

DESCRIPTION

Title of Invention: PASSENGER BOARDING BRIDGE

Technical Field

[0001] The present invention relates to a passenger boarding bridge.

Background Art

[0002] Conventionally, a passenger boarding bridge is known as boarding/disembarking equipment for passengers, which is used between an aircraft and a terminal building of an airport. When the cab of the passenger boarding bridge is connected to an entrance of the aircraft, the passenger boarding bridge is used to form a passenger walkway to the aircraft.

[0003] Here, there are cases where at the time of opening/closing the door of the entrance of the aircraft, the bottom end of the door is moved to be lower than the floor (door sill) of the entrance of the aircraft. Therefore, if the position of the walkway of the cab is set such that no difference in level is formed between the door sill of the entrance and the walkway of the cab of the passenger boarding bridge, the bottom end of the door will hit the walkway of the cab at the time of opening/closing the door of the entrance. This hinders the opening/closing of the door.

[0004] For the above reason, it is necessary to set the position of the walkway of the cab to be lower than the position of the door sill of the entrance, for example, by about 200 mm at a maximum. However, in this case, the difference in level formed between the door sill of the entrance and the walkway of the cab may become an obstacle for boarding or disembarking passengers. For example, it is difficult for a passenger in a wheelchair to board the aircraft from the terminal due to the presence of the difference in level.

[0005] Therefore, conventionally, for the purpose of eliminating the inconvenience due to the aforementioned difference in level, it has been proposed to form a part of the walkway of the cab as a movable floor, and level difference eliminating devices that incline or lift/lower (move upward/downward) the movable floor have been proposed (see Patent Literatures 1 to 4, for example).

Citation List

Patent Literature

- [0006] PTL 1: Japanese Laid-Open Patent Application Publication No. 2009-214686
PTL 2: Japanese Laid-Open Patent Application Publication No. 2004-155257
PTL 3: International Publication No. WO 2011/148419
PTL 4: Japanese Laid-Open Patent Application Publication No. 2013-32114

Summary of Invention**Technical Problem**

[0007] However, the above conventional art examples do not sufficiently give consideration to movement control of the movable floor of the cab at the time of opening/closing the door of the entrance of the aircraft.

[0008] Embodiments of the present invention provide a passenger boarding bridge capable of properly controlling the movement of the movable floor of the cab at the time of opening/closing the door of an entrance of an aircraft.

Solution to Problem

[0009]

According to an aspect of the present invention, there is provided a passenger boarding bridge including a cab provided at a distal end of a tunnel unit, the cab forming a walkway when attached to an entrance of an aircraft, the cab comprising: a movable floor used for connection to a door sill of the entrance of the aircraft and configured to be movable upward and downward; a door opening/closing detector configured to detect opening and closing of a door of the entrance of the aircraft; a motive power generator configured to generate motive power used for moving the movable floor; and a controller configured to prohibit the motive power generator from operating if the door opening/closing detector does not detect that the door is open, wherein the walkway of the cab is positioned below the entrance of the aircraft at a time of attaching the cab to the entrance of the aircraft, and the movable floor is prohibited from moving upward when the door is not open.

[0010] The above aspect, other aspects, features, and advantages of the present invention will be made clear by the following detailed description of one preferred embodiment with reference to the accompanying drawings.

Advantageous Effects of Invention

[0011] Embodiments of the present invention make it possible to properly control the movement of the movable floor of the cab of the passenger boarding bridge at the time of opening/closing the door of the entrance of the aircraft.

Brief Description of Drawings

[0012] Fig. 1 shows one example of a passenger boarding bridge according to one embodiment of the present invention.

Fig. 2 shows one example of a cab of the passenger boarding bridge according to the embodiment of the present invention.

Fig. 3 shows one example of the cab of the passenger boarding bridge according to the embodiment of the present invention.

Fig. 4 shows one example of the cab of the passenger boarding bridge according to the embodiment of the present invention.

Fig. 5 is a flowchart showing one example of operations of the passenger boarding bridge according to the embodiment of the present invention.

Fig. 6 is a flowchart showing one example of operations of the passenger boarding bridge according to the embodiment of the present invention.

Fig. 7 is a flowchart showing one example of operations of the passenger boarding bridge according to the embodiment of the present invention.

Fig. 8 is a flowchart showing one example of operations of the passenger boarding bridge according to the embodiment of the present invention.

Fig. 9 is a diagram for describing one example of operations of the passenger boarding bridge according to the embodiment of the present invention.

Fig. 10 is a diagram for describing one example of operations of the passenger boarding bridge according to the embodiment of the present invention.

Fig. 11 shows one example of a passenger boarding bridge according to Variation 5 of the present invention.

Description of Embodiments

[0013] (Embodiment)

The inventors of the present invention conducted diligent studies on the control of the movement of the movable floor of the cab at the time of opening/closing the door of an entrance of an aircraft. As a result of the diligent studies, they have found that by installing a door opening/closing detector for detecting the opening and closing of the door of the entrance of the aircraft, the movement of the movable floor of the cab can be controlled properly at the time of opening/closing the door of the entrance of the aircraft.

[0014] Specifically, a passenger boarding bridge according to a first aspect of the present invention is a passenger boarding bridge including a cab provided at a distal end of a tunnel unit, the cab forming a walkway when attached to an entrance of an aircraft. The cab includes: a movable floor used for connection to a door sill of the entrance of the aircraft and configured to be movable upward and downward; and a door opening/closing detector configured to detect opening and closing of a door of the entrance of the aircraft. The walkway of the cab is positioned below the entrance of the aircraft at a time of attaching the cab to the entrance of the

aircraft, and the movable floor is prohibited from moving upward when the door is not open.

[0015] A passenger boarding bridge according to a second aspect of the present invention is configured such that the passenger boarding bridge according to the first aspect includes: a motive power generator configured to generate motive power used for moving the movable floor; and a controller configured to prohibit the motive power generator from operating if the door opening/closing detector does not detect that the door is open.

[0016] According to the above configuration, since the passenger boarding bridge includes the door opening/closing detector for detecting the opening and closing of the door of the entrance of the aircraft, the movement of the movable floor of the cab can be controlled properly at the time of opening/closing the door of the entrance of the aircraft. Specifically, at the time of attaching the cab to the entrance of the aircraft, the movable floor is prohibited from moving upward if the door opening/closing detector does not detect that the door is open. This makes it possible to properly prevent contact between the movable floor and the door of the entrance.

[0017] A passenger boarding bridge according to a third aspect of the present invention is configured such that, in the passenger boarding bridge according to the second aspect, the controller controls operation of the motive power generator to move the movable floor upward automatically when the door opening/closing detector detects that the door is open.

[0018] According to the above configuration, at the time of attaching the cab to the entrance of the aircraft, the movable floor can be operated automatically in conjunction with an operation of opening the door. This makes it possible to move the movable floor upward promptly after the door of the entrance is opened.

