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] Embodiments of the present invention are made to solve the above-described problems. Embodiments of the present invention 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] According to an 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 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 repeatedly perform determination whether or not the current direction of the forward travel of the travel wheels is a direction within a forward-only travel docking enabling range during a period from when the cab starts being moved from a predetermined position until the cab is docked with the aircraft, the cab being moved through an operation of the operating device to cause the travel wheels to travel.

[0011] According to the above aspect, during a period from when the cab starts being moved from the predetermined position until the cab is docked with the aircraft, the determiner repeatedly performs the determination whether or not the current direction of the forward travel of the travel wheels is a direction within the forward-only travel docking enabling range. In a case where a result of the determination indicates that the current direction of the forward travel of the travel wheels is not a direction within the forward-only travel docking enabling range, docking of the cab with the aircraft by 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] According to an embodiment, in a case where, in a plan view, an angle formed by a direction from a left side to a right side of the tunnel unit along a tunnel orthogonal line and the direction of the forward travel of the travel wheels, the tunnel orthogonal line being a straight line orthogonal to a center line of the tunnel unit, the angle being calculated with respect to the tunnel orthogonal line while defining a counterclockwise direction as a positive direction, is an angle θw, and in the plan view, an angle formed by the direction from the left side to the right side of the tunnel unit along the tunnel orthogonal line and a direction from a front to a back of the aircraft along a fuselage guide line on an apron, the angle being calculated with respect to the tunnel orthogonal line while defining the counterclockwise direction as the positive direction, is an angle θt, the determiner may be configured to perform the determination whether or not the direction of the forward travel of the travel wheels is a direction within the forward-only travel docking enabling range based on whether or not the angle θw is an angle within a range that is set, based on restricting condition information, within a range that is greater than the angle θt and less than an angle obtained by adding 180 degrees to the angle θt.

[0013] In embodiments of the present invention, when an angle formed by a direction A and a direction B is referred to, this angle corresponds to an angle formed by a directional vector indicating the direction A and a directional vector indicating the direction B. For example, the above “angle formed by a direction from a left side to a right side of the tunnel unit along a tunnel orthogonal line and the direction of the forward travel of the travel wheels” corresponds to

an “angle formed by a directional vector indicating the direction from the left side to the right side of the tunnel unit along the tunnel orthogonal line and a directional vector indicating the direction of the forward travel of the travel wheels”.

[0014] According to an embodiment, in a case where, in a plan view, an angle formed by a direction from a left side to a right side of the tunnel unit along a tunnel orthogonal line and the direction of the forward travel of the travel wheels, the tunnel orthogonal line being a straight line orthogonal to a center line of the tunnel unit, the angle being calculated with respect to the tunnel orthogonal line while defining a counterclockwise direction as a positive direction, is an angle θw, and in the plan view, an angle formed by the direction from the left side to the right side of the tunnel unit along the tunnel orthogonal line and a direction from a front to a back of the aircraft along an aircraft axis line of the aircraft, the angle being calculated with respect to the tunnel orthogonal line while defining the counterclockwise direction as the positive direction, is an angle θt1, the determiner may be configured to perform the determination whether or not the direction of the forward travel of the travel wheels is a direction within the forward-only travel docking enabling range based on whether or not the angle θw is an angle within a range that is set, based on restricting condition information, within a range that is greater than the angle θt1 and less than an angle obtained by adding 180 degrees to the angle θt1.

[0015] According to an embodiment, in a case where, in a plan view, an angle formed by a direction from a left side to a right side of the tunnel unit along a tunnel orthogonal line and the direction of the forward travel of the travel wheels, the tunnel orthogonal line being a straight line orthogonal to a center line of the tunnel unit, the angle being calculated with respect to the tunnel orthogonal line while defining a counterclockwise direction as a positive direction, is an angle θw, and in the plan view, an angle formed by the direction from the left side to the right side of the tunnel unit along the tunnel orthogonal line and a direction from a front to a back of the aircraft along a tangent line, the tangent line extending horizontally and touching a cab-docked part of the aircraft, the angle being calculated with respect to the tunnel orthogonal line while defining the counterclockwise direction as the positive direction, is an angle θt2, the determiner may be configured to perform the determination whether or not the direction of the forward travel of the travel wheels is a direction within the forward-only travel docking enabling range based on whether or not the angle θw is an angle within a range that is set, based on restricting condition information, within a range that is greater than the angle θt2 and less than an angle obtained by adding 180 degrees to the angle θt2.

