse angle. The link member 28 is rotatably attached to a swing shaft 29, which is fixed to the base portion 26 and shaped as a round rod that extends in the vertical direction, in the central portion thereof. Accordingly, the link member 28 is installed so as to be able to swing about the swing shaft 29, which configures a shaft that extends in the vertical direction on the present embodiment.

[0061] Also, the link member 28 has a pressing roller 28a that is rotatably joined to the end portion on one end side that extends so as to protrude outward in the vehicle width direction relative to the central portion, which is rotatably joined to the swing shaft 29. Furthermore, the end portion of the link member 28 on the other end side, which extends so as to protrude inward in the vehicle width direction relative to the central portion that is rotatably joined to the swing shaft 29, is joined to the tip portion of the rod 27b via a joining shaft 30. The joining shaft 30 penetrates an elongated through-hole 28b, which is formed in the end portion of the link member 28 on the other end side, in a loosely fitted state.

[0062] FIG. 6 shows the pressing mechanism 16 in the state in which the rod 27b has extended out of the cylinder body 27a. On the other hand, FIG. 8 is a plan view schematically showing the first pressing mechanism 16 as well as a portion of the door 11a similarly to FIG. 6, and shows the pressing mechanism 16 in the state in which the rod 27b has retracted into the cylinder body 27a.

[0063] Due to the position of the rod 27b becoming displaced by the operation of the actuator 27, the link member 28 swings about the swing shaft 29 along with the displacement of the position of the rod 27b. Then, due to the rod 27b becoming displaced from the extended position to the retracted position, that is to say due to shifting from the state shown in FIG. 6 to the state shown in FIG. 8, the link member 28 swings about the swing shaft 29, and the outer circumferential face of the pressing roller 28a presses against a door-side contact portion 31 that is provided on the end portion of the door 11a on the door trailing end side.

[0064] The door-side contact portion 31, which is provided at a position that comes into contact with the pressing roller 28a in the end portion of the door 11a on the door trailing end side, is provided with a recessed portion 31a that has an arc-shaped recessed cross-section in correspondence with the outer circumferential face of the cylindrical pressing roller 28a. When the rod 27b retracts into the cylinder body 27a and the link member 28 swings, the pressing roller 28a of the link member 28 presses the recessed portion 31a of the door-side contact portion 31 in the directions indicated by an arrow D1 and an arrow D2 in FIG. 8. In other words, when the rod 27b retracts and the link member 28 swings, the link member 28 presses the door 11a outward in the vehicle width direction (the direction indicated by the arrow D1 in FIG. 8) as well as presses the door trailing end side of the door 11a in the closing direction of the door 11 (the direction indicated by the arrow D2 in FIG. 8).

[0065] Note that in addition to the actuator 27 and the link member 28, a limit switch mechanism 32 is also installed on the base portion 26. The limit switch mecha-

nism 32 has a head portion 32a that comes into contact with a limit switch contact portion 27c that has an inclined face and is attached to the tip-side end portion of the rod 27b. When the rod 27b becomes displaced, the head portion 32a becomes displaced along the inclined face of the limit switch contact portion 27c. The operating state of the actuator 27 is thus detected in the limit switch mechanism 32. Note that a signal regarding the operating state of the actuator 27 detected by the limit switch mechanism 32 is acquired by the door controller 25. The door controller 25 can thus become aware of the operating state of the pressing mechanism 16.

[0066] The pressing mechanisms 17 configure the second pressing mechanisms of the present embodiment. Accordingly, the pressing mechanisms 17 are installed at the other one of the top and the bottom of the doors 11, that is to say, at the bottom of the doors 11 in the present embodiment, which is the side on which the door open-close drive mechanism 12 is not installed. These pressing mechanisms 17 are configured as mechanisms that, when the doors 11 are in the fully-closed position, press the doors 11 toward the side wall 101 of the vehicle body by pressing the doors 11 outward in the vehicle width direction on the door leading end side of the doors 11.

[0067] Note that as described above, the doorway packing 23 is provided in the peripheral portion of the doorway 102 on the side wall 101. Accordingly, when the doors 11 are in the fully-closed position, and the pressing mechanisms 17 press the doors 11 outward in the vehicle width direction, the doors 11 are pressed against the peripheral portion of the doorway 102 via the doorway packing 23. Accordingly, the doors 11 and the side wall 101 of the vehicle body are in close contact via the doorway packing 23, and an airtight state is ensured between the doors 11 and the vehicle body in the doorway 102.

[0068] The configuration of the pressing mechanisms 17 will be described in more detail below FIG. 9 is a plan view schematically showing the structure of a lower portion of the door device 1, the doors 11 being in the fully-closed position. FIG. 10 is an enlarged view of a portion of FIG. 9. FIG. 11 is a view corresponding to FIG. 10, and shows the doors 11 in the state of being partially opened so as to open a portion of the doorway 102. FIG. 12 is an enlarged schematic view of the state in FIG. 10 as viewed from the position of arrows E-E. FIG. 13 is an enlarged schematic view of the state in FIG. 11 as viewed from the position of arrows F-F. Note that hatching indicating cross-sections has been omitted from FIGS. 9 to 13 in order to more clearly show the structure.

[0069] The pressing mechanisms 17 (17a, 17b) shown in FIGS. 9 to 12 are provided as a pair in correspondence with the doors 11 (11a, 11b). Specifically, the pressing mechanism 17a is installed in correspondence with the door 11a at a position at the bottom of the door 11a, and the pressing mechanism 17b is installed in correspondence with the door 11b at a position at the bottom of the door 11b. Note that the pressing mechanism 17a and the pressing mechanism 17b have a similar configuration. In view of this, the following describes the structure of the pressing mechanism 17a, and a description will not be given for the structure of the pressing mechanism 17b.

[0070] The pressing mechanism 17a is configured so as to include a cam portion 33 that has an inclined face 33a, and a guide roller 34. The cam portion 33 is provided as a thick plate-shaped member, and is provided on the door leading end side of a lower end portion 35 of the door 11a. Also, the inclined face 33a is formed at an end portion of the cam portion 33 arranged on the door leading end side.

[0071] The guide roller 34 is installed on the floor frame 106, which is part of the vehicle body, and is installed so as to be able to come into contact with the cam portion 33. The guide roller 34 is installed so as to be able to rotate about a rotation shaft 34a that is fixed to the floor frame 106 and extends in the vertical direction. Also, the guide roller 34 is provided on a portion of the floor frame 106 that opposes the door leading end side of the door 11a when the door 11a is in the fully-closed position. Furthermore, the guide roller 34 is installed so as to press the door 11a outward in the vehicle width direction due to coming into contact with the cam portion 33 when the door 11a is in the fully-closed position.

[0072] In the state shown in FIG. 11, the guide roller 34 is in contact with the inner face, with respect to the vehicle width direction, of the lower end portion 35 of the door 11a. When the door 11a moves in the closing direction from this state, the cam portion 33 also moves along with the door 11a, and the inclined face 33a comes into contact with the outer circumferential face of the guide roller 34. The inclined face 33a then moves along the outer circumferential face of the guide roller 34, and the cam portion 33 becomes displaced outward in the vehicle width direction. Accordingly, the lower end portion 35 of the door 11a becomes displaced outward in the vehicle width direction along with the cam portion 33. Then, as shown in FIGS. 10 and 12, when the door 11a is in the fully-closed position, the door 11a is pressed outward in the vehicle width direction by the guide roller 34. At this time, the lower end portion 35 of the door 11 and the side wall 101 of the vehicle body come into close contact with each other via the doorway packing 23, and the airtight state is ensured between the door 11 and the vehicle body in the doorway 102.

[0073] Note that as shown in FIGS. 9 to 11 and 13, the door device 1 includes support roller units 36. Each support roller unit 36 is configured so as to include a base 36a that is fixed to the floor frame 106, a rotation shaft 36b that is fixed to the base 36a, a support roller 36c that is rotatably attached to the rotation shaft 36b, and the like. The support roller 36c is installed such that its outer circumferential face can come into contact with the inner face, in terms of the vehicle width direction, of the lower end portion 35 of the door 11a. Accordingly, with this configuration, when the door 11a moves in the forward-rearward direction of the vehicle while the cam portion

33 is not in contact with the guide roller 34, the movement direction of the door 11a is guided by the support roller 36c as well.

[0074] The following describes the operation of the door device 1 when the doors 11 are closed. When the doors 11 are in the fully-open position, the door open-close drive mechanism 12 operates based on an instruction to close the doors 11 from the door controller 25, and an operation for closing the doors 11 is performed. In this case, due to the operation of the door open-close drive mechanism 12, the joining members 19 and the hanger members 14 (14a, 14b) that are joined to the pair of racks in the door open-close drive mechanism 12 move in the direction of approaching each other. The doors (11 (11a, 11b) also move in the direction of approaching each other along with the hanger members 14. At this time, the movement direction of the hanger members 14 is guided by the guiding member 13 (13a, 13b).