[0019] A passenger boarding bridge according to a fourth aspect of the present invention is configured such that the passenger boarding bridge according to the second or third aspect includes: a door locking member configured to be movable between an adjacent position adjacent to the entrance of the aircraft and a distant position distant from the entrance of the aircraft than the adjacent position at the time of attaching the cab to the entrance of the aircraft; and a door locking member position detector configured to detect movement of the door locking member to the adjacent position and movement of the door locking member to the distant position. The controller allows the motive power generator to operate when the door opening/closing detector detects that the door is open and the door locking member position detector detects that the door locking member has moved to the adjacent position.

[0020] According to the above configuration, since the passenger boarding bridge includes the door locking member position detector, contact between the movable floor and the door of the entrance can be prevented more properly at the time of attaching the cab to the entrance of

the aircraft.

[0021] A passenger boarding bridge according to a fifth aspect of the present invention is configured such that, in the passenger boarding bridge according to the fourth aspect, the controller controls operation of the motive power generator to move the movable floor upward automatically when the door opening/closing detector detects that the door is open and the door locking member position detector detects that the door locking member has moved to the adjacent position.

[0022] According to the above configuration, the movable floor can be automatically operated in conjunction with an operation of opening the door and movement of the door locking member to the adjacent position at the time of attaching the cab to the entrance of the aircraft. This makes it possible to move the movable floor upward promptly after the door of the entrance is opened.

[0023] A passenger boarding bridge according to a sixth aspect of the present invention is configured such that, in the passenger boarding bridge according to the fourth or fifth aspect, the door locking member is used as a member serving to block movement of the door at the adjacent position, the door being configured as an outward opening door.

[0024] The above configuration makes it possible to properly block the movement of the outward opening door.

[0025] A passenger boarding bridge according to a seventh aspect of the present invention is configured such that, in the passenger boarding bridge according to any one of the fourth to sixth aspects, the door locking member is used as a fence on the walkway of the cab at the adjacent position.

[0026] According to the above configuration, the door locking member can be utilized as a fence that allows the passengers to properly pass through the walkway.

[0027] A passenger boarding bridge according to an eighth aspect of the present invention is configured such that, in the passenger boarding bridge according to any one of the fourth to seventh aspects, the door locking member position detector includes: a first detector configured to detect movement of the door locking member to the adjacent position; and a second detector configured to detect movement of the door locking member to the distant position.

[0028] According to the above configuration, movement of the door locking member to the adjacent position and movement of the door locking member to the distant position can be properly detected by the door locking member position detector.

[0029] A passenger boarding bridge according to a ninth aspect of the present invention is configured such that, in the passenger boarding bridge according to any one of the fourth to

eighth aspects, at a time of detaching the cab from the entrance of the aircraft, the controller controls operation of the motive power generator to move the movable floor downward automatically when the door locking member position detector detects that the door locking member has moved from the adjacent position to the distant position.

[0030] According to the above configuration, at the time of detaching the cab from the entrance of the aircraft, the movable floor can be lowered in advance based on a detection signal from the door locking member position detector. This makes it possible to properly prevent contact between the movable floor and the door of the entrance.

[0031] Hereinafter, specific examples of one embodiment of the present invention are described with reference to the drawings. In the drawings, the same or corresponding elements are denoted by the same reference signs, and repeating the same descriptions is avoided in some cases below. The passenger boarding bridges according to the above first to ninth aspects of the present invention are not limited by the specific description given below.

[Overall Apparatus Configuration]

Fig. 1 shows one example of a passenger boarding bridge according to the embodiment of the present invention. Fig. 1 shows a state where the overall length of a tunnel unit 10 is expanded.

[0032] Hereinafter, for the sake of convenience of the description, the direction in which the overall length of the tunnel unit 10 of the passenger boarding bridge 100 is expanded and contracted is referred to as a front-rear direction; the direction in which gravity is exerted on the passenger boarding bridge 100 is referred to as a vertical direction; and the width direction of the passenger boarding bridge 100 (i.e., the direction perpendicular to the front-rear direction and the vertical direction) is referred to as a right-left direction. In addition, as shown in Fig. 1, the aircraft 200 side of the passenger boarding bridge 100 is referred to as a front side, and the terminal building (not shown) side of the passenger boarding bridge 100 is referred to as a rear side in the description below.

[0033] The passenger boarding bridge 100 according to the present embodiment includes: a rotunda (a rear round room) 12 connected to an entrance of the terminal building; the tunnel unit 10 connected to the rotunda 12; and a cab (a front round room) 20 disposed at the front end of the tunnel unit 10.

[0034] The tunnel unit 10 is configured such that adjoining tunnels 10A and 10B thereof are fitted together in such a manner that the inner tunnel is nested in the outer tunnel, and the overall length of the tunnel unit 10 can be expanded and contracted in the front-rear direction.

Specifically, drive columns 15 are coupled to a suitable part of the tunnel unit 10 (to be specific,

a front part of the outer tunnel 10B) in a manner to sandwich the tunnel unit 10. Accordingly, when drive wheels at the bottom of the drive columns 15 run on the ground 18 (apron 18), expanding or contracting power in the front-rear direction is exerted on the tunnel unit 10. As a result of the overall length of the tunnel unit 10 being expanded, the cab 20 disposed at the front end of the tunnel unit 10 reaches an entrance 202 (see Fig. 2, for example) of the aircraft 200, and thereby a walkway for passengers is formed between the entrance of the terminal building of the airport and the entrance 202 of the aircraft 200. At the time, the tunnel unit 10 can be moved upward or downward with respect to the rotunda 12 by vertical expanding or contracting movement of the drive columns 15.

[0035] It should be noted that a control board 50 (see Fig. 2, for example) is disposed inside the cab 20, and an operator can operate various devices (e.g., drive columns 15) of the passenger boarding bridge 100 by using a joystick (not shown) of the control board 50. Auxiliary stairs 16 are provided on the side of the tunnel unit 10 in a manner to connect between the inside of the tunnel unit 10 and the apron 18. The auxiliary stairs 16 are used, for example, to allow the operator to get in and out of the cab 20.

[Configuration of Cab]

Hereinafter, the configuration of the cab according to the present embodiment is described with reference to the drawings.

[0036] Fig. 2, Fig. 3, and Fig. 4 show one example of the cab of the passenger boarding bridge according to the embodiment of the present invention.

[0037] As shown in Fig. 2 and Fig. 3, the cab 20 includes a walkway 21, a door opening/closing detector 22, a door locking member 23, a door locking member position detector 24, a closure 28, and a level difference eliminating device 30.

[0038] The walkway 21 includes: a fixed floor (not shown) coupled to the distal end of the tunnel unit 10; and an inclined floor 21A connected to the fixed floor and configured to be inclinable in a width direction 300. It should be noted that the inclined floor 21A may include an inclination mechanism that is the same as one described in the aforementioned Patent Literature 3 or 4. Therefore, the inclination mechanism is not described in detail herein, but is described briefly below.

[0039] For example, the fixed floor and the inclined floor 21A are coupled to each other via a coupling hinge or the like that is not shown. The right end portion or left end portion of the inclined floor 21A is vertically moved by motive power generated by a motive power generator (not shown), such as a power cylinder, electric motor, or the like. At the time, the front end portion of the inclined floor 21A can swing about the coupling hinge. In this manner, the

inclined floor 21A can be inclined in the width direction 300. It should be noted that a bumper 21B made of synthetic rubber is disposed on the front end portion of the inclined floor 21A. The bumper 21B has a function of reducing an impact shock when the inclined floor 21A comes into contact with the entrance 202 of the aircraft 200, and has a function of keeping a space between the front end portion of the inclined floor 21A and the entrance 202 of the aircraft 200.

