case of docking the passenger boarding bridge with the aircraft, the operator performs operations to cause the travel wheels to travel forward, thereby docking the distal-end cab of the passenger boarding bridge with the door of the aircraft. Then, in the case of undocking the passenger boarding bridge from the aircraft, the operator performs operations to cause the travel wheels to travel backward, thereby undocking and returning the passenger boarding bridge to a predetermined standby position.

[0007] In the above cases where the docking and undocking are controlled through operations performed by the operator, the docked state of the passenger boarding bridge with the aircraft depends on the skill of the operator. Some operator may dock the cab with the aircraft by backward travel of the travel wheels. In such a case, in order to undock the passenger boarding bridge from the aircraft, the operator needs to cause the travel wheels to travel forward. However, there may be a case where the undocking operation is performed by a different operator from an operator having performed the previous docking operation. In such a case, at the time of undocking, if the operator is unaware of the current state (i.e., current docked state), there is a risk that the operator causes the travel wheels to travel backward as he or she would do so in normal undocking, and as a result, the undocking from the aircraft is hindered.

[0008] Also, there may be a case where the distal end of the cab is provided with a limit switch that detects docking of the cab with an aircraft, and when the limit switch has detected that the cab has been docked with the aircraft, forward travel of the travel wheels is prohibited. In such a case, if an operator has docked the cab with the aircraft by backward travel of the travel wheels, then the travel wheels cannot be caused to travel forward. That is, the cab cannot be undocked from the aircraft through operations of the operating device by the operator.

[0009] ~~The~~Embodiments of the present invention ~~has been~~are made to solve the above-described problems. ~~An object~~Embodiments of the present invention ~~is to~~ provide a passenger boarding bridge capable of avoiding a situation where a cab thereof is docked with an aircraft by backward travel of travel wheels.

Solution to Problem

[0010] ~~In order to achieve the above object, a passenger boarding bridge a~~According to ~~one~~ an aspect of the present invention, there is provided a passenger boarding bridge ~~includes~~including: a rotunda connected to an entrance of a terminal building ~~and supported such that the rotunda is rotatable horizontally~~; a tunnel unit whose proximal end is connected to the rotunda, the tunnel unit being extendable and retractable, the tunnel unit being rotatable about the rotunda; a cab provided at a distal end of the tunnel unit, the cab being configured to be docked with an aircraft; a travel device that supports the tunnel unit and includes travel wheels

configured to travel forward and backward, the travel device being configured such that a direction of forward travel of the travel wheels and a direction of backward travel of the travel wheels are changeable; an operating device that is operated to input an operation command to the travel device; and a determiner configured to, during a period from when the cab starts being moved from a predetermined position, the cab being moved through an operation of the operating device to cause the travel wheels to travel, until the cab is docked with the aircraft, while the travel wheels are traveling backward in accordance with an input of a backward travel operation command from the operating device, perform determination whether or not there is a possibility that the cab comes closer to the aircraft to get docked with the aircraft as a result of the travel wheels traveling backward.

[0011] According to the above ~~configuration~~aspect, during the period from when the cab starts being moved from the predetermined position until the cab is docked with the aircraft, while the travel wheels are traveling backward, the determiner performs the determination whether or not there is a possibility that the cab comes closer to the aircraft to get docked with the aircraft. In a case where a result of the determination indicates that there is a possibility that the cab comes closer to the aircraft to get docked with the aircraft, docking of the cab with the aircraft by the backward travel of the travel wheels can be avoided by, for example, giving a warning to an operator and/or restricting the backward travel of the travel wheels.

[0012] ~~The~~In an embodiment, the determiner may be configured to: while the travel wheels are traveling backward, calculate, multiple times sequentially, a coordinate value of a current position of a predetermined part of one of the tunnel unit, the cab, or the travel device by using an orthogonal coordinate system whose origin is a ~~position of a rotational center~~center point of the rotunda in a plan view; and perform the determination based on a change in the coordinate value of the current position of the predetermined part, the coordinate value being calculated multiples times sequentially.

[0013] ~~As~~In an embodiment, as the orthogonal coordinate system, an XY orthogonal coordinate system whose origin is the ~~position of the rotational center~~center point of the rotunda in a plan view may be preset such that, in the XY orthogonal coordinate system, regions that are located on an opposite side of the origin from the entrance of the terminal building are a first quadrant and a second quadrant. The determiner may be configured to: in a case where an entrance, of the aircraft, with which the cab is to be docked is scheduled to be located in the first quadrant, while the travel wheels are traveling backward, calculate, multiple times sequentially, a Y coordinate value of the current position of the predetermined part of one of the tunnel unit, the cab, or the travel device by using the XY orthogonal coordinate system; and perform the determination whether or not there is a possibility that the cab comes closer to the aircraft to get

docked with the aircraft based on whether or not the Y coordinate value of the current position, the Y coordinate value being calculated multiple times sequentially, increases.

