not a person, such as a worker, is present outside the boarding bridge.

[0007] In both of the above-described cases of Patent Literatures 1 and 2, at the time of remotely operating the boarding bridge, whether or not a person is present outside the boarding bridge can be checked, and thereby coordination with persons outside the boarding bridge can be secured. However, in both of the above-described cases of Patent Literatures 1 and 2, checking whether or not a person is present inside the boarding bridge is not performed.

[0008] Embodiments of the present invention provide a boarding bridge remote operation system and a boarding bridge remote operation program that make it possible to perform remote operation of a boarding bridge in improved coordination with persons.

Solution to Problem

[0009] According to a first aspect of the present invention, there is provided a boarding bridge remote operation system that is a remote operation system for performing remote operation of a boarding bridge. The boarding bridge includes: a rotunda connected to a gate of a terminal building; a tunnel unit whose proximal end is connected to the rotunda, the tunnel unit being configured to be extendable and retractable in a longitudinal direction of the tunnel unit; a cab provided at a distal end of the tunnel unit, the cab including a distal end part to be docked with an entrance of an aircraft; a lifting/lowering device that is mounted to the tunnel unit or the cab and that lifts and lowers the tunnel unit and the cab; and a travel device that is mounted under the lifting/lowering device and that travels on a ground. The boarding bridge remote operation system includes: first image capturing equipment that is provided on the cab and that captures an image ahead of the distal end part of the cab; inside monitoring equipment to monitor an inside of the boarding bridge; a remote controller provided corresponding to the gate and configured to be communicable with remote equipment, the remote equipment including an operating unit with which an operator performs an input operation of inputting an operation command for the boarding bridge and an information outputter configured to output information inputted thereto, wherein the remote controller gives an operation command corresponding to the input operation performed with the operating unit of the remote equipment to the boarding bridge to perform remote control of the boarding bridge, obtains image information of the image captured by the first image capturing equipment and monitoring information of monitoring by the inside monitoring equipment, and outputs the obtained image information and the obtained monitoring information to the remote equipment; and a notifier that is provided inside the boarding bridge and that notifies a person inside the boarding bridge of predetermined information about the remote operation of the boarding bridge. The operating unit of the remote equipment is configured to be operated by the operator in a state where the travel device and an area therearound are directly or indirectly visually checkable by the operator.

[0010] According to this aspect, the remote operation of the boarding bridge is performed in a state where the operator can visually check directly or indirectly the travel device and the area therearound. This embodiment makes it possible to check whether or not a person that may cause inconvenience for (i.e., that may interfere with) the operation of the boarding bridge 1 is present outside the boarding bridge, and thereby coordination with persons outside the boarding bridge can be secured. Moreover, since the monitoring information of the monitoring by the inside monitoring equipment can be obtained by the remote equipment, whether or not a person is present inside the boarding bridge can be checked, and thereby coordination with persons inside the boarding bridge can be secured. This consequently makes it possible to perform the remote operation of the boarding bridge in improved coordination with persons. Furthermore, the image information of the image captured by the first image capturing equipment, the image showing a part of the aircraft, the part being located forward of the distal end part of the cab, is outputted from the information outputter of the remote equipment. This allows the operator to perform the remote operation of the boarding bridge while looking at the image of the entrance of the aircraft.

[0011] The inside monitoring equipment may include second image capturing equipment

that captures an image of an inside of the boarding bridge, and image information of the image captured by the second image capturing equipment may be the monitoring information.

[0012] According to this embodiment, the image information of the image captured by the second image capturing equipment, the image showing the inside of the boarding bridge, is outputted from the information outputter of the remote equipment. This allows the operator to perform the remote operation of the boarding bridge while monitoring, for example, whether or not a person is present inside the boarding bridge.

[0013] The inside monitoring equipment may include a sensor to detect whether or not a person is present in a predetermined area inside the boarding bridge, and a result of detection by the sensor may be the monitoring information.

[0014] According to this embodiment, the result of the detection by the sensor is outputted from the information outputter of the remote equipment. This allows the operator to perform the remote operation of the boarding bridge while recognizing whether or not a person is present inside the boarding bridge.

[0016] According to the above aspect, a person present inside the boarding bridge can be notified of the information that gives a warning or an evacuation advice in relation to the remote operation.

[0017] The boarding bridge remote operation system may further include third image capturing equipment that captures an image of the travel device and the area therearound. The remote controller may be configured to obtain image information of the image captured by the third image capturing equipment and to output the obtained image information to the remote equipment.