[0040] The closure 28 includes: a bellows portion (not shown) capable of expanding and contracting in the front-rear direction; and a gate-shaped contacting body (not shown) provided on the front end of the bellows portion and coming into contact with the aircraft 200. Accordingly, when the passenger boarding bridge 100 becomes attached to the aircraft 200, the contacting body can come into contact with the aircraft 200 around the entrance 202 by inclining forward.

[0041] The level difference eliminating device 30 includes a lifting/lowering floor 31, a driven slope 32, and a door sill detector 39. In the present embodiment, the lifting/lowering floor 31 is used for connection to a door sill 202A of the entrance 202 of the aircraft 200 (details will be given below), and is one example of a movable floor configured to be movable upward and downward.

[0042] As shown in Fig. 2 and Fig. 3, the leftward portion of the inclined floor 21A is provided with a substantially rectangular opening 29, the long sides of which coincide with a passage direction 301 (the front-rear direction) for the passengers. The rectangular lifting/lowering floor 31 and the driven slope 32 are arranged in the plane of the inclined floor 21A (i.e., in the plane of the walkway 21) such that when the inclined floor 21A is vertically seen in a plan view, the rectangular lifting/lowering floor 31 and the driven slope 32 cover the substantially entire opening 29.

[0043] The level difference eliminating device 30 according to the present embodiment is configured such that the back surface of the lifting/lowering floor 31 can be accessed by various structured bodies from below via the opening 29. This makes it possible to readily apply motive power for lifting/lowering (moving upward/downward) the lifting/lowering floor 31 and motive power for horizontally moving the lifting/lowering floor 31 to the lifting/lowering floor 31.

[0044] Specifically, in the level difference eliminating device 30 according to the present embodiment, in the vicinity of the opening 29, the lifting/lowering floor 31 is provided with: a lifting/lowering mechanism capable of lifting and lowering the lifting/lowering floor 31; and a horizontal movement mechanism capable of horizontally moving the lifting/lowering floor 31 in the passage direction 301.

[0045] <Lifting/Lowering Mechanism of Lifting/Lowering Floor 31>

As shown in Fig. 4, the lifting/lowering mechanism of the lifting/lowering floor 31 includes support frames 33, a linear motion guide 34, a coupling frame 37, and a motive power generator 35.

[0046] In the present embodiment, the support frames 33 include a pair of frames extending in the right-left direction and a pair of frames extending in the vertical direction, thereby forming a substantially quadrangular ring. However, the support frames 33 are not thus limited. For example, the support frames 33 may be arranged in parallel crosses.

[0047] The linear motion guide 34 includes a table 34A and a vertically extending rail 34B. The rail 34B of the linear motion guide 34 is fixed to the support frames 33 by using suitable fixing means (e.g., bolts). The coupling frame 37 is fixed to the inclined floor 21A by using suitable fixing means (such as supporting members and bolts; not shown).

[0048] The lifting/lowering floor 31 is supported by the support frames 33 via the horizontal movement mechanism (details will be given below) of the lifting/lowering floor 31. Such a support structure for the lifting/lowering floor 31 will be described below.

[0049] The motive power generator 35 generates motive power for lifting/lowering the lifting/lowering floor 31. The motive power generator 35 may be configured in any manner, so long as the motive power generator 35 is capable of generating motive power for lifting/lowering the lifting/lowering floor 31. For example, a specific configuration of the motive power generator 35 may be the same as a configuration described in the aforementioned Patent Literature 3 or 4. Therefore, a detailed description of the configuration of the motive power generator 35 is omitted herein. Examples of a driver for the motive power generator 35 include a power cylinder and an electric motor.

[0050] With the above-described configuration, the motive power generated by the motive power generator 35 causes the support frames 33 to slide in the vertical direction with respect to the coupling frame 37 via the linear motion guide 34, and thereby the lifting/lowering floor 31 can be lifted or lowered.

[0051] At the time, as shown in Fig. 3 and Fig. 4, the front end portion (fixed end portion) of the plate-shaped driven slope 32 is in the state of being swingably coupled to the rear end portion of the lifting/lowering floor 31 via a coupling hinge 38 (a coupling swing shaft). In addition, as shown in Fig. 4, the rear end portion (free end portion) of the driven slope 32 is placed, in a free state, on the inclined floor 21A by the action of gravity on (i.e., by the weight of) the driven slope 32. Accordingly, the driven slope 32 is allowed to swing about the coupling hinge 38 relative to the lifting/lowering floor 31.

[0052] With the above-described configuration, when the lifting/lowering floor 31 moves upward, the coupling hinge 38 also moves upward. Accordingly, the inclination angle θ of the driven slope 32, which is an angle formed by the main surface of the lifting/lowering floor 31 and the main surface of the driven slope 32, increases continuously. At the same time, the rear end portion of the driven slope 32 moves forward on the inclined floor 21A. On the other hand, when the lifting/lowering floor 31 moves downward, the coupling hinge 38 also moves downward. Accordingly, the inclination angle θ of the driven slope 32 decreases continuously. At the same time, the rear end portion of the driven slope 32 moves rearward on the inclined floor 21A.

[0053] As described above, the passenger boarding bridge 100 according to the present embodiment is configured such that the inclination angle θ of the driven slope 32 changes when the lifting/lowering floor 31 is lifted/lowered (i.e., the driven slope 32 swings relative to the lifting/lowering floor 31), and such that the rear end portion of the driven slope 32 makes linear movement on the inclined floor 21A in the passage direction 301. Thus, the driven slope 32 forms an inclined path between the lifting/lowering floor 31 and the inclined floor 21A (the walkway 21).

[0054] <Horizontal Movement Mechanism of Lifting/Lowering Floor 31>

As shown in Fig. 4, the horizontal movement mechanism of the lifting/lowering floor 31 includes a linear motion guide 44, an urging mechanism 41, and a motive power generator 45.

[0055] The linear motion guide 44 includes a table 44A and a rail 44B extending in the passage direction 301 (front-rear direction). The rail 44B of the linear motion guide 44 is fixed to the support frames 33 by using suitable fixing means (such as supporting members and bolts; not shown).

[0056] The urging mechanism 41 includes: a columnar spring shaft 42 extending in the passage direction 301; a spring 42A (an elastic body) fitted around the spring shaft 42; and a pair of stopper members 43A and 43B being in contact with the respective ends of the spring 42A. It should be noted that both ends of the spring shaft 42 are threaded, and by screwing suitable fixing means (such as nuts) on both ends of the spring shaft 42, movement of the stopper members 43A and 43B in the passage direction 301 is restricted. The stopper member 43B on the rear end side is fixed to the table 44A of the linear motion guide 44 by using suitable fixing means (such as a bolt). On the other hand, the stopper member 43A on the front end side is fixed to the back surface of the lifting/lowering floor 31 by using suitable fixing means (such as a supporting member and a bolt). That is, the lifting/lowering floor 31 is mounted on the table

44A of the linear motion guide 44 via the urging mechanism 41. This configuration allows the lifting/lowering floor 31 (and the driven slope 32 coupled to the lifting/lowering floor 31) to move horizontally in the same direction by sliding in the passage direction 301 of the table 44A of the linear motion guide 44. It should be noted that a bumper 31B made of synthetic rubber is disposed on the front end portion of the lifting/lowering floor 31. The bumper 31B has a function of reducing an impact shock when the lifting/lowering floor 31 comes into contact with the entrance 202 of the aircraft 200, and has a function of keeping a space between the front end portion of the lifting/lowering floor 31 and the entrance 202 of the aircraft 200.