[0014] ~~The~~In an embodiment, the determiner may be configured to: in a case where the entrance, of the aircraft, with which the cab is to be docked is scheduled to be located in the second quadrant, while the travel wheels are traveling backward, calculate, multiple times sequentially, an X coordinate value of the current position of the predetermined part by using the XY orthogonal coordinate system; and perform the determination whether or not there is a possibility that the cab comes closer to the aircraft to get docked with the aircraft based on whether or not the X coordinate value of the current position, the X coordinate value being calculated multiple times sequentially, decreases.

[0015] ~~As~~In an embodiment, as the orthogonal coordinate system, an XY orthogonal coordinate system whose origin is the ~~position of the rotational center~~center point of the rotunda in a plan view may be preset such that, in the XY orthogonal coordinate system, regions that are located on an opposite side of the origin from the entrance of the terminal building are a first quadrant and a second quadrant. The determiner may be configured to: in a case where an entrance, of the aircraft, with which the cab is to be docked is scheduled to be located in the second quadrant, while the travel wheels are traveling backward, calculate, multiple times sequentially, an X coordinate value of the current position of the predetermined part of one of the tunnel unit, the cab, or the travel device by using the XY orthogonal coordinate system; and perform the determination whether or not there is a possibility that the cab comes closer to the aircraft to get docked with the aircraft based on whether or not the X coordinate value of the current position, the X coordinate value being calculated multiple times sequentially, decreases.

[0016] ~~The~~In an embodiment, the passenger boarding bridge may further include a distance sensor that is mounted to the cab and that measures a distance between the cab and the aircraft. The determiner may be configured to, while the travel wheels are traveling backward, perform the determination whether or not there is a possibility that the cab comes closer to the aircraft to get docked with the aircraft based on whether or not the distance between the cab and the aircraft, the distance being measured by the distance sensor, decreases.

[0017] ~~The~~In an embodiment, the determiner may be configured to perform the determination when the distance between the cab and the aircraft is a predetermined distance or less.

[0018] ~~The~~In an embodiment, the passenger boarding bridge may further include a warning unit configured to perform warning in a case where the determiner determines that there is a possibility that the cab comes closer to the aircraft to get docked with the aircraft.

[0019] According to the above ~~configuration~~embodiment, in a case where it is determined

that there is a possibility that the cab comes closer to the aircraft to get docked with the aircraft, docking of the cab with the aircraft by the backward travel of the travel wheels can be avoided by giving a warning to the operator by the warning unit. The warning notifies, for example, that backward travel or backward docking should not be performed.

[0020] ~~The~~In an embodiment, the passenger boarding bridge may be configured to stop the travel wheels from traveling backward in a case where the determiner determines that there is a possibility that the cab comes closer to the aircraft to get docked with the aircraft.

[0021] According to the above ~~configuration~~embodiment, in a case where it is determined that there is a possibility that the cab comes closer to the aircraft to get docked with the aircraft, docking of the cab with the aircraft by the backward travel of the travel wheels can be avoided by stopping the backward travel of the travel wheels.

Advantageous Effects of Invention

[0022] ~~The~~Embodiments of the present invention ~~is configured~~ as described above~~, and has~~ have an advantage of being able to provide a passenger boarding bridge capable of avoiding a situation where a cab thereof is docked with an aircraft by backward travel of travel wheels.

[0023] The above ~~object, other objects~~aspect, features, and advantages of the present invention will be made clear by the following detailed description of preferred embodiments with reference to the accompanying drawings.

Brief Description of Drawings

[0024] FIG. 1 shows a schematic plan view showing one example of a passenger boarding bridge according to one embodiment of the present invention.

FIG. 2 is a front view of the distal end part of a cab to be docked with an aircraft.

FIG. 3 shows one example of a control panel, etc.

FIG. 4 is a flowchart showing one example of steps that a controller carries out when performing a determination process and its related processes.

FIG. 5 is a schematic plan view showing one example where the passenger boarding bridge is in the state of being docked with the aircraft in a case where a door of the aircraft is located in a first quadrant.

FIG. 6 is a schematic plan view showing one example where the passenger boarding bridge is in the state of being docked with the aircraft in a case where the door of the aircraft is located in a second quadrant.

FIG. 7A is a diagram for describing various fuselage guide lines in a case where the door of the aircraft is located in the first quadrant, and FIG. 7B is a diagram for describing