[0018] According to this embodiment, the image information of the image captured by the third image capturing equipment, the image showing the travel device and the area therearound, is outputted from the information outputter of the remote equipment. Accordingly, even if the operator is at a location where the operator cannot visually observe the travel device and the area therearound, the operator can still visually check the travel device and the area therearound in an indirect manner. This allows the operator to perform the remote operation of the boarding bridge while monitoring, for example, whether or not a person is present at or around the travel device.

[0019] The remote equipment may be disposed under the rotunda.

[0020] According to this embodiment, the operator can visually observe (visually check directly) the travel device and the area therearound. This allows the operator to perform the remote operation of the boarding bridge while monitoring, for example, whether or not a person is present at or around the travel device. This embodiment also allows the operator to monitor the outside of the boarding bridge over a wide range.

[0021] The boarding bridge remote operation system may further include an emergency stop switch disposed under the rotunda, the emergency stop switch being a switch to bring the boarding bridge to an emergency stop when the boarding bridge is operating.

[0022] According to this embodiment, during the remote operation of the boarding bridge, if any abnormality has occurred in, for example, the boarding bridge, the boarding bridge can be brought to an emergency stop by operating the emergency stop switch.

[0023] The remote equipment may be a portable communication terminal. For example, a portable communication terminal, such as a commercially available tablet or smartphone, can be used as the remote equipment.

[0024] The gate of the terminal building may be a plurality of gates. The operator may operate the operating unit of the remote equipment to select one of the plurality of gates. The remote controller corresponding to the selected gate and the remote equipment may be configured to communicate with each other.

[0025] According to this embodiment, for example, the operator in a central monitoring room in the terminal building can operate the remote equipment to select a desired gate and to perform remote operation of the boarding bridge that is connected to the selected gate.

[0026] According to a second aspect of the present invention, there is provided a boarding bridge remote operation program installed on a portable communication terminal, the portable communication terminal including an operating unit with which to perform an input operation and an information outputter configured to output information, the boarding bridge remote operation program causing the portable communication terminal to communicate with a remote controller configured to perform remote control of a boarding bridge. The boarding bridge includes: a rotunda connected to a gate of a terminal building; a tunnel unit whose proximal end is connected to the rotunda, the tunnel unit being configured to be extendable and retractable in a longitudinal direction of the tunnel unit; a cab provided at a distal end of the tunnel unit, the cab including a distal end part to be docked with an entrance of an aircraft; a lifting/lowering device that is mounted to the tunnel unit or the cab and that lifts and lowers the tunnel unit and the cab; a travel device that is mounted under the lifting/lowering device and that travels on a ground; first image capturing equipment that is provided on the cab and that captures an image ahead of the distal end part of the cab; inside monitoring equipment to monitor an inside of the boarding bridge; and a notifier that is provided inside the boarding bridge and that notifies a person inside the boarding bridge of predetermined information about the remote operation of the boarding bridge. The remote controller is configured to obtain image information of the image captured by the first image capturing equipment and monitoring information of monitoring by the inside monitoring equipment. The boarding bridge remote operation program causes the portable communication terminal to perform: a process of causing a display included in the information outputter to display an operation screen with which to perform remote operation of the boarding bridge; a process of, when an operator has performed an input operation of inputting an operation command for the boarding bridge by operating the operating unit on the operation screen displayed by the display, transmitting a signal corresponding to the input operation to the remote controller; and a process of causing the information outputter to output the image information of the image captured by the first image capturing equipment and the monitoring information of the monitoring by the inside monitoring equipment, the image information and the monitoring information being received from the remote controller.

[0027] By installing the remote operation program on the portable communication terminal, which is, for example, a commercially available tablet or smartphone, the remote operation of the boarding bridge can be performed by using the portable communication terminal.

