the passenger boarding bridge with the aircraft, the operator performs operations to cause the travel device 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 device 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 by 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 device. In such a case, in order to undock the passenger boarding bridge from the aircraft, the operator needs to cause the travel device to travel forward. However, there may be a case where the undocking operation is performed by an operator different from the operator for 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 device 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] ~~The~~Embodiments of the present invention ~~has~~have been made to solve the above-described problems. ~~An object~~Embodiments of the present invention ~~is to~~ provide a passenger boarding bridge that makes it possible to eliminate a hindrance to undocking of the passenger boarding bridge from an aircraft.

Solution to Problem

[0009] ~~In order to achieve the above object, a passenger boarding bridge according to one aspect of the present invention includes~~According to an aspect of the present invention, there is provided a passenger boarding bridge including: a rotunda connected to a terminal building ~~and supported in a horizontally rotatable manner~~; a tunnel unit whose proximal end is connected to the rotunda, the tunnel unit being extendable and retractable, the tunnel unit being rotated about the rotunda; 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 travel direction of forward travel of the travel wheels and a travel direction of backward travel of the travel wheels are changeable; a cab provided at a distal end of the tunnel unit, the cab being configured to be docked with an aircraft; and a determiner configured to, at a time before undocking the cab docked with the aircraft from the aircraft, perform determination whether or not the travel direction of the backward travel of the travel wheels at the time is a direction within a smooth undocking range.

[0010] According to the above ~~configuration~~aspect, before undocking the cab from the

aircraft, the determiner determines whether or not the travel direction of the backward travel of the travel wheels is a direction within the smooth undocking range. Accordingly, by changing the method of undocking the cab from the aircraft in accordance with a result of the determination performed by the determiner, a hindrance to the undocking from the aircraft can be eliminated.

[0011] According to an embodiment, ~~I~~in a case where, in a plan view, an angle formed by an axis of the travel wheels, the angle being calculated clockwise with respect to a center line of the tunnel unit before undocking the cab from the aircraft, is an angle Wr, and in the plan view, an angle obtained by adding 90 degrees to an angle that is formed by a tangent line and that is calculated clockwise with respect to the center line of the tunnel unit before undocking the cab from the aircraft is an angle Wt, the tangent line extending horizontally and touching a cab-docked part of the aircraft, the determiner may be configured to perform the determination whether or not the travel direction of the backward travel of the travel wheels is a direction within the smooth undocking range based on whether or not the angle Wr is within an angle range that is set based on predetermined information within a range less than the angle Wt.

[0012] According to an embodiment, ~~I~~in a case where, in a plan view, an angle formed by an axis of the travel wheels, the angle being calculated clockwise with respect to a center line of the tunnel unit before undocking the cab from the aircraft, is an angle Wr, and in the plan view, an angle obtained by adding 90 degrees to an angle that is formed by a straight line and that is calculated clockwise with respect to the center line of the tunnel unit before undocking the cab from the aircraft is an angle Wt, the straight line extending along a distal end edge of the cab, the determiner may be configured to perform the determination whether or not the travel direction of the backward travel of the travel wheels is a direction within the smooth undocking range based on whether or not the angle Wr is within an angle range that is set based on predetermined information within a range less than the angle Wt.

[0013] According to an embodiment, ~~I~~in a case where, in a plan view, an angle formed by an axis of the travel wheels, the angle being calculated clockwise with respect to a center line of the tunnel unit before undocking the cab from the aircraft, is an angle Wr, and in the plan view, an angle obtained by adding 90 degrees to an angle that is formed by a fuselage guide line on an apron and that is calculated clockwise with respect to the center line of the tunnel unit before undocking the cab from the aircraft is an angle Wt, the determiner may be configured to perform the determination whether or not the travel direction of the backward travel of the travel wheels is a direction within the smooth undocking range based on whether or not the angle Wr is within an angle range that is set based on predetermined information within a range less than the angle Wt.

