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 equipment that forms a passenger walkway between an aircraft and a terminal building of an airport (see Patent Literatures 1 and 2, for example).

[0003] The passenger boarding bridge includes: a rotunda connected to the terminal building and supported in a turnable manner; a tunnel unit whose proximal end is connected to the rotunda, the tunnel unit including a plurality of tunnels that are fitted together in a telescopic manner, such that the tunnel unit is extendable and retractable; and a turnable cab provided at the distal end of the tunnel unit. Drive columns serving as support legs are further provided at the distal side of the tunnel unit.

[0004] The drive columns are provided with: a lifting/lowering device configured to support the tunnel unit and move the tunnel unit upward/downward; and a running device including a plurality of running wheels, the running device being positioned below the lifting/lowering device. By moving the tunnel unit upward/downward by the lifting/lowering device, the tunnel unit can be swung vertically with respect to the rotunda. By causing the drive columns to run on the apron by means of the running device, the tunnel unit can be extended and retracted in the front-rear direction and/or swung horizontally with respect to the rotunda. The tunnel unit is moved by the drive columns thus configured, and thereby the cab disposed at the front end of the tunnel unit is brought into connection with the entrance of an aircraft. The front end of the floor of the cab is provided with a bumper that is made of synthetic rubber for the purpose of reducing an impact shock when the floor of the cab comes into contact with the aircraft. The cab is connected to the entrance of the aircraft, with the bumper being in contact with the fuselage of the aircraft.

[0005] The aircraft moves upward/downward due to, for example, boarding/disembarking of passengers and loading/unloading of cargo. The passenger boarding bridge includes a level detection device configured to detect the amount of such upward/downward movement of the aircraft. When the amount of upward/downward movement detected by the level detection device is greater than or equal to a predetermined amount, the lifting/lowering device of the drive columns is controlled such that the cab follows the upward/downward movement of the aircraft.

Citation List

Patent Literature

[0006] PTL 1: Japanese Laid-Open Utility Model Application Publication No. S62-145800
PTL 2: Japanese Examined Utility Model Application Publication No. H03-11119

Summary of Invention

Technical Problem

[0007] The aircraft fuselage, which, as mentioned above, comes into contact with the front end bumper of the cab when the cab is connected to the entrance of the aircraft, has a curved surface. For this reason, after the cab is connected to the aircraft, if the aircraft moves upward/downward, a gap may be formed between the bumper and the aircraft, or the pressing force of the bumper applied to the fuselage may become excessively great.

[0008] In the above-described case where the passenger boarding bridge includes the level detection device, when the amount of upward/downward movement of the aircraft is greater than or equal to the predetermined amount, the lifting/lowering device of the drive columns is controlled such that the front end bumper of the cab follows the upward/downward movement of the aircraft. However, even in the case of adopting such a configuration, since the lifting/lowering by the lifting/lowering device causes the tunnel unit and the cab to swing vertically with respect to the rotunda, the front end bumper of the cab is also caused to swing vertically with respect to the rotunda. That is, the front end bumper of the cab does not linearly move in the vertical direction. As a result, a gap may be formed between the bumper and the aircraft, or the pressing force of the bumper applied to the fuselage may become excessively great. If there is such a gap, the passengers may get scared due to the presence of the gap, or some objects may fall through the gap. Moreover, if the pressing force of the bumper applied to the fuselage becomes excessively great, the fuselage may get damaged.

[0009] Patent Literature 1 discloses operating the running device of the drive columns in order to avoid the above problems, i.e., the formation of the gap and the excessive application of the pressing force to the fuselage. However, in reality, it is difficult to finely adjust the space between the cab and the aircraft by controlling the running of the drive columns, which are supporting one end of the passenger boarding bridge, which is heavy in weight.

[0010] Embodiments of the present invention are made to solve the above-described problems. Embodiments of the present invention provide a passenger boarding bridge that is capable of keeping a suitable contact state between an aircraft and a bumper of a cab even when the aircraft moves upward/downward (i.e., even when the fuselage is lifted/lowered) due to, for example, boarding/disembarking of passengers.