[0057] The motive power generator 45 generates motive power for horizontally moving the lifting/lowering floor 31. The motive power generator 45 may be configured in any manner, so long as the motive power generator 45 is capable of generating motive power for horizontally moving the lifting/lowering floor 31. For example, a specific configuration of the motive power generator 45 may be the same as a configuration described in the aforementioned Patent Literature 3 or 4. Therefore, a detailed description of the configuration of the motive power generator 45 is omitted herein. Examples of a driver for the motive power generator 45 include a power cylinder and an electric motor.

[0058] With the above-described configuration, in the passenger boarding bridge 100 according to the present embodiment, the lifting/lowering floor 31 can be moved horizontally by using the horizontal movement mechanism of the lifting/lowering floor 31 and supported by the support frames 33 via the horizontal movement mechanism.

[0059] At the time, as shown in Fig. 10, by using the above-described urging mechanism 41 of the horizontal movement mechanism, the table 44A of the linear motion guide 44 is horizontally moved forward to push the lifting/lowering floor 31 such that the bumper 31B of the lifting/lowering floor 31, which is already positioned in contact with the entrance 202 of the aircraft 200, is further pushed against the entrance 202. As a result, urging force of the lifting/lowering floor 31 (the bumper 31B) against the aircraft 200 is exerted. Specifically, when the table 44A is horizontally moved forward to push the lifting/lowering floor 31 against the entrance 202 from the aforementioned contacting position, the stopper member 43B moves forward along the spring shaft 42 against reaction force of the spring 42A. As a result, the spring 42A is compressed by the stopper members 43A and 43B, and based on reaction force of the spring 42A generated thereby, urging force of the lifting/lowering floor 31 (the bumper 31B) against the aircraft 200 is exerted.

[0060] In the passenger boarding bridge 100 according to the present embodiment with the above-described configuration, even if the distance between the lifting/lowering floor 31 (the

bumper 31B) and the entrance 202 (the outer wall) of the aircraft 200 changes when the aircraft 200 is lifted or lowered due to boarding or disembarking of the passengers, the lifting/lowering floor 31 (the bumper 31B) can be moved in the passage direction 301 (the front-rear direction) in accordance with the lifting or lowering of the aircraft 200 in a manner to follow the changes in the distance owing to the function of the urging mechanism 41 of the horizontal movement mechanism. This makes it possible to properly prevent the occurrence of a gap between the lifting/lowering floor 31 (the bumper 31B) and the entrance 202 (the outer wall) of the aircraft 200.

[0061] <Lock Mechanism of Aircraft Door>

Next, a lock mechanism of the door 201 of the cab 20 is described.

[0062] As shown in Fig. 2 and Fig. 3, the door locking member 23 is configured to be movable between an adjacent position 400 adjacent to the entrance 202 of the aircraft 200 and a distant position 401 distant from the entrance 202 of the aircraft 200 than the adjacent position 400 at the time of attaching the cab 20 to the entrance 202 of the aircraft 200.

[0063] In the lock mechanism of the door 201 according to the present embodiment, the door locking member 23 includes a rod 23A, around which cushioning 23B such as synthetic rubber is wound. An end (fixed end) portion of the rod 23A of the door locking member 23 is fixed at a rotation supporting point 25, which includes a vertical rotary shaft 25A substantially parallel to the vertical direction. Accordingly, the rod 23A is allowed to rotate about the rotation supporting point 25 on a horizontal plane that includes the width direction 300 and the passage direction 301. It should be noted that the rod 23A can be fixed at a desired position on a horizontal plane that includes the adjacent position 400 and the distant position 401 by manual operation by an operator by using suitable fixing means (e.g., a pin and a pin insertion hole).

[0064] The adjacent position 400 herein is a position at which the door locking member 23 and the door 201, which is configured as an outward opening door, interfere with each other. Specifically, if the door locking member 23 is placed at the adjacent position 400, then as shown in Fig. 3, the door locking member 23 crosses a track of the door 201, the track being drawn when the door 201 is opened or closed (see a one-dot chain line shown in Fig. 3). That is, the door locking member 23 is used as a member serving to block the movement of the outward opening door 201 at the adjacent position 400. This makes it possible to properly block the movement of the door 201. For example, as shown in Fig. 3, after the door 201 is opened, closing of the door 201 can be blocked, so long as the door locking member 23 is placed at the adjacent position 400. Therefore, the door locking member 23 is useful as a lock mechanism capable of properly preventing contact between the door 201 and the lifting/lowering floor 31 at

the time of closing the door 201.

[0065] The distant position 401 is a position at which the door locking member 23 and the outward opening door 201 do not interfere with each other. Specifically, if the door locking member 23 is placed at the distant position 401, then as shown in Fig. 2, the door locking member 23 does not cross the track of the door 201, which is drawn when the door 201 is opened or closed (see a one-dot chain line shown in Fig. 2). The distant position 401 serves also as a storage position of the door locking member 23 distant position. Accordingly, when the door locking member 23 is placed at the distant position 401, the door 201 is allowed to move freely. Thus, the door locking member 23 can be stored properly so that the movement of the door 201 will not be hindered.

[0066] [Configuration of Control System]

Next, the configuration of a control system of the passenger boarding bridge 100 according to the present embodiment is described.

[0067] First, a detector of the control system is described.

[0068] The door opening/closing detector 22 detects opening and closing of the door 201 of the entrance 202 of the aircraft 200. In the present embodiment, the door opening/closing detector 22 is fixed in the vicinity of the ceiling of the cab 20 on the center line of the closed door 201 in the width direction 300 so that opening and closing of the door 201 can be detected properly. The door opening/closing detector 22 may be configured in any manner, so long as the door opening/closing detector 22 is capable of detecting opening and closing of the door 201 of the entrance 202. Examples of the door opening/closing detector 22 include a light detector, such as an infrared sensor. That is, in a case where the door opening/closing detector 22 is an infrared sensor, opening or closing of the door 201 can be detected based on the amount of change in infrared energy, the change occurring when infrared rays from the door opening/closing detector 22 are reflected by the door 201 or transmitted through without being reflected by the door 201.