[0075] When the doors 11 (11a, 11b) move to a position close to the fully-closed position, the moving rollers 22 move outward in the vehicle width direction along the inclined portions 21a of the guiding rail 21, and the hanger members 14 (14a, 14b) also swing outward in the vehicle width direction. Accordingly, the doors 11 (11a, 11b) also move outward in the vehicle width direction. Then, when the doors 11 (11a, 11b) are in the fully-closed position, the doors 11 (11a, 11b) come into close contact with the doorway packing 23 and are pressed against the vehicle body.

[0076] Also, when the doors 11 (11a, 11b) move to a position close to the fully-closed position, the pressing mechanisms 17 (17a, 17b) also operate. Specifically, at this time, the cam portion 33 comes into contact with the guide roller 34, and the lower end portion 35 of the door 11a is pressed outward in the vehicle width direction by the guide roller 34. Then, when the doors 11 (11a, 11b) are in the fully-closed position, the doors 11 (11a, 11b) come into close contact with the doorway packing 23 and are pressed against the vehicle body.

[0077] When the doors 11 (11a, 11b) are in the fully-closed position as described above, the pressing mechanisms 16 subsequently operate based on a command signal from the door controller 25. At this time, each pressing mechanism 16 operates such that the rod 27b of the actuator 27 retracts into the cylinder body 27a. Accordingly, the link member 28 swings about the swing shaft 29. The recessed portion 31a of the door-side contact portion 31 on the door trailing end side of the door 11 (11a, 11b) is then pressed by the pressing roller 28a outward in the vehicle width direction, and also in the closing direction of the doors 11 (11a, 11b). Accordingly, the doors 11 (11a, 11b) are pressed against the vehicle body while being in close contact with the doorway packing 23, and are also pressed such that their door leading end sides come into close contact with each other.

[0078] When the doors 11 open, the operation of the door device 1 is the opposite of the above-described operation. Firstly, the actuators 27 operate such that the rods 27b extend from the cylinder bodies 27a based on a command signal from the door controller 25. Accordingly, the operation of the pressing mechanisms 16 for pressing the doors 11 (11a, 11b) is canceled.

[0079] The door open-close drive mechanism 12 then operates based on a command to open the doors 11 from the door controller 25, and an operation for opening the doors 11 is started. The moving rollers 22 move inward in the vehicle width direction along the inclined portions 21a of the guiding rails 21, and the hanger members 14 (14a, 14b) also swing inward in the vehicle width direction. Accordingly, the operation in which the doors 11 (11a, 11b) are pressed against the vehicle body via the doorway packing 23 is canceled. Also, at this time, the cam portions 33 move away from the guide rollers 34, and the operation in which the lower end portions 35 of the doors 11 (11a, 11b) are pressed against the vehicle body via the doorway packing 23 is also canceled.

[0080] After the operation for pressing the doors 11 (11a, 11b) is canceled, the operation of the door open-close drive mechanism 12 continues, and thus the joining members 19 and the hanger members 14 (14a, 14b) that are joined to the pair of racks of the door open-close drive mechanism 12 move in the direction of separating from each other. The doors 11 (11a, 11b) also move in the direction of separating from each other along with the hanger members 14. At this time, the movement direction of the hanger members 14 is guided by the guiding member 13 (13a, 13b). When the doors 11 (11a, 11b) reach the fully-open position, the doors 11 (11a, 11b) become accommodated in the door pockets 103.

[0081] According to the door device 1 described above, the double sliding doors 11 (11a, 11b) provided as a pair are opened and closed by the operation of the door open-close drive mechanism 12. This enables a large number of passengers to board and get off smoothly in a short amount of time. Also, according to the door device 1, when in the fully-closed position, the door trailing end sides of the doors 11 (11a, 11b) are pressed by the pressing mechanisms 16 outward in the vehicle width direction against the vehicle body. Also, at the top of the doors 11 (11a, 11b), which are on the side where the door open-close drive mechanism is installed, the doors 11 (11a, 11b) are pressed toward the vehicle body when in the fully-closed position by the vehicle width direction guiding mechanisms 15 (15a, 15b) that move the doors 11 (11a, 11b) in the vehicle width direction along with the operation of the door open-close drive mechanism 12. Furthermore, at the bottom of the doors 11 (11a, 11b), which are on the side opposite to the side on which the door open-close drive mechanism 12 is installed, the door leading end sides of the doors 11 (11a, 11b) are pressed outward in the vehicle width direction against the vehicle body by the pressing mechanisms 17 (17a, 17b) when in the fully-closed position. Accordingly, the periphery of the double sliding doors 11 (11a, 11b) is pressed closely against the vehicle body, thus making it possible to obtain an airtight door structure in which an airtight state applicable to high-

speed vehicles is ensured.

[0082] Accordingly the present embodiment enables providing a vehicle door device 1 that has double sliding doors 11 (11a, 11b) and can ensure an airtight state that is applicable to high-speed vehicles.

[0083] Also, the door device 1 is provided with the doorway packing 23 that is provided between the doors 11 (11a, 11b) and a portion of the vehicle body on the outer side in the vehicle width direction, and can come into close contact with the doors 11 (11a, 11b) and the vehicle body. This enables further improving the airtightness of the double sliding door type of airtight door structure.

[0084] Also, according to the door device 1, the pressing mechanisms 16 press the doors 11 (11a, 11b) at at least positions at the bottom of the doors 11 (11a, 11b), which are on the side opposite to the side on which the door open-close drive mechanism 12 is installed. This enables efficiently pressing the periphery of the doors 11 (11a, 11b) against the vehicle body using the vehicle width direction guiding mechanisms 15 (15a, 15b) and the pressing mechanisms 16. Also, since the pressing mechanisms 16 can press the doors 11 (11a, 11b) in the closing direction as well, the pair of door leading end sides of the doors 11 (11a, 11b) can be pressed against each other in the closing direction, and it is possible to further improve the airtightness of the double sliding door type of airtight door structure.

[0085] Also, according to the door device 1, the pressing mechanisms 16, which press the doors 11 (11a, 11b) outward in the vehicle width direction against the vehicle body and also press the pair of door leading end sides of the doors 11 (11a, 11b) against each other in the closing direction, are realized with a simple structure in which the link members 28 swing about the swing shafts 29, which extend in the vertical direction, due to the operation of the actuators 27. Also, the function of pressing the doors 11 (11a, 11b) outward in the vehicle width direction against the vehicle body and the function of pressing the pair of door leading end sides of the doors 11 (11a, 11b) against each other are realized by a single mechanism.

[0086] Also, according to the door device 1, the pressing mechanisms 17 (17a, 17b) are configured by a cam portion 33 and a guide roller 34 that comes into contact with the cam portion 33, and therefore the doors 11 (11a, 11b) can be pressed outward in the vehicle width direction using drive force from the door open-close drive mechanism 12. Also, the pressing mechanisms 17 (17a, 17b), which press the doors 11 (11a, 11b) outward in the vehicle width direction at the door leading end sides of the doors 11 (11a, 11b) when in the fully-closed position, are realized with a simple structure in which the cam portion 33 and the guide roller 34 are provided on the doors 11 (11a, 11b) and the vehicle body.

[0087] Also, according to the door device 1, when the doors 11 (11a, 11b) are to be opened and closed by the door open-close drive mechanism 12, the movement direction of the hanger members 14 (14a, 14b), which suspend the doors 11 (11a, 11b), is guided by the guiding members 13 (13a, 13b) while the doors 11 (11a, 11b) are opened and closed. At this time, the hanger members 14 (14a, 14b) can swing in the vehicle width direction relative to the guiding members 13 (13a, 13b), thus making it possible to suppress the extent to which momentum from the doors 11 (11a, 11b) acts on the door open-close drive mechanism 12. This enables realizing a vehicle door device 1 in which the door open-close drive mechanism 12 is not readily damaged.

[0088] Although an embodiment of the present invention is described above, the present invention is not limited to the above-described embodiment, and can be carried out with various modifications within the scope of the claims. For example, the present invention may be carried out with the following modifications.

(1) The above embodiment is described taking the example of a mode in which the doorway packing, which is provided as a close-contact member able to come into close contact with the door and the vehicle body, is installed on the vehicle body, but this need not be the case. The close-contact member capable of coming into close contact with the door and the vehicle body need only be installed on at least one of the door and the vehicle body.

(2) The above embodiment is described taking the example of a mode in which the door open-close drive mechanism is configured so as to include a planetary gear mechanism and a rack-and-pinion mechanism, but this need not be the case. It is possible to implement a door open-close drive mechanism that is configured so as to include a driving wheel member and a driven wheel member that are configured as pulleys, sprockets, or the like, and an endless member configured as a belt, a chain, a wire, or the like that is wound around the driving wheel member and the driven wheel member.

(3) The above embodiment is described taking the example of a mode in which the door open-close drive mechanism is installed at the top of the doors, and the second pressing mechanisms are installed at the bottom of the doors, but this need not be the case. A mode may be implemented in which the door open-close drive mechanism is installed at the bottom of the doors, and the second pressing mechanisms are installed at the top of the doors.

(4) The above embodiment is described taking the example of a mode in which the second pressing mechanisms are configured such that the cam portion is provided on the door, and the guide roller is provided on the vehicle body, but this need not be the case. A mode may be implemented in which the cam portion is provided on the vehicle body, and the guide roller is provided on the door.