[0016] According to an embodiment, a direction within the forward-only travel docking enabling range may be defined as a direction in which when the travel wheels travel forward, in a plan view, the travel wheels come closer to one of a fuselage guide line on an apron, an aircraft

axis line of the aircraft, or a tangent line extending horizontally and touching a cab-docked part of the aircraft.

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

[0018] According to an embodiment, the passenger boarding bridge may further include a warning unit configured to perform warning if an operation command to cause the travel device to travel backward is inputted from the operating device in a case where a result of the determination performed by the determiner indicates that the current direction of the forward travel of the travel wheels is not a direction within the forward-only travel docking enabling range.

[0019] According to the above embodiment, in a case where the current direction of the forward travel of the travel wheels is not a direction within the forward-only travel docking enabling range, docking of the cab with the aircraft by backward travel of the travel wheels can be avoided, for example, by giving a warning by the warning unit to an operator regarding backward travel or backward docking.

[0020] According to an embodiment, the passenger boarding bridge may be configured to prohibit backward travel of the travel wheels if an operation command to cause the travel device to travel backward is inputted from the operating device in a case where a result of the determination performed by the determiner indicates that the current direction of the forward travel of the travel wheels is not a direction within the forward-only travel docking enabling range.

[0021] According to the above embodiment, in a case where the current direction of the forward travel of the travel wheels is not a direction within the forward-only travel docking enabling range, even if an operation command to cause the travel device to travel backward is inputted from the operating device, backward travel of the travel wheels is prohibited, and thereby docking of the cab with the aircraft by backward travel of the travel wheels can be avoided.

[0022] According to an embodiment, the passenger boarding bridge may further include a controller configured to, in a case where a result of the determination performed by the determiner indicates that the current direction of the forward travel of the travel wheels is not a direction within the forward-only travel docking enabling range, control the travel device such that the direction of the forward travel of the travel wheels becomes a direction within the forward-only travel docking enabling range.

[0023] According to the above embodiment, in a case where the current direction of the

forward travel of the travel wheels is not a direction within the forward-only travel docking enabling range, the travel device is controlled such that the direction of the forward travel of the travel wheels becomes a direction within the forward-only travel docking enabling range, and thereby docking of the cab with the aircraft by backward travel of the travel wheels can be avoided.

[0024] According to an embodiment, passenger boarding bridge may further include a controller configured to, if an operation command to cause the travel device to travel backward is inputted from the operating device in a case where a result of the determination performed by the determiner indicates that the current direction of the forward travel of the travel wheels is not a direction within the forward-only travel docking enabling range, control the travel device such that the direction of the forward travel of the travel wheels becomes a direction within the forward-only travel docking enabling range.

[0025] According to the above embodiment, if an operation command to cause the travel device to travel backward is inputted from the operating device in a case where the current direction of the forward travel of the travel wheels is not a direction within the forward-only travel docking enabling range, the travel device is controlled such that the direction of the forward travel of the travel wheels becomes a direction within the forward-only travel docking enabling range, and thereby docking of the cab with the aircraft by backward travel of the travel wheels can be avoided.

Advantageous Effects of Invention

[0026] Embodiments of the present invention as described above 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.

[0027] The above aspect, features, and advantages of the present invention will be made clear by the following detailed description of a preferred embodiment with reference to the accompanying drawings.

Brief Description of Drawings

[0028] FIG. 1 is a schematic plan view showing one example of a passenger boarding bridge according to an 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 schematic plan view showing one example where the passenger boarding bridge is in the state of being docked with the aircraft.