[0069] The door sill detector 39 of the level difference eliminating device 30 is provided on the lifting/lowering floor 31. In the present embodiment, the door sill detector 39 is fixed to the distal end portion of the lifting/lowering floor 31 in the vicinity of the left end thereof. The door sill detector 39 detects the door sill 202A of the entrance 202 of the aircraft 200. Specifically, while the lifting/lowering floor 31 is being lifted or lowered, the door sill detector 39 outputs a detection signal when the distal end portion of the lifting/lowering floor 31 has reached onto the same plane as that of the door sill 202A of the entrance 202 of the aircraft 200. The door sill detector 39 may be configured in any manner, so long as the door sill detector 39 is

capable of detecting the door sill 202A of the entrance 202 of the aircraft 200. Examples of the door sill detector 39 include a light detector, such as an infrared sensor. That is, in a case where the door sill detector 39 is an infrared sensor, the door sill 202A of the entrance 202 can be detected based on the amount of change in infrared energy, the change occurring when infrared rays from the door sill detector 39 are reflected by the door sill 202A or transmitted through without being reflected by the door sill 202A.

[0070] The door locking member position detector 24 detects movement of the door locking member 23 to the adjacent position 400 and movement of the door locking member 23 to the distant position 401. For example, the door locking member position detector 24 includes: a first detector 24A configured to detect movement of the door locking member 23 to the adjacent position 400; and a second detector 24B configured to detect movement of the door locking member 23 to the distant position 401.

[0071] The first detector 24A is disposed on an end (free end) portion of the rod 23A of the door locking member 23. The first detector 24A may be configured in any manner, so long as the first detector 24A is capable of detecting movement of the door locking member 23 to the adjacent position 400. Examples of the first detector 24A include a light detector, such as an infrared sensor. That is, in a case where the first detector 24A is an infrared sensor, movement of the door locking member 23 to the adjacent position 400 can be detected based on the amount of change in infrared energy, the change occurring when infrared rays from the first detector 24A are reflected by the door 201 or transmitted through without being reflected by the door 201.

[0072] The second detector 24B is disposed at a suitable position corresponding to the distant position 401. The second detector 24B may be configured in any manner, so long as the second detector 24B is capable of detecting movement of the door locking member 23 to the distant position 401. Examples of the second detector 24B include a limit switch. That is, in a case where the second detector 24B is a limit switch, when the door locking member 23 has moved to the distant position 401, the contact point of the second detector 24B changes due to its contact with the door locking member 23.

[0073] Next, a controller and a control target of the control system are described.

[0074] A controller 50A of the control board 50 prohibits the motive power generator 35 from operating if the door opening/closing detector 22 is not currently detecting that the door 201 of the entrance 202 is open. That is, if the door 201 is not open at the time of attaching the cab 20 to the entrance 202 of the aircraft 200, the lifting/lowering floor 31 is prohibited from moving upward.

[0075] As described above, since the passenger boarding bridge 100 according to the

present embodiment includes the door opening/closing detector 22, the lifting or lowering movement of the lifting/lowering floor 31 can be controlled properly at the time of opening or closing the door 201 of the entrance 202. That is, at the time of attaching the cab 20 to the entrance 202 of the aircraft 200, contact between the lifting/lowering floor 31 of the level difference eliminating device 30 and the door 201 of the entrance 202 can be prevented properly.

[0076] The controller 50A allows the motive power generator 35 to operate when the door opening/closing detector 22 detects that the door 201 of the entrance 202 is open and the door locking member position detector 24 detects that the door locking member 23 has moved to the adjacent position 400.

[0077] Thus, since the passenger boarding bridge 100 includes the door locking member position detector 24, contact between the lifting/lowering floor 31 of the level difference eliminating device 30 and the door 201 of the entrance 202 can be prevented more properly at the time of attaching the cab 20 to the entrance 202 of the aircraft 200.

[0078] The controller 50A controls the operation of the motive power generator 35 to move the lifting/lowering floor 31 upward automatically when the door opening/closing detector 22 detects that the door 201 of the entrance 202 is open and the door locking member position detector 24 detects that the door locking member 23 has moved to the adjacent position 400.

[0079] With the above-described configuration, at the time of attaching the cab 20 to the entrance 202 of the aircraft 200, the lifting/lowering floor 31 of the level difference eliminating device 30 can be automatically operated in conjunction with an operation of opening the door 201 and movement of the door locking member 23 to the adjacent position 400. This makes it possible to move the lifting/lowering floor 31 upward promptly after the door 201 of the entrance 202 is opened.

[0080] At the time of detaching the cab 20 from the entrance 202 of the aircraft 200, the controller 50A controls the operation of the motive power generator 35 to move the lifting/lowering floor 31 downward automatically when the door locking member position detector 24 detects that the door locking member 23 has moved from the adjacent position 400 to the distant position 401.

[0081] With the above-described configuration, at the time of detaching the cab 20 from the entrance 202 of the aircraft 200, the lifting/lowering floor 31 of the level difference eliminating device 30 can be lowered in advance based on a detection signal from the door locking member position detector 24. This makes it possible to properly prevent contact between the lifting/lowering floor 31 of the level difference eliminating device 30 and the door 201 of the entrance 202.

[0082] The controller 50A may be configured in any manner, so long as the controller 50A has control functions. The controller 50A may include, for example, an arithmetic operation unit (not shown) and a storage unit (not shown) storing a control program. Examples of the arithmetic operation unit include a PLC, MPU, and CPU. The storage unit is a memory, for example. The controller 50A may be configured as a single controller, or may be configured as a plurality of controllers.

[0083] [Operations]

Fig. 5, Fig. 6, Fig. 7, and Fig. 8 are flowcharts showing examples of operations of the passenger boarding bridge according to the embodiment of the present invention. It should be noted that automatic control operations of the passenger boarding bridge 100 described below are performed in accordance with the control program of the controller 50A.

[0084] Steps S1 to S7 shown in Fig. 5 may be the same as operations of an automatic docking function described in Japanese Laid-Open Patent Application Publication No. 2002-37196. Therefore, steps S1 to S7 are not described in detail herein, but are described briefly below.

[0085] Fig. 5 shows operations that are performed when the passenger boarding bridge 100 moves from a parking position to an attaching position where the passenger boarding bridge 100 is attached to the aircraft 200.

[0086] First, in step S1, an operator pushes an aircraft type selection button on an operation panel (not shown) of the control board 50 to select the aircraft type of the aircraft 200. Based on the selected aircraft type, a predetermined attaching position corresponding to the aircraft type is selected among a plurality of predetermined attaching positions set in advance.

[0087] Next, when the operator pushes a start button on the operation panel, automatic control described below is started. It should be noted that, in the present embodiment, the start button is in an ON state only while the operator is pushing the button, i.e., configured as a dead man's switch. Accordingly, when the operator releases their hand from the button, the automatic control described below is stopped forcibly.

[0088] In step S2, based on the above selection of the aircraft type and detection results from any suitable angle sensor (not shown) and position sensor (not shown), various control amounts to reach the attaching position (e.g., the turning angle of the cab 20, the amount of upward/downward movement of the tunnel unit 10, and the turning angle and running distance of the drive wheels of the drive columns 15) are calculated.

[0089] Next, based on the results of the calculation, the cab 20 is turned in step S4, and the tunnel unit 10 is moved upward/downward in step S5.

[0090] At the same time, the drive wheels of the drive columns 15 are controlled in steps S3 and S6. Specifically, in step S3, the drive wheels are turned in the direction of the attaching position (target position), and then in step S6, the drive wheels are caused to run on the apron 18 in this direction.