(5) The above embodiment is described taking the example of a mode in which the vehicle width direction guiding mechanism is configured so as to include a guiding rail and a moving roller, but this need

not be the case. The vehicle width direction guiding mechanism may be configured as, for example, a linking mechanism for swinging the doors along the vehicle width direction when the doors move in the vicinity of the fully-closed position.

Industrial Applicability

[0089] The present invention is widely applicable as a vehicle door device for installation in the doorway of a vehicle.

Descriptions of Reference Numerals

[0090]

1	Vehicle door device
11, 11a, 11b	Door
12	Door open-close drive mechanism
15, 15a, 15b	Vehicle width direction guiding mechanism
16	Pressing mechanism (first pressing mechanism)
17, 17a, 17b	Pressing mechanism (second pressing mechanism)
102	Doorway

Claims

1. A vehicle door device for installation in a doorway of a vehicle, comprising:

double sliding doors that are provided as a pair and are able to open and close the doorway by moving along a side wall of the vehicle in a forward-rearward direction of the vehicle;
a door open-close drive mechanism that is installed at one of the top and the bottom of the doors and drives the doors to be opened and closed;
a vehicle width direction guiding mechanism that guides the doors so as to move in a vehicle width direction along with operation of the door open-close drive mechanism, the vehicle width direction being the width direction of the vehicle;
first pressing mechanisms that, when the doors are in a fully-closed position, press the doors toward a vehicle body of the vehicle by pressing the doors outward in the vehicle width direction on door trailing end sides that are end portion sides in an opening direction of the doors; and
second pressing mechanisms that are installed at the other of the top and the bottom of the doors and, when the doors are in the fully-closed position, press the doors toward the vehicle body by pressing the doors outward in the vehicle width direction on door leading end sides that are end portion sides in a closing direction of the doors.

2. The vehicle door device according to claim 1, comprising:

a close-contact member that is installed on at least one of the door and the vehicle body and is able to come into close contact with the door and the vehicle body,
wherein the close-contact member is installed so as to be interposed between the door and a portion of the vehicle body that is located outward of the door in the vehicle width direction.

3. The vehicle door device according to claim 1 or 2, wherein the first pressing mechanisms are installed at at least the other of the top and the bottom of the doors, and are able to press the doors in the closing direction of the doors as well.

4. The vehicle door device according to claim 3, wherein each of the first pressing mechanisms has an actuator and a link member that is installed so as to be able to swing about a shaft that extends in a vertical direction, the actuator having a cylinder mechanism, a solenoid mechanism, or a ball screw mechanism, and
due to operation of the actuators, the link members swing about the shafts, press the doors outward in the vehicle width direction, and press the door trailing end sides of the doors in the closing direction of the doors.

5. The vehicle door device according to any one of claims 1 to 4,
wherein each of the second pressing mechanisms has a cam portion that has an inclined face, and a guide roller that presses the door outward in the vehicle width direction upon coming into contact with the cam portion when the doors are in the fully-closed position,
either the cam portions or the guide rollers are provided on the door leading end sides of the doors, and the other of the cam portions and the guide rollers are provided on portions of the vehicle body that oppose the door leading end sides of the doors when the doors are in the fully-closed position.

6. The vehicle door device according to any one of claims 1 to 5, further comprising:

a guiding member that is provided on the vehicle body at the top of the doors; and

hanger members that are joined to the doors so as to suspend the doors, a movement direction of the hanger members being guided by the guiding member,

wherein the hanger members are installed on the guiding member so as to be able to swing along the vehicle width direction.

FIG. 1

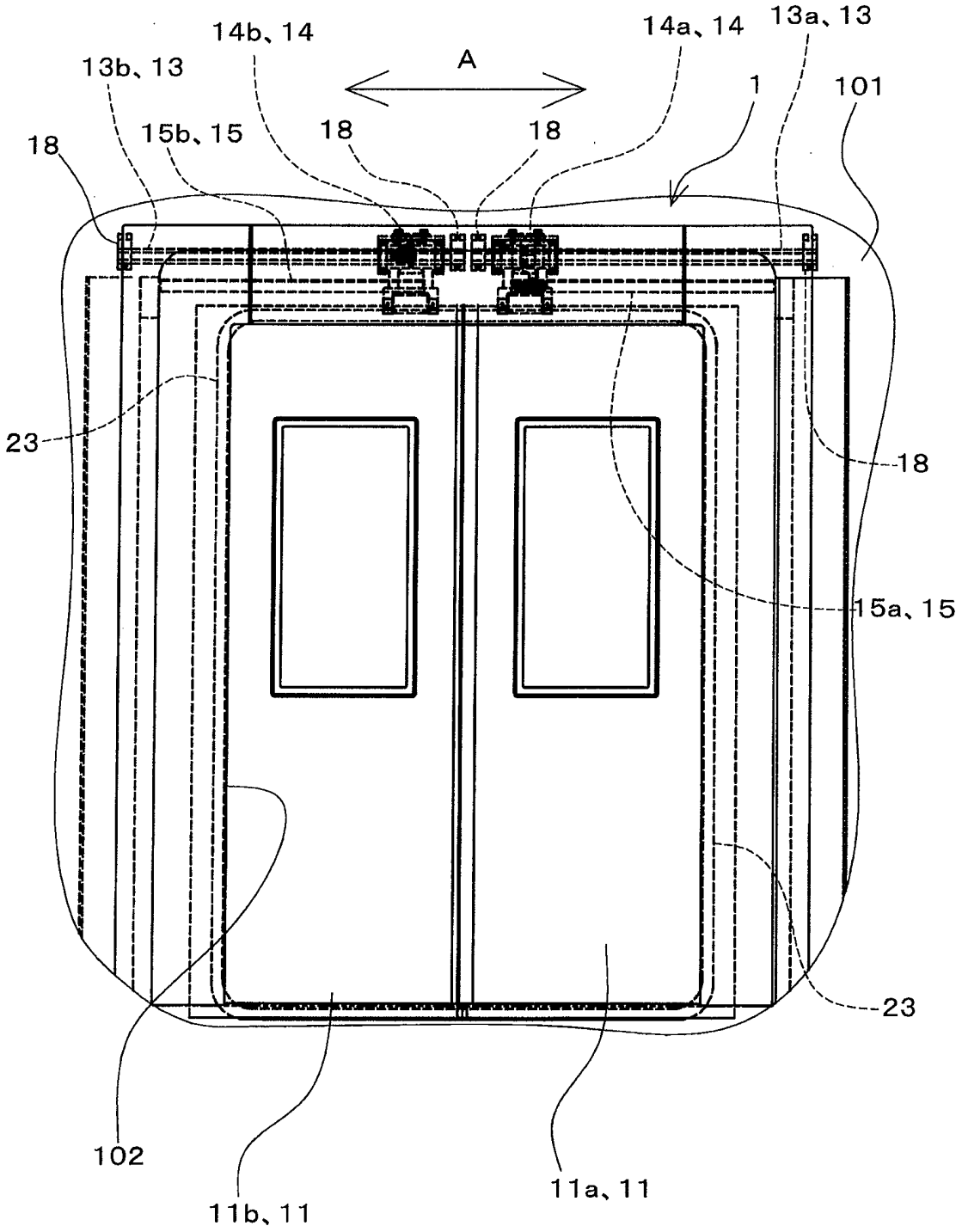
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FIG. 2