[0014] According to an embodiment, ~~I~~in a case where, in a plan view, an angle formed by

an axis of the travel wheels, the angle being calculated clockwise with respect to a center line of the tunnel unit before undocking the cab from the aircraft, is an angle Wr, and in the plan view, an angle obtained by adding 90 degrees to an angle that is formed by an aircraft axis line of the aircraft and that is calculated clockwise with respect to the center line of the tunnel unit before undocking the cab from the aircraft is an angle Wt, the determiner may be configured to perform the determination whether or not the travel direction of the backward travel of the travel wheels is a direction within the smooth undocking range based on whether or not the angle Wr is within an angle range that is set based on predetermined information within a range less than the angle Wt.

[0015] According to an embodiment, ~~The~~the predetermined information may be information about an angle range that is excluded from the range less than the angle Wt and that is preset in accordance with an aircraft type of the aircraft.

[0016] According to an embodiment, ~~The~~the smooth undocking range may be an angle range that is, in a plan view, not less than 90 degrees as calculated clockwise with respect to a center line of the tunnel unit before undocking the cab from the aircraft, and is, in the plan view, set based on predetermined information within a range less than an angle that is obtained by adding 180 degrees to one of the following angles: an angle that is formed by a tangent line and that is calculated clockwise with respect to the center line of the tunnel unit before undocking the cab from the aircraft, the tangent line extending horizontally and touching a cab-docked part of the aircraft; an angle that is formed by a straight line and that is calculated clockwise with respect to the center line of the tunnel unit before undocking the cab from the aircraft, the straight line extending along a distal end edge of the cab; an angle that is formed by a fuselage guide line on an apron and that is calculated clockwise with respect to the center line of the tunnel unit before undocking the cab from the aircraft; and an angle that is formed by an aircraft axis line of the aircraft and that is calculated clockwise with respect to the center line of the tunnel unit before undocking the cab from the aircraft.

[0017] According to an embodiment, ~~The~~the determiner may be configured to perform the determination when an undocking command is inputted. The travel device may be configured to: in a case where a result of the determination performed by the determiner indicates that the travel direction of the backward travel of the travel wheels is a direction within the smooth undocking range, perform automatic travel in which the travel device travels backward by a predetermined distance without changing a facing direction of the travel wheels and then travels backward to a predetermined standby position; and in a case where the result of the determination performed by the determiner indicates that the travel direction of the backward travel of the travel wheels is not a direction within the smooth undocking range, not perform the automatic travel. The passenger boarding bridge may further include a warning unit configured

to perform warning in the case where the result of the determination performed by the determiner indicates that the travel direction of the backward travel of the travel wheels is not a direction within the smooth undocking range.

[0018] According to the above ~~configuration~~embodiment, in the case where the result of the determination performed by the determiner when the undocking command is inputted indicates that the travel direction of the backward travel of the travel wheels is a direction within the smooth undocking range, the travel device can be caused to perform automatic travel to the standby position. On the other hand, in the case where the result of the determination performed by the determiner indicates that the travel direction of the backward travel of the travel wheels is not a direction within the smooth undocking range, the travel device is not caused to perform the automatic travel, but instead the warning unit performs warning so that an operator will perform manual operation, while paying attention to safety, to undock the cab from the aircraft and cause the travel device to travel to the standby position.

Advantageous Effects of Invention

[0019] ~~The~~Embodiments of present invention ~~is configured~~ as described above~~, and has~~have an advantage of being able to provide a passenger boarding bridge that makes it possible to eliminate a hindrance to undocking of the passenger boarding bridge from an aircraft.

[0020] 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

[0021] 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 board, etc.

FIG. 4 shows a state that is a result of, in FIG. 1, rotating an X-axis and a Y-axis clockwise by a predetermined angle, such that the Y-axis is parallel to a fuselage guide line.

FIG. 5 is a flowchart showing one example of operations performed when undocking the passenger boarding bridge from the aircraft and returning the passenger boarding bridge to a standby position.

Description of Embodiments

[0022] Hereinafter, preferred embodiments of the present invention are described with