[0091] Next, in step S7, based on a detection result from a photoelectric distance sensor (not shown), it is determined whether or not the distance between the bumper 21B of the inclined floor 21A of the cab 20 and the aircraft 200 is a predetermined distance set in advance (e.g., 1 m).

[0092] If the result of the determination in step S7 is No, the above-described operation is kept performed. On the other hand, if the result of the determination in step S7 is Yes, the flow proceeds to step S8.

[0093] In step S8, inclination angle automatic control of the inclined floor 21A of the cab 20 in the width direction 300 is performed based on an output signal from an angle adjustment detector (not shown) that detects the inclination angle of the inclined floor 21A in the width direction 300. Specifically, the motive power generator is controlled based on the output signal from the angle adjustment detector, such that the inclination angle of the inclined floor 21A is a predetermined target value. For example, the motive power generator is controlled such that the inclined floor 21A is parallel to the apron 18. In this manner, if the inclined floor 21A of the cab 20 and the door sill 202A of the entrance 202 of the aircraft 200 are not parallel to each other, the controller 50A automatically controls the inclination angle of the inclined floor 21A in the width direction 300 based on the output signal from the angle adjustment detector.

[0094] Thereafter, the cab 20 is attached to the entrance 202 of the aircraft 200 by manual operation by the operator, and thus the attaching of the cab 20 of the passenger boarding bridge 100 to the aircraft 200 is completed.

[0095] Also, by manual operation by the operator using a key switch (not shown) on the control board 50, the passenger boarding bridge 100 is set to an automatic leveling mode. Accordingly, for example, in a case where the body of the aircraft 200 moves upward or downward due to boarding or disembarking of passengers, a vertical expansion/contraction mechanism of the drive columns 15 is controlled such that the cab 20 follows such upward or downward movement of the aircraft body.

[0096] Here, as shown in Fig. 9, at the time of attaching the cab 20 to the entrance 202 of the aircraft 200, the walkway 21 (the inclined floor 21A) coupled to the distal end of the tunnel unit 10 (see Fig. 1) is positioned below the entrance 202 of the aircraft 200 (hereinafter, this position is referred to as a “retraction position”). The reason for this is described below.

[0097] There are cases where, at the time of opening/closing the door 201, the bottom end

of the door 201 of the entrance 202 is moved to be lower than the door sill 202A of the entrance 202 of the aircraft 200. In such a case, if the position of the walkway 21 (the inclined floor 21A) of the cab 20 is set such that no difference in level G is formed between the door sill 202A of the entrance 202 and the walkway 21 (the inclined floor 21A) of the cab 20, the door 201 cannot be opened/closed, i.e., the door 201 will hit the walkway 21 (the inclined floor 21A) of the cab 20 at the time of opening/closing the door 201 of the entrance 202. For this reason, as shown in Fig. 9, the walkway 21 (the inclined floor 21A) is positioned below the entrance 202 of the aircraft 200 at the time of attaching the cab 20 to the entrance 202 of the aircraft 200, and thereby opening/closing of the door 201 is performed properly.

[0098] Fig. 6 shows operations that are performed at the time of eliminating a difference in level G between the door sill 202A of the entrance 202 and the lifting/lowering floor 31 of the cab 20 by the level difference eliminating device 30 and thereafter attaching the lifting/lowering floor 31 to the door sill 202A of the entrance 202.

[0099] First, in step S9, based on a detection result from the door opening/closing detector 22, it is determined whether or not the door 201 of the entrance 202 has been opened by manual operation by an operator.

[0100] If the result of the determination in step S9 is No, the lifting/lowering floor 31 is kept in the retraction position, and the lifting/lowering floor 31 is prohibited from moving upward. On the other hand, if the result of the determination in step S9 is Yes, the flow proceeds to the next determination step S10.

[0101] In step S10, based on a detection result from the door locking member position detector 24, it is determined whether or not the door locking member 23 has been moved to the adjacent position 400 by manual operation by the operator.

[0102] If the result of the determination in step S10 is No, the lifting/lowering floor 31 is kept in the retraction position, and the lifting/lowering floor 31 is prohibited from moving upward. On the other hand, if the result of the determination in step S10 is Yes, the flow proceeds to the next step S11, in which the lifting/lowering floor 31 of the cab 20 is moved upward by motive power generated by the motive power generator 35.

[0103] Next, in step S12, based on a detection result from the door sill detector 39, it is determined whether or not the door sill 202A of the entrance 202 has been detected.

Specifically, as shown in Fig. 4, when the distal end portion of the lifting/lowering floor 31 of the cab 20 has reached onto the same plane as that of the door sill 202A of the entrance 202, the door sill detector 39 outputs a detection signal. Based on the detection signal from the door sill detector 39, it is determined that the door sill 202A of the entrance 202 has been detected.

[0104] If the result of the determination in step S12 is No, the above-described operation of moving the lifting/lowering floor 31 upward is kept performed. On the other hand, if the result of the determination in step S12 is Yes, the flow proceeds to step S13, in which the upward movement of the lifting/lowering floor 31 based on the motive power generated by the motive power generator 35 is stopped. In this manner, when the distal end portion of the lifting/lowering floor 31 has moved to be on the same plane as that of the door sill 202A of the entrance 202, the lifting/lowering movement of the lifting/lowering floor 31 can be stopped properly so that there will be no difference in level between the door sill 202A of the entrance 202 and the lifting/lowering floor 31 of the cab 20 of the passenger boarding bridge 100.

[0105] Next, in step S14, the lifting/lowering floor 31 of the cab 20 is horizontally moved forward by motive power generated by the motive power generator 45.

[0106] In step S15, based on a detection result from a limit switch that is not shown, it is determined whether or not contact between the bumper 31B of the lifting/lowering floor 31 and the door sill 202A of the entrance 202 has been detected. The limit switch may be included in the urging mechanism 41. For example, as shown in Fig. 10, the limit switch may be a detector that is turned ON when the stopper member 43B has moved forward along the spring shaft 42 by a predetermined amount against reaction force of the spring 42A after the bumper 31B and the door sill 202A have come into contact with each other. This makes it possible to readily set the pressing force of the contact between the bumper 31B and the door sill 202A.

[0107] If the result of the determination in step S15 is No, the above-described operation of horizontally moving the lifting/lowering floor 31 forward is kept performed. On the other hand, if the result of the determination in step S15 is Yes, the flow proceeds to step S16, in which the horizontal forward movement of the lifting/lowering floor 31 of the cab 20 based on the motive power generated by the motive power generator 45 is stopped.

[0108] As described above, the passenger boarding bridge 100 according to the present embodiment can properly control the lifting/lowering movement of the lifting/lowering floor 31 based on a detection signal from the door opening/closing detector 22 at the time of opening/closing the door 201 of the entrance 202. That is, at the time of attaching the cab 20 to the entrance 202 of the aircraft 200, if it is not detected that the door 201 is open, the lifting/lowering floor 31 is prohibited from moving upward. This makes it possible to properly prevent contact between the lifting/lowering floor 31 of the level difference eliminating device 30 and the door 201 of the entrance 202.