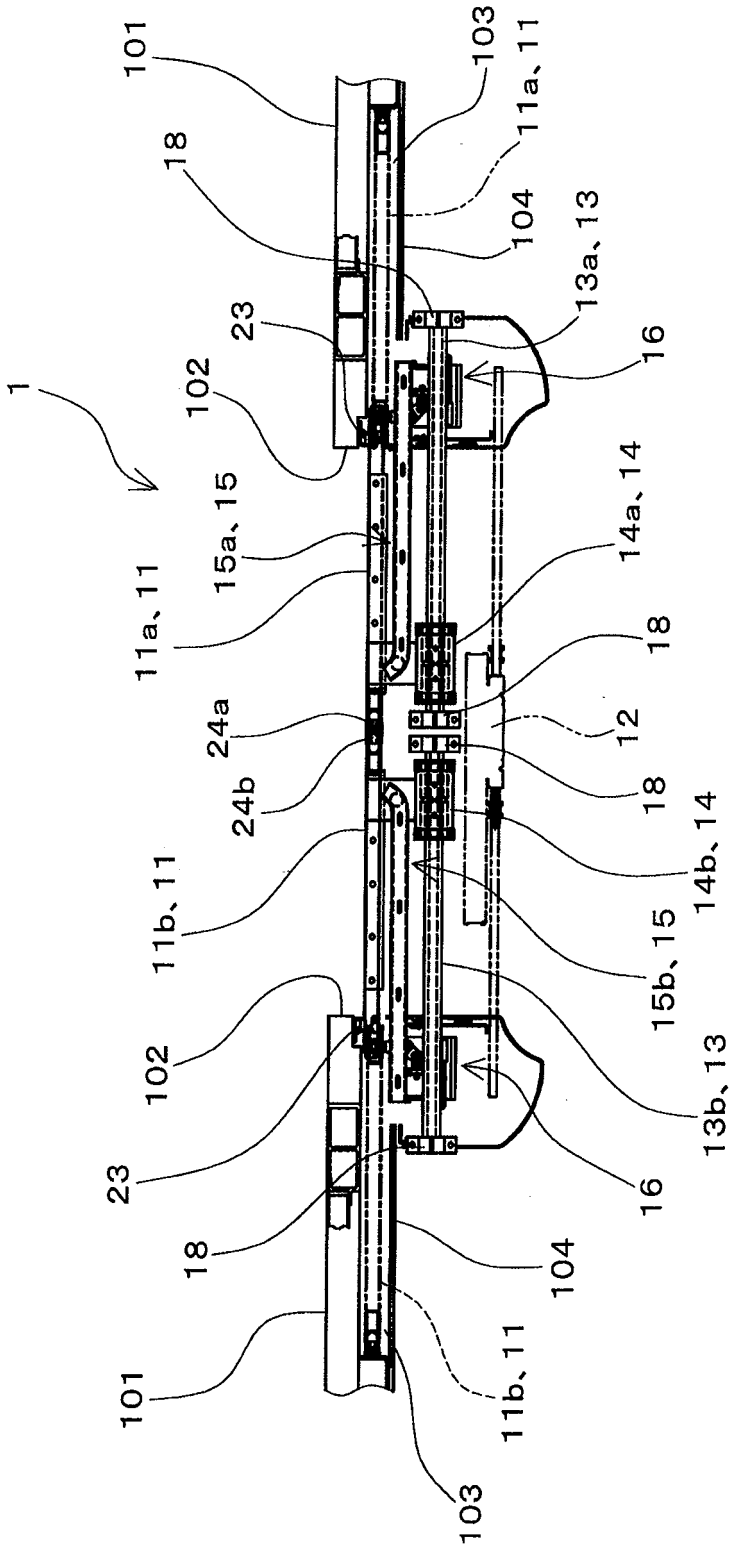
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FIG. 3

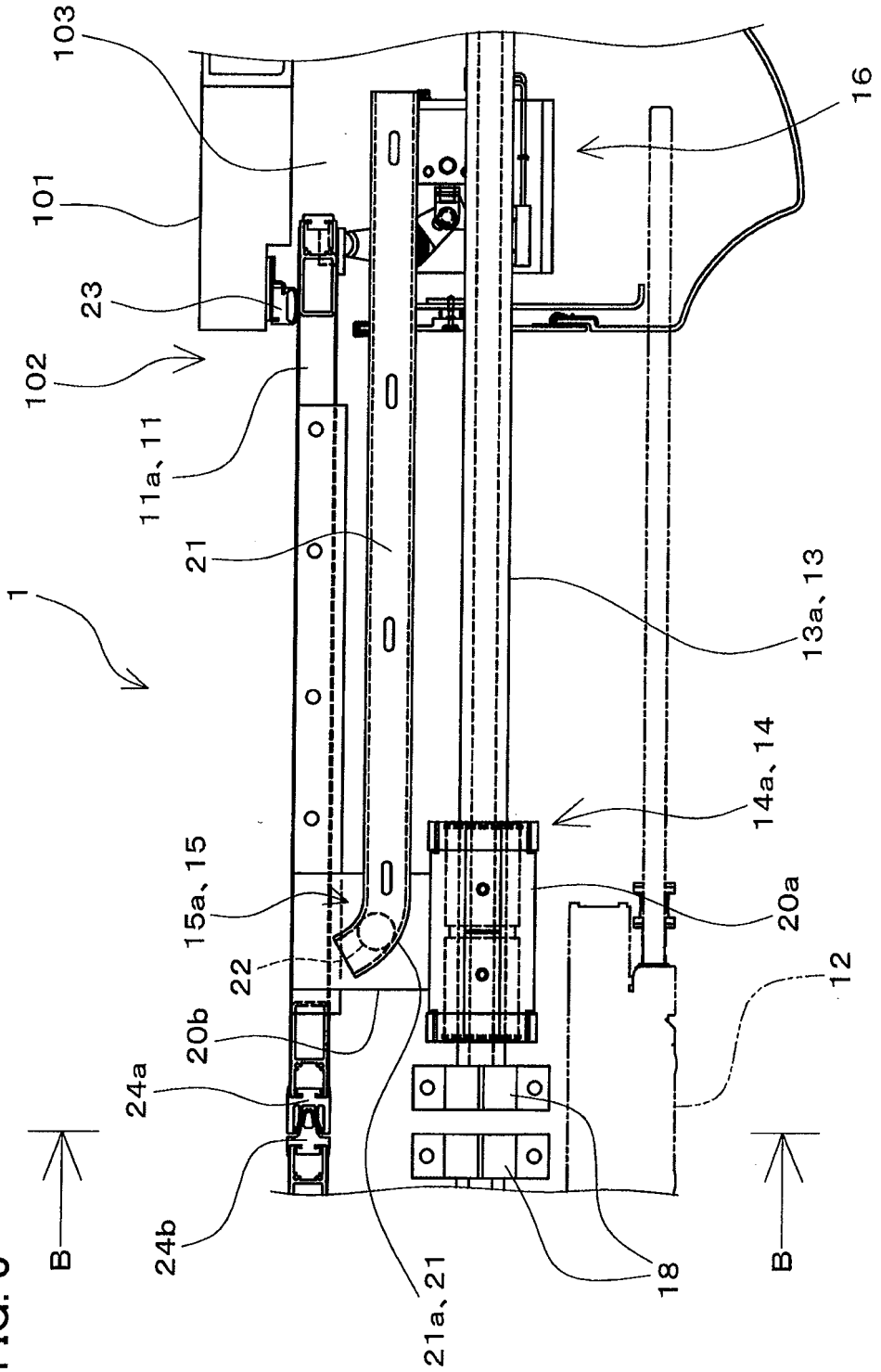
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FIG. 4