Solution to Problem

[0011] According to a first aspect of the present invention, there is provided a passenger boarding bridge including: a rotunda connected to a terminal building; a tunnel unit whose proximal end is connected to the rotunda, the tunnel unit being swingable vertically such that a

distal end of the tunnel unit is lifted and lowered; a cab provided at the distal end of the tunnel unit; and a lifting/lowering device configured to support the tunnel unit and lift and lower the tunnel unit, wherein the cab includes: a floor serving as a walkway connected to the tunnel unit; a moving member movable in a passage direction of the walkway relative to the floor; a bumper urged in the passage direction relative to the moving member via an urging member; and a moving mechanism configured to move the moving member in the passage direction relative to the floor, the passenger boarding bridge further including: a detector configured to detect a contact state between the bumper and the aircraft; and a control device configured to control the moving mechanism when the cab is in a docked state with the aircraft, wherein if the detector detects that the bumper has been brought into a state of being in non-contact with the aircraft, the control device controls the moving mechanism to move the moving member in a direction toward the aircraft, such that the bumper is brought into a state of being in contact with the aircraft with a suitable pressure in a predetermined range; and if the detector detects that the bumper in the state of being in contact with the aircraft with a suitable pressure in the predetermined range has been brought into a state of being in contact with the aircraft with an excessive pressure, the control device controls the moving mechanism to move the moving member in a direction away from the aircraft, such that the bumper is brought into the state of being in contact with the aircraft with a suitable pressure in the predetermined range the detector includes: a first switch configured to operate such that the first switch is turned on or off in accordance with whether or not the bumper is in a state of being in contact with the aircraft; a second switch configured to operate such that the second switch is turned on or off in accordance with whether or not the bumper is in a state of being in contact with the aircraft with a pressure greater than or equal to a lower limit value of the predetermined range; a third switch configured to operate such that the third switch is turned on or off in accordance with whether or not the bumper is in a state of being in contact with the aircraft with a pressure greater than an upper limit value of the predetermined range; and a contact state determiner configured to: determine based on an operation state of the first switch whether or not the bumper is in the state of being in non-contact with the aircraft; and determine based on an operation state of the second switch and an operation state of the third switch whether the bumper is in the state of being in contact with the aircraft with a suitable pressure in the predetermined range or is in the state of being in contact with the aircraft with an excessive pressure.

[0012] According to a second aspect of the present invention, there is provided a passenger boarding bridge including: a rotunda connected to a terminal building; a tunnel unit whose proximal end is connected to the rotunda, the tunnel unit being swingable vertically such that a distal end of the tunnel unit is lifted and lowered; a cab provided at the distal end of the tunnel unit; and a lifting/lowering device configured to support the tunnel unit and lift and lower the tunnel unit, wherein the cab includes: a floor serving as a walkway connected to the tunnel unit; a moving member movable in a passage direction of the walkway relative to the floor; a bumper urged in the passage direction relative to the moving member via an urging member; and a

moving mechanism configured to move the moving member in the passage direction relative to the floor, the passenger boarding bridge further including: a detector configured to detect a contact state between the bumper and the aircraft; and a control device configured to control the moving mechanism when the cab is in a docked state with the aircraft, wherein if the detector detects that the bumper has been brought into a state of being in non-contact with the aircraft, the control device controls the moving mechanism to move the moving member in a direction toward the aircraft, such that the bumper is brought into a state of being in contact with the aircraft with a suitable pressure in a predetermined range; and if the detector detects that the bumper in the state of being in contact with the aircraft with a suitable pressure in the predetermined range has been brought into a state of being in contact with the aircraft with an excessive pressure, the control device controls the moving mechanism to move the moving member in a direction away from the aircraft, such that the bumper is brought into the state of being in contact with the aircraft with a suitable pressure in the predetermined range the cab further includes a slide plate including two edge portions that are away from each other in the passage direction, of the two edge portions, one edge portion is mounted along an upper end of the bumper, and the other edge portion is placed on a surface of the floor, and the slide plate slides along the surface of the floor in accordance with movement of the bumper.