[0109] Moreover, based on a detection signal from the door locking member position detector 24, the lifting/lowering movement of the lifting/lowering floor 31 can be controlled

properly at the time of opening/closing the door 201 of the entrance 202. That is, if the door locking member 23 has not moved to the adjacent position 400, the lifting/lowering floor 31 is prohibited from moving upward. This makes it possible to prevent contact between the lifting/lowering floor 31 of the level difference eliminating device 30 and the door 201 of the entrance 202 more properly.

[0110] As described above, in the automatic control of the lifting/lowering movement of the lifting/lowering floor 31 according to the present embodiment, contact between the lifting/lowering floor 31 and the door 201 can be properly and sufficiently prevented owing to the combination of the movement prohibiting function based on a detection signal from the door opening/closing detector 22 and the movement prohibiting function based on a detection signal from the door locking member position detector 24.

[0111] In addition, in the passenger boarding bridge 100 according to the present embodiment, at the time of attaching the cab 20 to the entrance 202 of the aircraft 200, the lifting/lowering floor 31 of the level difference eliminating device 30 can be automatically operated in conjunction with an operation of opening the door 201 and movement of the door locking member 23 to the adjacent position 400. Therefore, after the door 201 of the entrance 202 is opened, the lifting/lowering floor 31 can be moved upward promptly.

[0112] Fig. 7 shows operations that are performed at the time of detaching the cab 20 from the entrance 202 of the aircraft 200 and until the lifting/lowering floor 31 of the passenger boarding bridge 100 is moved to the retraction position.

[0113] First, in step S20, based on a detection result from the door locking member position detector 24, it is determined whether or not the door locking member 23 has been moved to the distant position 401 by manual operation by the operator.

[0114] If the result of the determination in step S20 is No, the current state is maintained. On the other hand, if the result of the determination in step S20 is Yes, the flow proceeds to the next determination step S21.

[0115] In step S21, based on a detection result from a limit switch that is not shown, it is determined whether or not the lifting/lowering floor 31 is in the retraction position.

[0116] If the result of the determination in step S21 is No, then in step S22, the lifting/lowering floor 31 of the cab 20 is horizontally moved rearward by motive power generated by the motive power generator 45. Also, in step S23, the lifting/lowering floor 31 of the cab 20 is moved downward by motive power generated by the motive power generator 35. Consequently, as shown in Fig. 9, the lifting/lowering floor 31 is moved to the retraction position.

[0117] As described above, in the passenger boarding bridge 100 according to the present

embodiment, at the time of detaching the cab 20 from the entrance 202 of the aircraft 200, the lifting/lowering floor 31 of the level difference eliminating device 30 can be lowered in advance based on a detection signal from the door locking member position detector 24. This makes it possible to properly prevent contact between the lifting/lowering floor 31 of the level difference eliminating device 30 and the door 201 of the entrance 202.

[0118] Thereafter, the door 201 is closed by manual operation by the operator. Also, by manual operation by the operator using a key switch (not shown) on the control board 50, the automatic leveling mode of the passenger boarding bridge 100 is canceled. In addition, by manual operation by the operator, the passenger boarding bridge 100 is operated such that the distance between the bumper 21B of the inclined floor 21A of the cab 20 and the aircraft 200 becomes a predetermined distance set in advance (e.g., 1 m).

[0119] Fig. 8 shows operations that are performed from the above state until the passenger boarding bridge 100 is moved to the parking position.

[0120] In step S24, the operator pushes an aircraft type selection button on the operation panel (not shown) of the control board 50, thereby selecting a parking position. It should be noted that steps S25 to S31 in Fig. 8 will be readily understood by referring to the foregoing description of steps S2 to S8 of Fig. 2. Therefore, the description of the operations in steps S25 to S31 is omitted herein.

[0121] (Variation 1)

In the passenger boarding bridge 100 according to the present embodiment, the door locking member 23 includes the rod 23A, around which the cushioning 23B is wound, and the above-described embodiment shows an example in which the door locking member 23 is used as a member serving to block the movement of the outward opening door 201 at the adjacent position 400. However, the door locking member may be used at the adjacent position 400 as a fence on the walkway 21 of the cab 20 (e.g., as a guard fence on the walkway 21 for preventing entry of passengers). In this manner, the door locking member can be utilized as a fence that allows the passengers to properly pass through the walkway 21.

[0122] (Variation 2)

In the present embodiment, the passenger boarding bridge 100 is described in relation to the door 201, which is configured as an outward opening door. However, the door of the aircraft 200 may be configured as an inward opening door. In this case, if the first detector 24A is an infrared sensor, movement of the door locking member 23 to the adjacent position 400 can be detected based on the amount of change in infrared energy, the change occurring when infrared rays from the first detector 24A are reflected by the aircraft body.

[0123] (Variation 3)

The present embodiment has given an example in which the door sill detector 39 of the passenger boarding bridge 100 outputs a detection signal when the distal end portion of the lifting/lowering floor 31 has reached onto the same plane as that of the door sill 202A of the entrance 202 of the aircraft 200 during lifting/lowering movement (upward/downward movement) of the lifting/lowering floor 31. However, in place of the lifting/lowering floor 31, the level difference eliminating device 30 may include a swing floor (not shown) that swings via any suitable coupling hinge with respect to the walkway 21 of the cab 20. In Variation 3, the swing floor is used for connection to the door sill 202A of the entrance 202 of the aircraft 200, and is one example of the movable floor configured to be movable upward and downward.

[0124] The door sill detector 39 may output a detection signal when the distal end portion of the swing floor has reached onto the same plane as that of the door sill 202A of the entrance 202 of the aircraft 200 during the swinging of the swing floor.

[0125] (Variation 4)

The present embodiment has given an example in which the controller 50A of the passenger boarding bridge 100 controls the motive power generator 35 to move the lifting/lowering floor 31 upward automatically when detecting that the door 201 of the entrance 202 is open and that the door locking member 23 has moved to the adjacent position 400. However, instead of such automatic control, the lifting/lowering floor 31 may be moved upward by manual operation by the operator. Moreover, the controller 50A may perform the aforementioned automatic control by means of the motive power generator 35 immediately when detecting that the door 201 of the entrance 202 is open.

[0126] (Variation 5)

The present embodiment has given an example in which, in the passenger boarding bridge 100, the rod 23A of the door locking member 23 rotates, on the horizontal plane including the width direction 300 and the passage direction 301, about the rotation supporting point 25 including the vertical rotary shaft 25A substantially parallel to the vertical direction. However, the door locking member 23 may be configured in any manner, so long as the door locking member 23 is movable between the adjacent position 400 adjacent to the entrance 202 of the aircraft 200 and the distant position 401 distant from the entrance 202 of the aircraft 200 than the adjacent position 400 at the time of attaching the cab 20 to the entrance 202 of the aircraft 200.

[0127] For example, as shown in Fig. 11, an end portion of a rod 123A of a door locking member 123 placed parallel to the door 201 may be fixed at a rotation supporting point 125, which includes a horizontal rotary shaft 125A substantially parallel to the passage direction 301.

With this configuration, the door locking member 123 may rotate about the rotation supporting point 125 on a vertical plane including the vertical direction and the width direction 300.