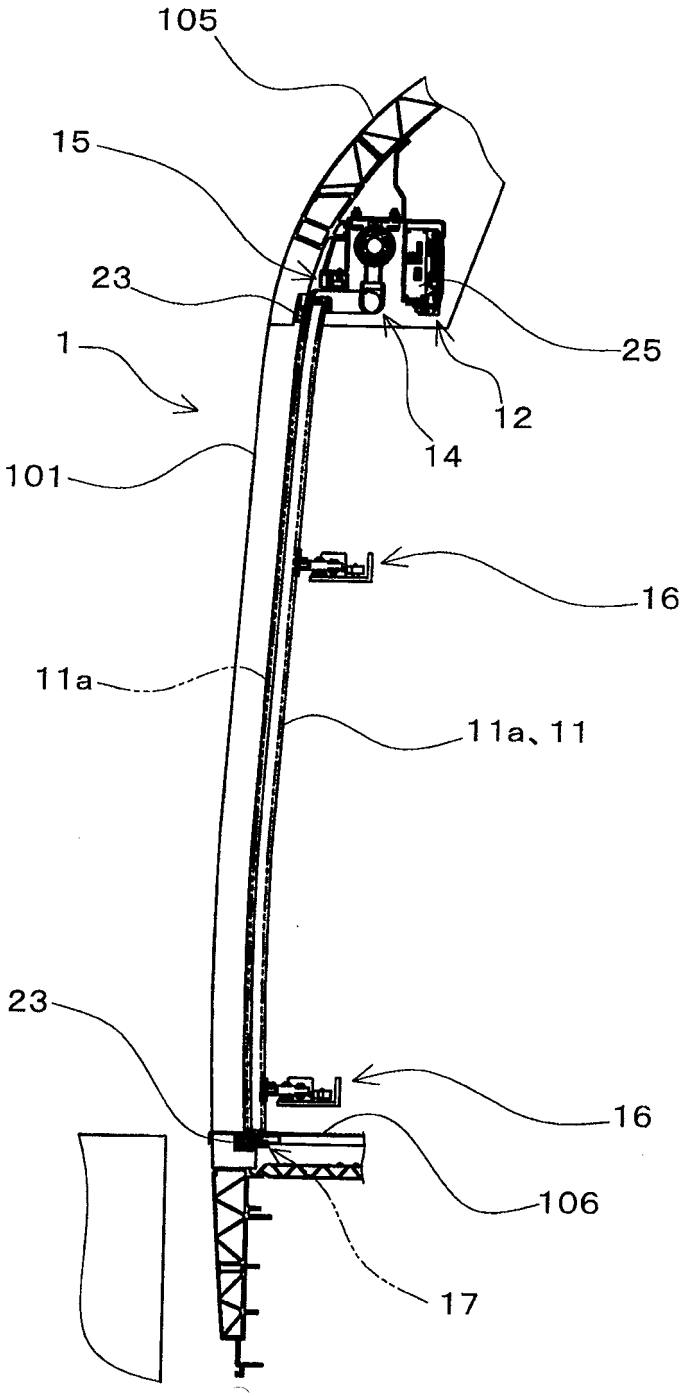
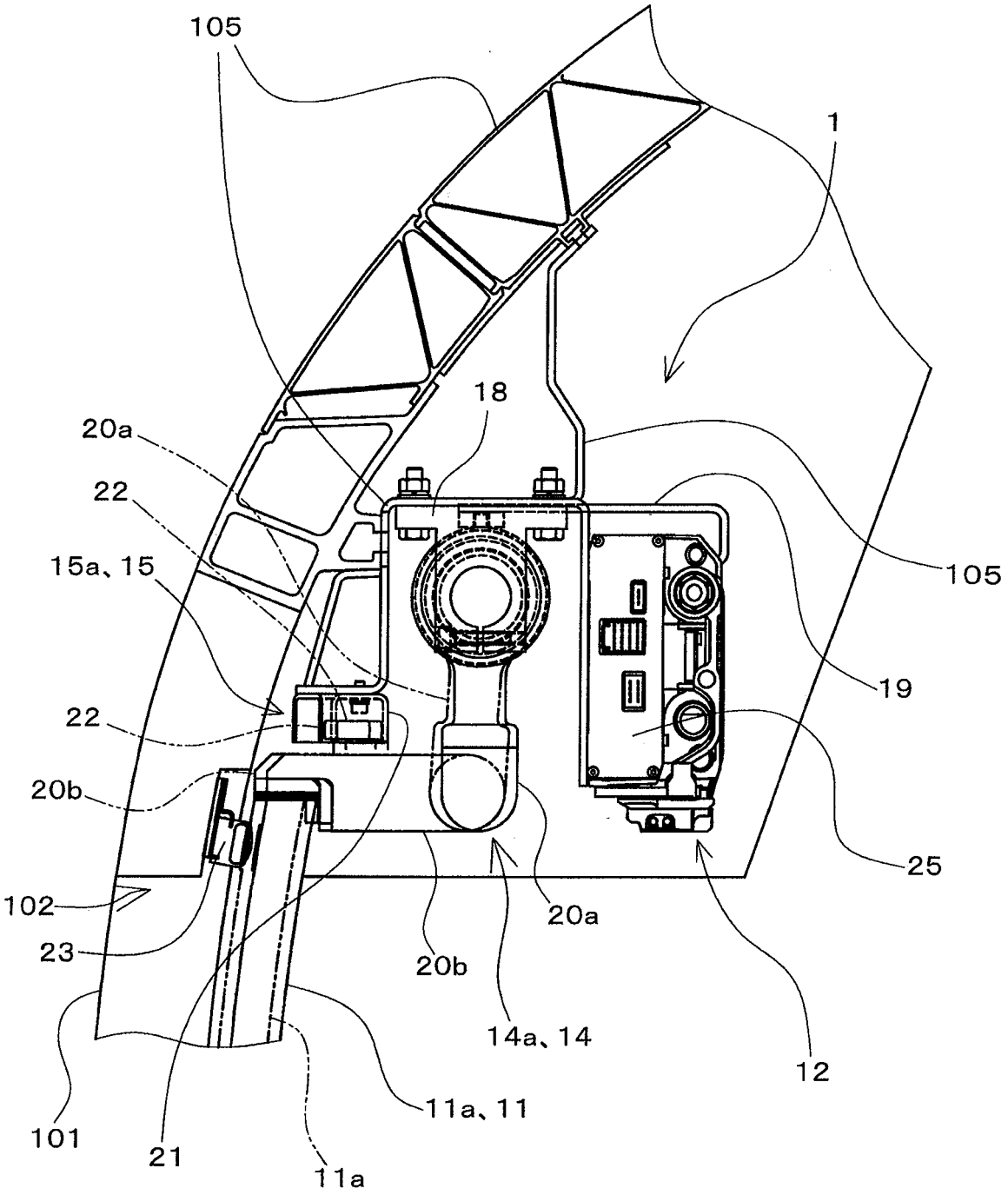