[0013] According to the above aspects, if the detector detects that the bumper has been brought into the state of being in non-contact with the aircraft, the control device controls the moving mechanism to move the moving member in a direction toward the aircraft, such that the bumper is brought into the state of being in contact with the aircraft with a suitable pressure in the predetermined range. If the detector detects that the bumper in the state of being in contact with the aircraft with a suitable pressure in the predetermined range has been brought into the state of being in contact with the aircraft with an excessive pressure, the control device controls the moving mechanism to move the moving member in a direction away from the aircraft, such that the bumper is brought into the state of being in contact with the aircraft with a suitable pressure in the predetermined range. Performing such control makes it possible to keep a suitable contact state between the aircraft and the bumper of the cab even when the aircraft moves upward/downward due to, for example, boarding/disembarking of passengers.

[0014] In an embodiment, passenger boarding bridge may further include a level detection device configured to detect an amount of vertical upward/downward movement of the aircraft relative to the cab after the cab is docked with the aircraft. When the cab is in a docked state with the aircraft, the control device may be configured to control the lifting/lowering device based on a value outputted from the level detection device, such that the cab follows the upward/downward movement of the aircraft.

[0015] According to the above embodiment, when the aircraft moves upward/downward due to, for example, boarding/disembarking of passengers, the lifting/lowering device is controlled such that the cab follows the upward/downward movement of the aircraft.

[0016] In an embodiment, the cab may further include a slide plate including two edge

portions that are away from each other in the passage direction. Of the two edge portions, one edge portion may be mounted along an upper end of the bumper, and the other edge portion may be placed on a surface of the floor. The slide plate may slide along the surface of the floor in accordance with movement of the bumper.

Advantageous Effects of Invention

[0017] Embodiments of the present invention provide a passenger boarding bridge that is capable of keeping a suitable contact state between the aircraft and the bumper of the cab even when the aircraft moves upward/downward (i.e., even when the fuselage is lifted/lowered) due to, for example, boarding/disembarking of passengers.

Brief Description of Drawings

[0018] Fig. 1 is a schematic side view showing one example of a passenger boarding bridge according to one embodiment of the present invention.

Fig. 2 is a schematic plan view showing one example of the front end portion of a cab.

Fig. 3 is a schematic front view showing one example of the cab.

Fig. 4 is a side view showing one example of a state where the cab is docked with an aircraft.

Fig. 5A is a schematic sectional view taken along line A-A of Fig. 2 as viewed in the direction of arrows of line A-A; Fig. 5B is a schematic sectional view taken along line B-B of Fig. 2 as viewed in the direction of arrows of line B-B; and Fig. 5C shows an extendable/retractable bumper unit moved forward from the state shown in Fig. 5B.

Fig. 6A is a sectional view showing, for example, a mounting position of distal end limit switches; Fig. 6B is a sectional view showing, for example, a mounting position of a first limit switch; and Fig. 6C is a sectional view showing, for example, a mounting position of a second limit switch.

Fig. 7 is a flowchart showing one example of operations performed when docking the passenger boarding bridge with the aircraft.

Fig. 8 is a flowchart showing one example of operations performed after the docking of the passenger boarding bridge with the aircraft is completed.

Figs. 9A and 9B are conceptual diagrams for describing operations of a moving mechanism.

Description of Embodiments

[0019] Hereinafter, one preferred embodiment of the present invention is 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 below. The present

CLAIMS

1. A passenger boarding bridge comprising:

a rotunda connected to a terminal building;

a tunnel unit whose proximal end is connected to the rotunda, the tunnel unit being swingable vertically such that a distal end of the tunnel unit is lifted and lowered;

a cab provided at the distal end of the tunnel unit; and

a lifting/lowering device configured to support the tunnel unit and lift and lower the tunnel unit, wherein

the cab includes:

a floor serving as a walkway connected to the tunnel unit;

a moving member movable in a passage direction of the walkway relative to the floor;

a bumper urged in the passage direction relative to the moving member via an urging member; and

a moving mechanism configured to move the moving member in the passage direction relative to the floor,

the passenger boarding bridge further comprising:

a detector configured to detect a contact state between the bumper and the aircraft; and

a control device configured to control the moving mechanism when the cab is in a docked state with the aircraft, wherein

if the detector detects that the bumper has been brought into a state of being in non-contact with the aircraft, the control device controls the moving mechanism to move the moving member in a direction toward the aircraft, such that the bumper is brought into a state of being in contact with the aircraft with a suitable pressure in a predetermined range; and

if the detector detects that the bumper in the state of being in contact with the aircraft with a suitable pressure in the predetermined range has been brought into a state of being in contact with the aircraft with an excessive pressure, the control device controls the moving mechanism to move the moving member in a direction away from the aircraft, such that the bumper is brought into the state of being in contact with the aircraft with a suitable pressure in the predetermined range

the detector includes:

a first switch configured to operate such that the first switch is turned on or off in

accordance with whether or not the bumper is in a state of being in contact with the aircraft;

a second switch configured to operate such that the second switch is turned on or off in accordance with whether or not the bumper is in a state of being in contact with the aircraft with a pressure greater than or equal to a lower limit value of the predetermined range;

a third switch configured to operate such that the third switch is turned on or off in accordance with whether or not the bumper is in a state of being in contact with the aircraft with a pressure greater than an upper limit value of the predetermined range; and

a contact state determiner configured to:

determine based on an operation state of the first switch whether or not the bumper is in the state of being in non-contact with the aircraft; and

determine based on an operation state of the second switch and an operation state of the third switch whether the bumper is in the state of being in contact with the aircraft with a suitable pressure in the predetermined range or is in the state of being in contact with the aircraft with an excessive pressure.

2. A passenger boarding bridge comprising:

a rotunda connected to a terminal building;

a tunnel unit whose proximal end is connected to the rotunda, the tunnel unit being swingable vertically such that a distal end of the tunnel unit is lifted and lowered;

a cab provided at the distal end of the tunnel unit; and

a lifting/lowering device configured to support the tunnel unit and lift and lower the tunnel unit, wherein

the cab includes:

a floor serving as a walkway connected to the tunnel unit;

a moving member movable in a passage direction of the walkway relative to the floor;

a bumper urged in the passage direction relative to the moving member via an urging member; and

a moving mechanism configured to move the moving member in the passage direction relative to the floor,

the passenger boarding bridge further comprising:

a detector configured to detect a contact state between the bumper and the aircraft; and

a control device configured to control the moving mechanism when the cab is in a

docked state with the aircraft, wherein

if the detector detects that the bumper has been brought into a state of being in non-contact with the aircraft, the control device controls the moving mechanism to move the moving member in a direction toward the aircraft, such that the bumper is brought into a state of being in contact with the aircraft with a suitable pressure in a predetermined range; and

if the detector detects that the bumper in the state of being in contact with the aircraft with a suitable pressure in the predetermined range has been brought into a state of being in contact with the aircraft with an excessive pressure, the control device controls the moving mechanism to move the moving member in a direction away from the aircraft, such that the bumper is brought into the state of being in contact with the aircraft with a suitable pressure in the predetermined range

the cab further includes a slide plate including two edge portions that are away from each other in the passage direction,

of the two edge portions, one edge portion is mounted along an upper end of the bumper, and the other edge portion is placed on a surface of the floor, and

the slide plate slides along the surface of the floor in accordance with movement of the bumper.

3. The passenger boarding bridge of claim 1, wherein

the cab further includes a slide plate including two edge portions that are away from each other in the passage direction,

of the two edge portions, one edge portion is mounted along an upper end of the bumper, and the other edge portion is placed on a surface of the floor, and

the slide plate slides along the surface of the floor in accordance with movement of the bumper.

4. The passenger boarding bridge according to any one of claims 1 to 3, further comprising a level detection device configured to detect an amount of vertical upward/downward movement of the aircraft relative to the cab after the cab is docked with the aircraft, wherein

when the cab is in a docked state with the aircraft, the control device controls the lifting/lowering device based on a value outputted from the level detection device, such that the cab follows the upward/downward movement of the aircraft.