Although not illustrated, the door locking member placed parallel to the door 201 may move parallel to the width direction 300 or the passage direction 301.

[0128] In the case of the former rod 123A rotating on the vertical plane, for example, when the rod 123A has rotated to be in such a state that its longitudinal direction is parallel to the width direction 300 (i.e., in a substantially horizontal state) and the rod 123A interferes with opening/closing of the door 201, it means that the door locking member 123 is present at an adjacent position 500 adjacent to the entrance 202 of the aircraft 200. On the other hand, when the rod 123A has rotated to be in such a state that its longitudinal direction is parallel to the vertical direction (i.e., in a substantially vertical state) and the rod 123A does not interfere with opening/closing of the door 201, it means that the door locking member 123 is present at a distant position (not shown) distant from the entrance 202 of the aircraft 200 than the adjacent position 500.

[0129] Of the latter door locking members, in the case of the door locking member moving parallel to the width direction 300, for example, when the rod 123A has moved to the left parallel to the width direction 300 to be in such a position that the rod 123A interferes with opening/closing of the door 201, it means that the door locking member 123 is present at the adjacent position 500 adjacent to the entrance 202 of the aircraft 200. On the other hand, when the rod 123A has moved to the right parallel to the width direction 300 to be in such a position that the rod 123A does not interfere with opening/closing of the door 201, it means that the door locking member 123 is present at the distant position (not shown) distant from the entrance 202 of the aircraft 200 than the adjacent position 500.

[0130] Of the latter door locking members, in the case of the door locking member moving parallel to the passage direction 301, for example, when the rod 123A has moved forward parallel to the passage direction 301 to be in such a position that the rod 123A interferes with opening/closing of the door 201, it means that the door locking member 123 is present at the adjacent position 500 adjacent to the entrance 202 of the aircraft 200. On the other hand, when the rod 123A has moved rearward parallel to the passage direction 301 to be in such a position that the rod 123A does not interfere with opening/closing of the door 201, it means that the door locking member 123 is present at the distant position (not shown) distant from the entrance 202 of the aircraft 200 than the adjacent position 500.

[0131] (Variation 6)

The present embodiment has given an example in which the door locking member

position detector 24 of the passenger boarding bridge 100 includes: the first detector 24A configured to detect movement of the door locking member 23 to the adjacent position 400; and the second detector 24B configured to detect movement of the door locking member 23 to the distant position 401.

[0132] However, as an alternative, the door locking member position detector may be a single detector (e.g., an encoder detecting the moving amount and rotation angle of the door locking member 23).

[0133] The present embodiment has given an example in which, in the passenger boarding bridge 100, the rod 23A is fixed at a desired position on the horizontal plane including the adjacent position 400 and the distant position 401 by manual operation by the operator by using suitable fixing means. However, in Variation 6, the controller 50A may control the operation of a motive power generator (not shown) of the door locking member 23 based on an output from the encoder serving as the door locking member position detector so that the rod 23A can be moved to a desired position on the horizontal plane.

[0134] From the foregoing description, numerous modifications and other embodiments of the present invention are obvious to a person skilled in the art. Therefore, the foregoing description should be interpreted only as an example and is provided for the purpose of teaching the best mode for carrying out the present invention to a person skilled in the art. The structural and/or functional details can be substantially altered without departing from the spirit of the present invention.

Industrial Applicability

[0135] One aspect of the present invention makes it possible to properly control the movement of the movable floor of the cab at the time of opening/closing the door of the entrance of the aircraft. Therefore, the one aspect of the present invention is applicable to, for example, a passenger boarding bridge for an aircraft.

Reference Signs List

- [0136] 10 tunnel unit
 12 rotunda
 15 drive column
 16 auxiliary stairs
 18 ground (apron)
 20 cab

- 21 walkway
 - 21A inclined floor
 - 21B bumper
- 22 door opening/closing detector
- 23 door locking member
 - 23A rod
 - 23B cushioning
- 24 door locking member position detector
 - 24A first detector
 - 24B second detector
- 25 rotation supporting point
 - 25A rotary shaft
- 28 closure
- 29 opening
- 30 level difference eliminating device
- 31 lifting/lowering floor
 - 31B bumper
- 32 driven slope
- 33 support frame
- 34 linear motion guide
 - 34A table
 - 34B rail
- 35 motive power generator
- 37 coupling frame
- 38 coupling hinge
- 39 door sill detector
- 41 urging mechanism
- 42 spring shaft
 - 42A spring
- 43A, 43B stopper member
- 44 linear motion guide
 - 44A table
 - 44B rail
- 45 motive power generator

50	control board
50A	controller
100	passenger boarding bridge
200	aircraft
201	door
202	entrance
202A	door sill
300	width direction
301	passage direction
400	adjacent position
401	distant position

CLAIMS

1. A passenger boarding bridge including a cab provided at a distal end of a tunnel unit, the cab forming a walkway when attached to an entrance of an aircraft, the cab comprising:

a movable floor used for connection to a door sill of the entrance of the aircraft and configured to be movable upward and downward;

a door opening/closing detector configured to detect opening and closing of a door of the entrance of the aircraft;

a motive power generator configured to generate motive power used for moving the movable floor; and

a controller configured to prohibit the motive power generator from operating if the door opening/closing detector does not detect that the door is open,

wherein

the walkway of the cab is positioned below the entrance of the aircraft at a time of attaching the cab to the entrance of the aircraft, and the movable floor is prohibited from moving upward when the door is not open.

2. The passenger boarding bridge according to claim 1, wherein

the controller controls operation of the motive power generator to move the movable floor upward automatically when the door opening/closing detector detects that the door is open.

3. The passenger boarding bridge according to claim 1 or 2, comprising:

a door locking member configured to be movable between an adjacent position adjacent to the entrance of the aircraft and a distant position distant from the entrance of the aircraft than the adjacent position at the time of attaching the cab to the entrance of the aircraft; and

a door locking member position detector configured to detect movement of the door locking member to the adjacent position and movement of the door locking member to the distant position, wherein

the controller allows the motive power generator to operate when the door opening/closing detector detects that the door is open and the door locking member position detector detects that the door locking member has moved to the adjacent position.

4. The passenger boarding bridge according to claim 3, wherein
the controller controls operation of the motive power generator to move the movable floor upward automatically when the door opening/closing detector detects that the door is open and the door locking member position detector detects that the door locking member has moved to the adjacent position.
5. The passenger boarding bridge according to claim 3 or 4, wherein
the door locking member is used as a member serving to block movement of the door at the adjacent position, the door being configured as an outward opening door.
6. The passenger boarding bridge according to any one of claims 3 to 5, wherein
the door locking member is used as a fence on the walkway of the cab at the adjacent position.
7. The passenger boarding bridge according to any one of claims 3 to 6, wherein
the door locking member position detector includes:
 - a first detector configured to detect movement of the door locking member to the adjacent position; and
 - a second detector configured to detect movement of the door locking member to the distant position.
8. The passenger boarding bridge according to any one of claims 3 to 7, wherein
at a time of detaching the cab from the entrance of the aircraft, the controller controls operation of the motive power generator to move the movable floor downward automatically when the door locking member position detector detects that the door locking member has moved from the adjacent position to the distant position.