FIG. 5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21
11a

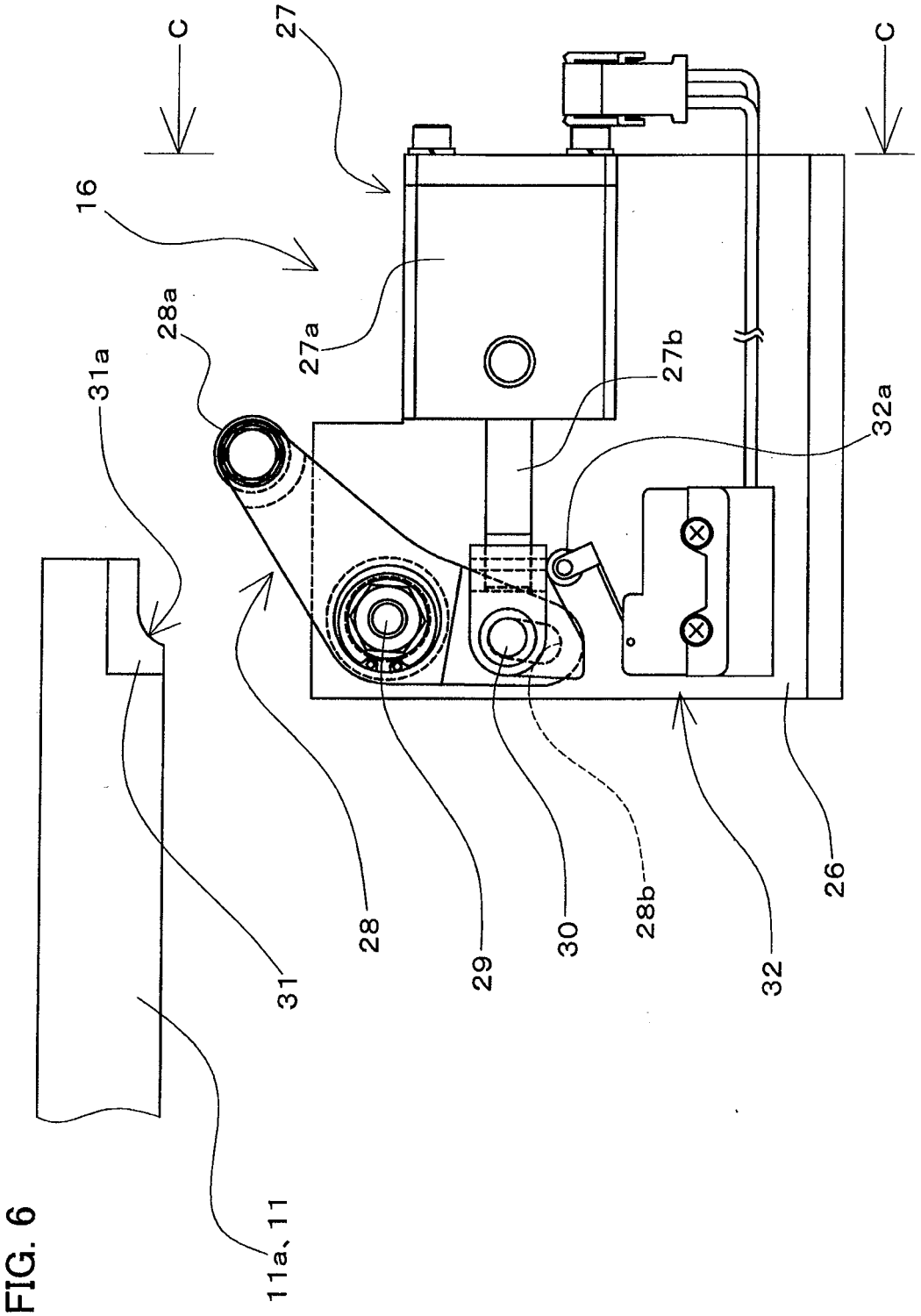


FIG. 6

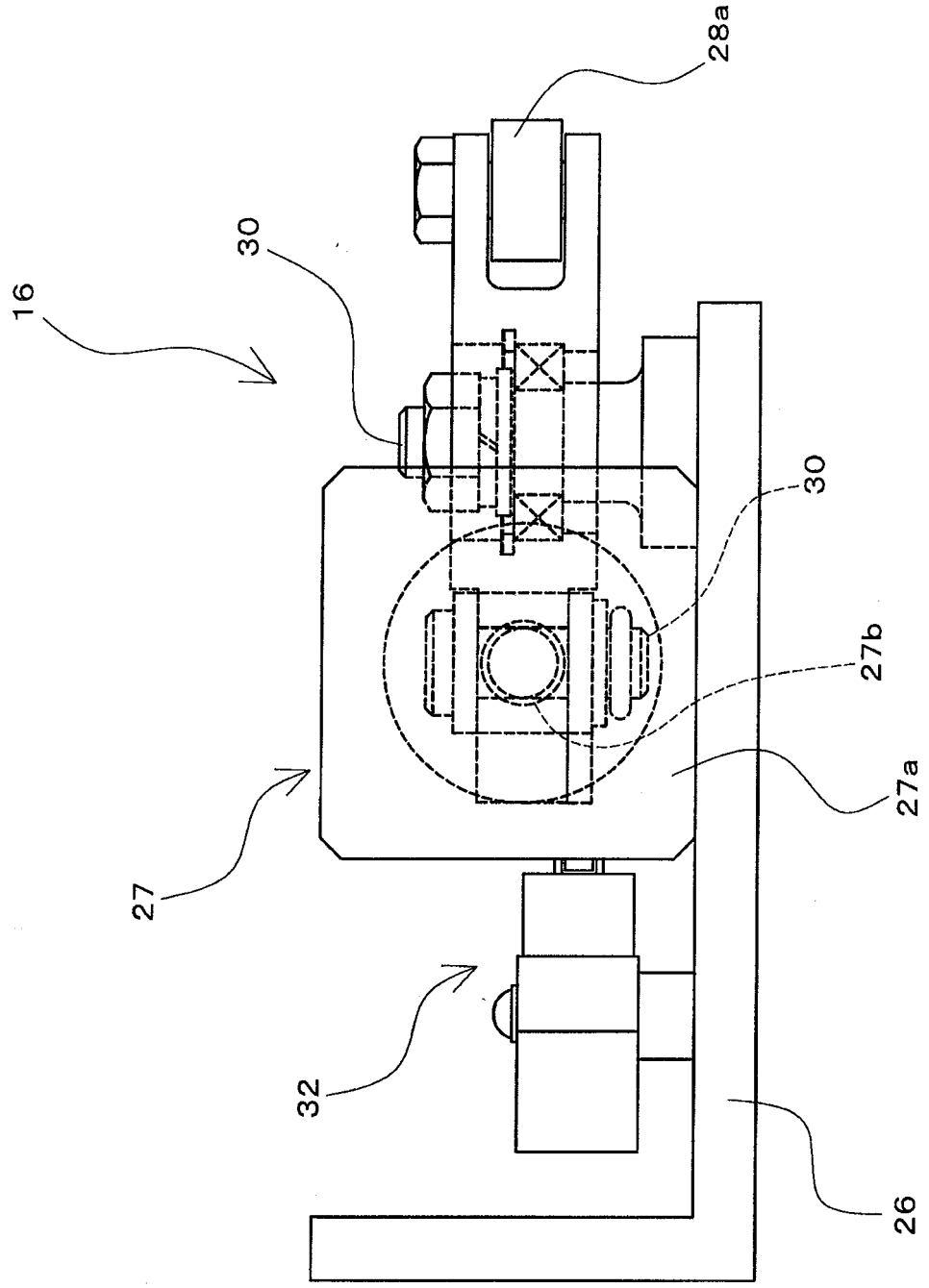


FIG. 7

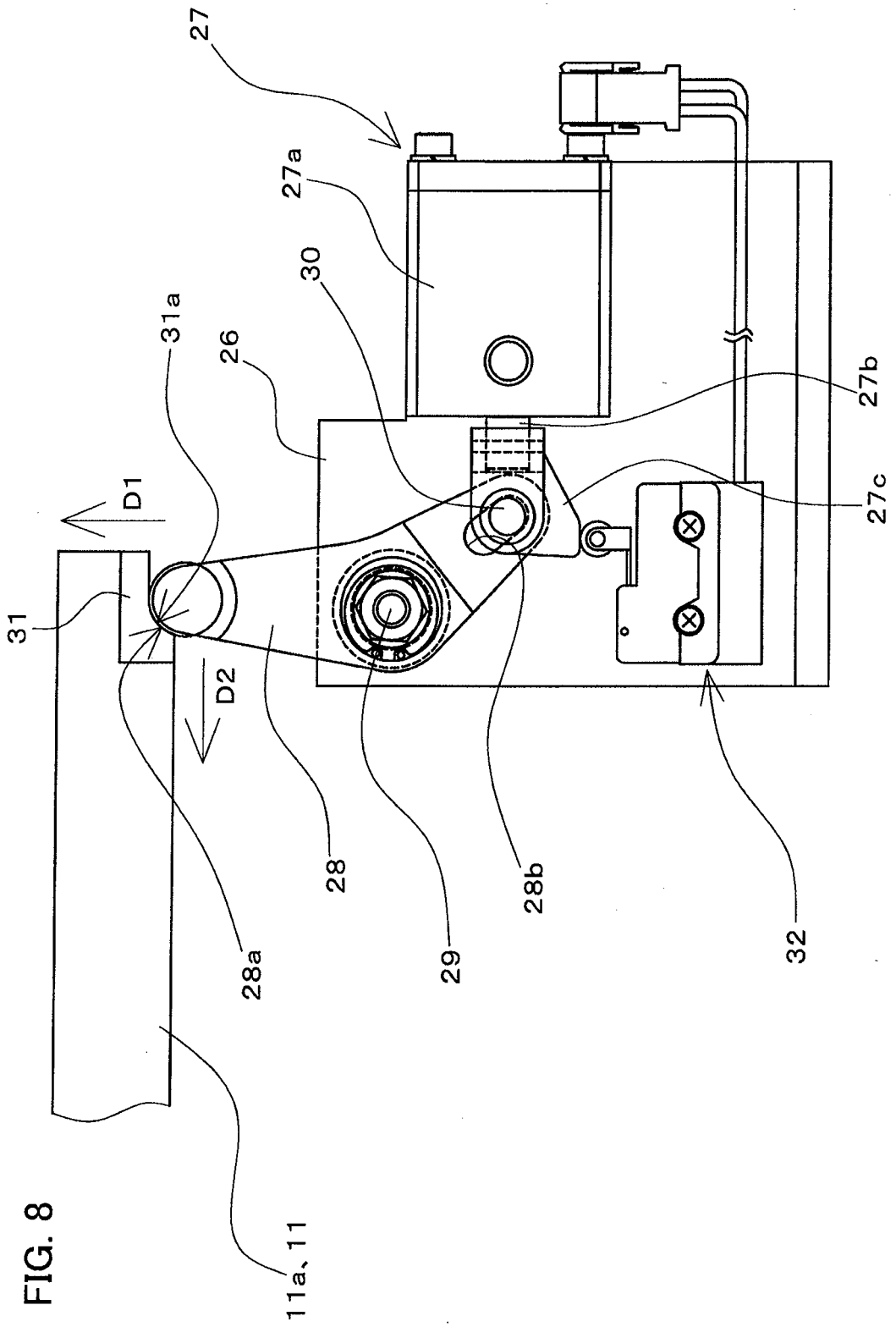


FIG. 8

FIG. 9

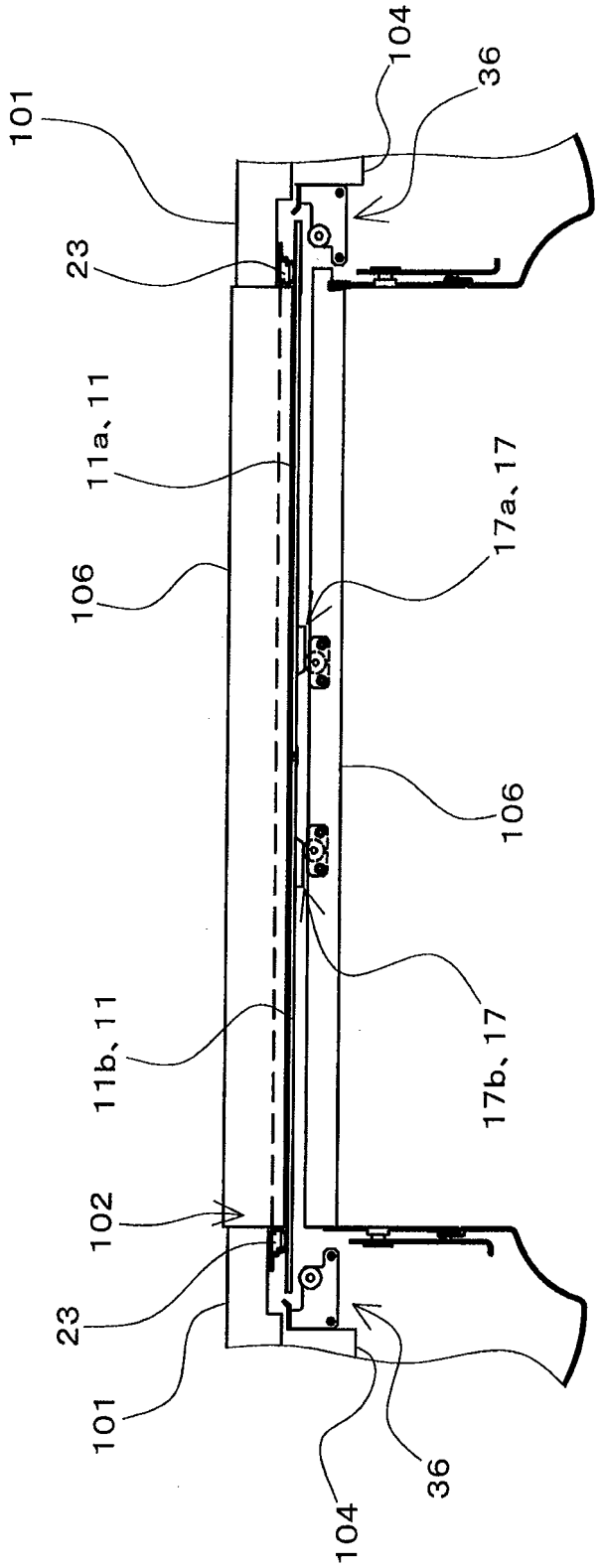
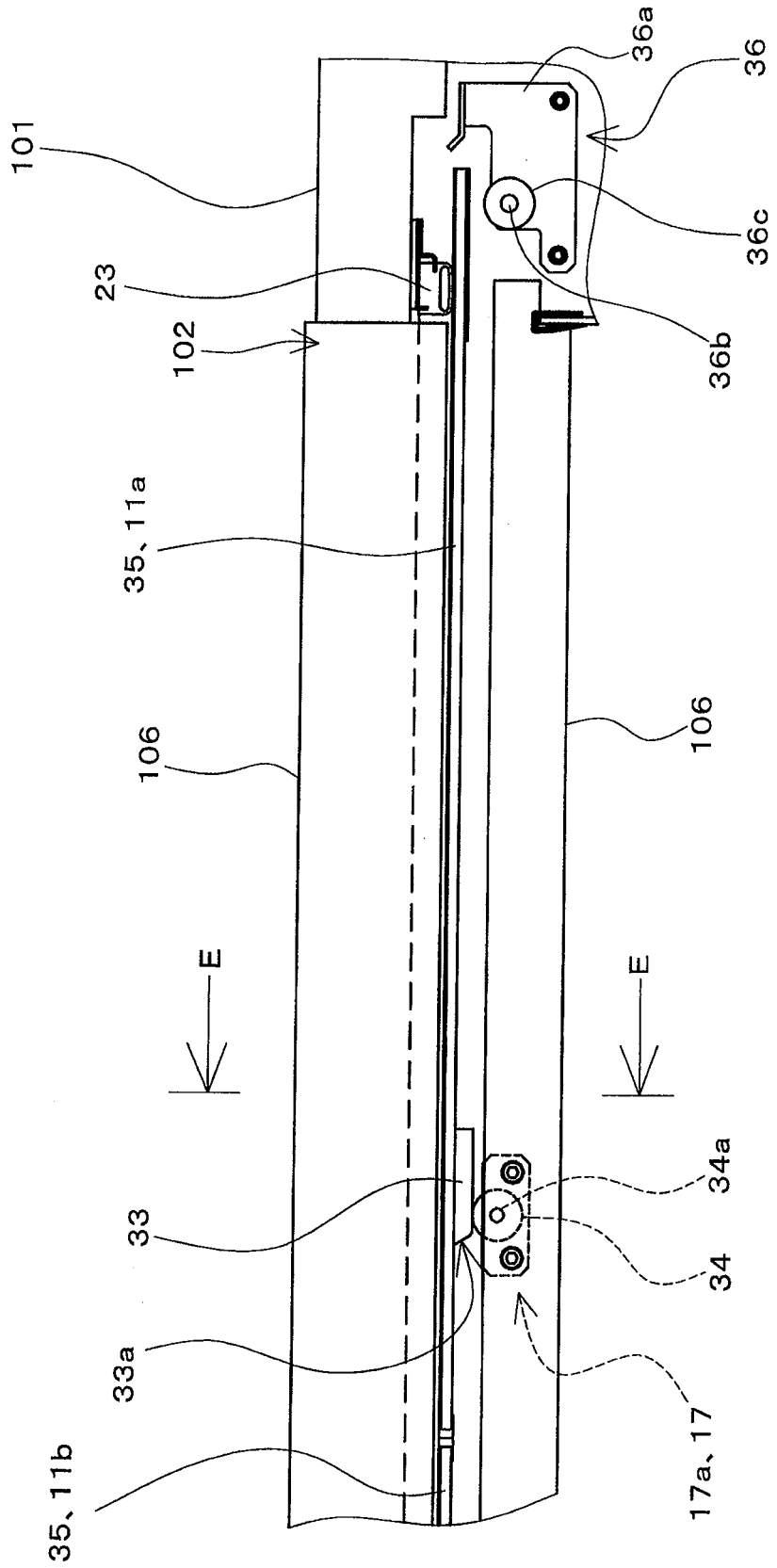


FIG. 10


36a
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34a
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34
33a
17a、17
35、11b

FIG. 11

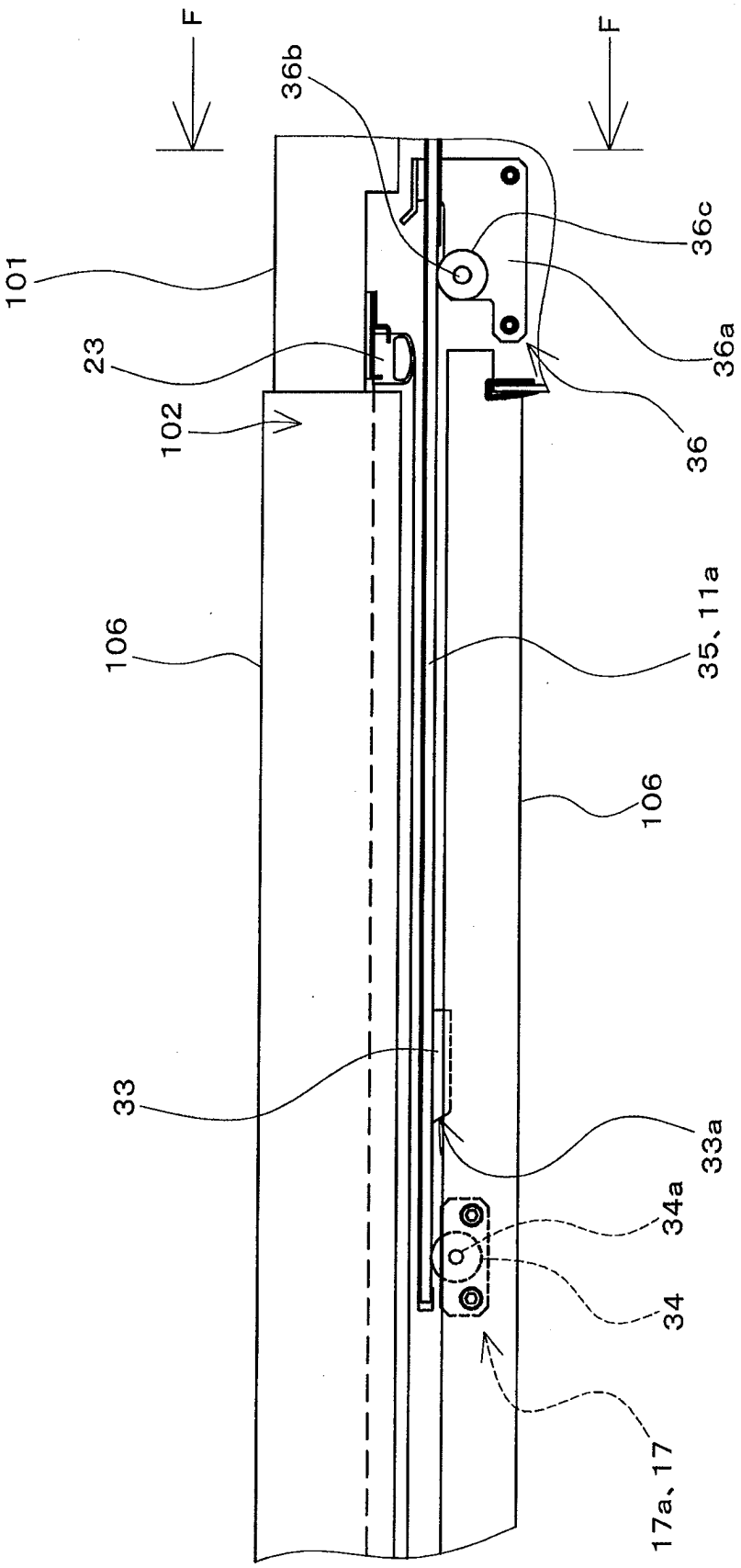


FIG. 12

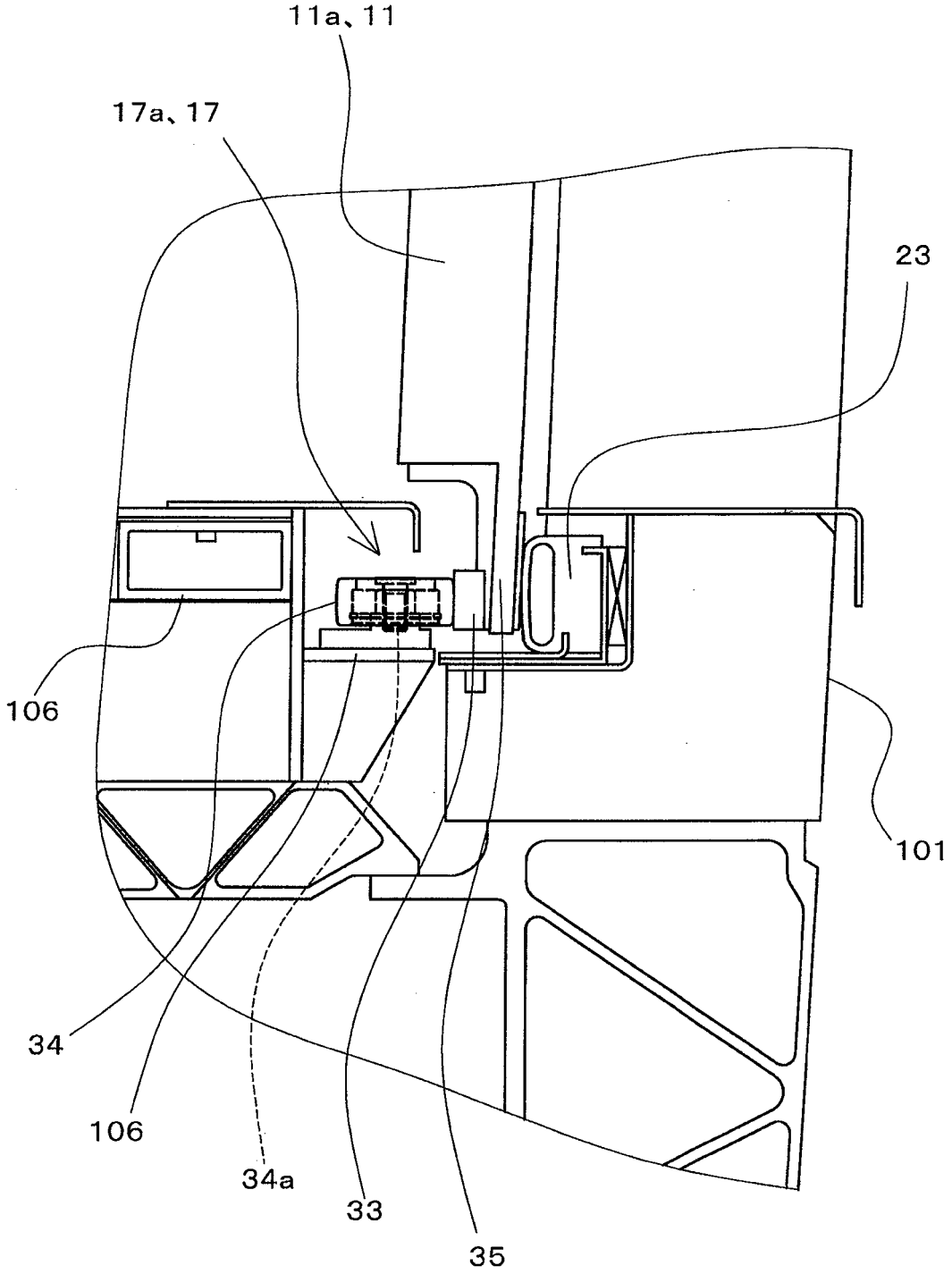
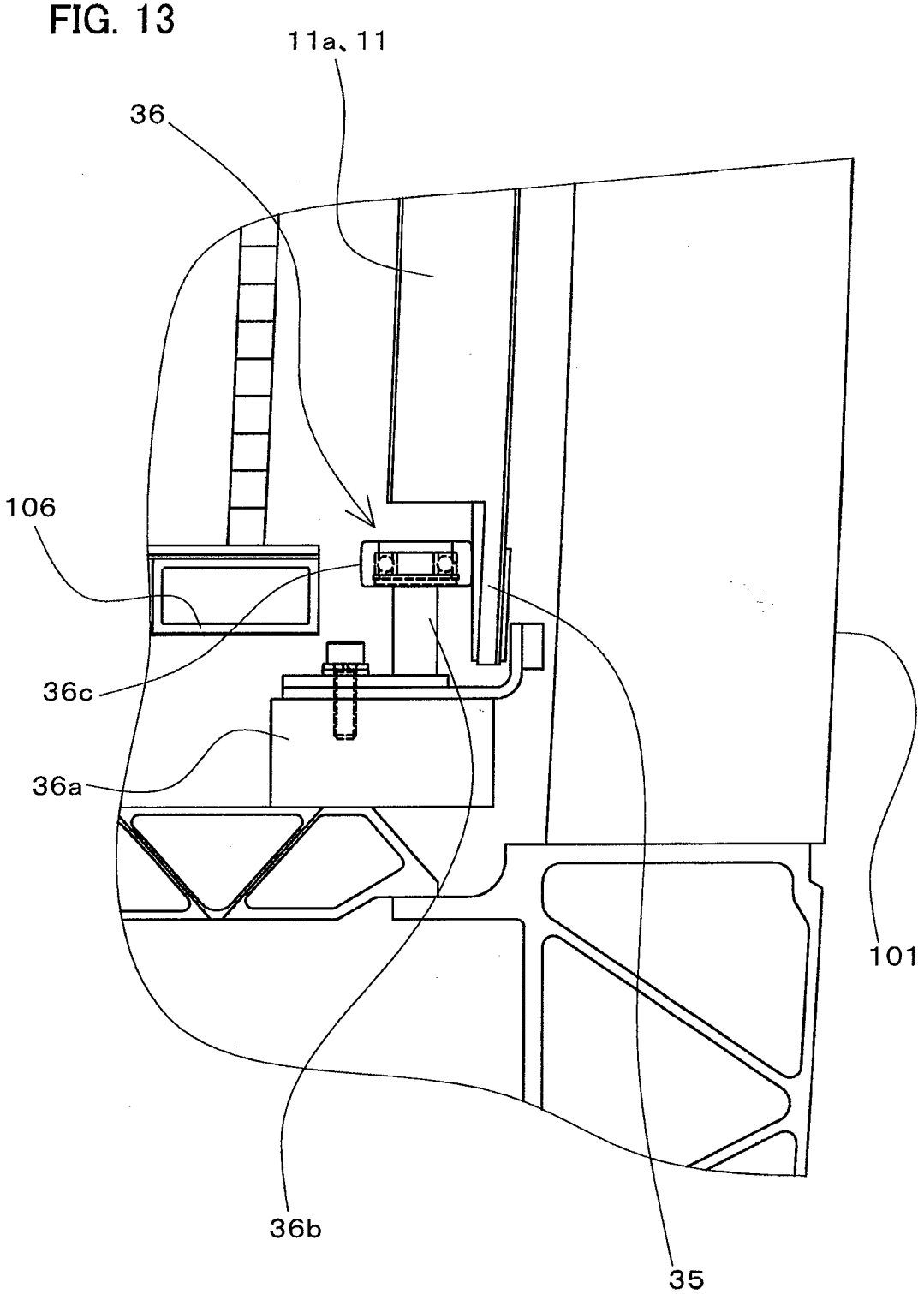


FIG. 13



INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2012/070894

A. CLASSIFICATION OF SUBJECT MATTER
B61D19/02(2006.01)i, *E05F15/14*(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)
B61D19/02, E05F15/14

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	1996-2012
Kokai Jitsuyo Shinan Koho	1971-2012	Toroku Jitsuyo Shinan Koho	1994-2012

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.
Y	Microfilm of the specification and drawings annexed to the request of Japanese Utility Model Application No. 35508/1991(Laid-open No. 129370/1992) (Central Japan Railway Co.), 26 November 1992 (26.11.1992), entire text; fig. 1 to 6 (Family: none)	1-6
Y	JP 11-139309 A (Industrie-Einrichtungen Fertigungs-AG), 25 May 1999 (25.05.1999), entire text; fig. 1 to 6 & EP 900708 A1 & PL 328300 A1 & ES 2205434 T3 & CN 1213736 A	1-6

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

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Date of the actual completion of the international search	Date of mailing of the international search report
12 November, 2012 (12.11.12)	20 November, 2012 (20.11.12)
Name and mailing address of the ISA/ Japanese Patent Office Facsimile No.	Authorized officer Telephone No.

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INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2012/070894

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 6-305421 A (Nabco Ltd.), 01 November 1994 (01.11.1994), paragraphs [0021] to [0029]; fig. 1, 8 to 9 (Family: none)	4-6
Y	Microfilm of the specification and drawings annexed to the request of Japanese Utility Model Application No. 33935/1982(Laid-open No. 136865/1983) (Hitachi, Ltd.), 14 September 1983 (14.09.1983), entire text; fig. 1 to 5 (Family: none)	6
Y	JP 2000-108898 A (Nippon Sharyo, Ltd.), 18 April 2000 (18.04.2000), paragraphs [0008] to [0013]; fig. 2 (Family: none)	6
A	JP 6-340256 A (Nabco Ltd.), 13 December 1994 (13.12.1994), entire text; fig. 1 to 11 (Family: none)	1-6
A	JP 2005-132353 A (Central Japan Railway Co.), 26 May 2005 (26.05.2005), entire text; fig. 1, 3, 8 to 9 (Family: none)	1-6
A	JP 2002-264805 A (Nabco Ltd.), 18 September 2002 (18.09.2002), paragraph [0021]; fig. 2 & KR 10-2002-0072179 A	1-6

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Patent documents cited in the description

- JP 2005132353 A **[0006]**
- JP 2008121244 A **[0006] [0031]**