[0028] According to a third aspect of the present invention, there is provided a boarding bridge remote operation program stored in a server that communicates with a portable communication terminal and a remote controller, the portable communication terminal including an operating unit with which to perform an input operation and an information outputter configured to output information, the remote controller being configured to perform remote control of a boarding bridge. The boarding bridge includes: a rotunda connected to a gate of a terminal building; a tunnel unit whose proximal end is connected to the rotunda, the tunnel unit being configured to be extendable and retractable in a longitudinal direction of the tunnel unit; a cab provided at a distal end of the tunnel unit, the cab including a distal end part to be docked with an entrance of an aircraft; a lifting/lowering device that is mounted to the tunnel unit or the cab and that lifts and lowers the tunnel unit and the cab; a travel device that is mounted under the lifting/lowering device and that travels on a ground; first image capturing equipment that is provided on the cab and that captures an image ahead of the distal end part of the cab; inside monitoring equipment to monitor an inside of the boarding bridge; and a notifier that is provided inside the boarding bridge and that notifies a person inside the boarding bridge of predetermined information about the remote operation of the boarding bridge. The remote controller is configured to obtain image information of the image captured by the first image capturing equipment and monitoring information of monitoring by the inside monitoring equipment. The boarding bridge remote operation program causes the server to perform: a process of transmitting, to the portable communication terminal, information for causing a display included

in the information outputter of the portable communication terminal to display an operation screen with which to perform remote operation of the boarding bridge; a process of, when an operator has performed an input operation of inputting an operation command for the boarding bridge by operating the operating unit on the operation screen displayed by the display, receiving a signal corresponding to the input operation from the portable communication terminal and transmitting the received signal corresponding to the input operation to the remote controller; and a process of transmitting the image information of the image captured by the first image capturing equipment and the monitoring information of the monitoring by the inside monitoring equipment, the image information and the monitoring information being received from the remote controller, to the portable communication terminal.

[0029] According to this aspect, for example, a website that is provided by the server and that is intended for the remote operation of the boarding bridge can be accessed and the remote operation of the boarding bridge can be performed by using the portable communication terminal, which is, for example, a commercially available tablet or smartphone.

[0030] According to a fourth aspect of the present invention, there is provided a boarding bridge remote operation program according to yet another aspect of the present invention is a boarding bridge remote operation program stored in a remote controller, the remote controller being configured to communicate with a portable communication terminal and to perform remote control of a boarding bridge, the portable communication terminal including an operating unit with which to perform an input operation and an information outputter configured to output information. The boarding bridge includes: a rotunda connected to a gate of a terminal building; a tunnel unit whose proximal end is connected to the rotunda, the tunnel unit being configured to be extendable and retractable in a longitudinal direction of the tunnel unit; a cab provided at a distal end of the tunnel unit, the cab including a distal end part to be docked with an entrance of an aircraft; a lifting/lowering device that is mounted to the tunnel unit or the cab and that lifts and lowers the tunnel unit and the cab; a travel device that is mounted under the lifting/lowering device and that travels on a ground; first image capturing equipment that is provided on the cab and that captures an image ahead of the distal end part of the cab; inside monitoring equipment to monitor an inside of the boarding bridge; and a notifier that is provided inside the boarding bridge and that notifies a person inside the boarding bridge of predetermined information about the remote operation of the boarding bridge. The remote controller is configured to obtain image information of the image captured by the first image capturing equipment and monitoring information of monitoring by the inside monitoring equipment. The boarding bridge remote operation program causes the remote controller to perform: a process of transmitting, to the portable communication terminal, information for causing a display included in the information outputter of the portable communication terminal to display an operation screen with which to perform remote operation of the boarding bridge; a process of, when an operator has performed an input operation of inputting an operation command for the boarding bridge by operating the operating unit on the operation screen displayed by the display, receiving a signal corresponding to the input operation from the portable communication terminal; and a process of transmitting the image information of the image captured by the first image capturing equipment and the monitoring information of the monitoring by the inside monitoring equipment to the portable communication terminal.

[0031] According to this aspect, the remote controller can be accessed from the portable communication terminal, which is, for example, a commercially available tablet or smartphone, and thereby the remote operation of the boarding bridge can be performed.

[0031a] According to a fifth aspect of the present invention, there is provided a boarding bridge remote operation system that is a remote operation system for performing remote operation of a boarding bridge, the boarding bridge including: a rotunda connected to a gate of a terminal building; a tunnel unit whose proximal end is connected to the rotunda, the tunnel unit being configured to be extendable and retractable in a longitudinal direction of the tunnel unit; a cab provided at a distal end of the tunnel unit, the cab including a distal end part to be docked with an entrance of an aircraft; a lifting/lowering device that is mounted to the tunnel unit or the cab and that lifts and lowers the tunnel unit and the cab; and a travel device that is mounted

under the lifting/lowering device and that travels on a ground, the boarding bridge remote operation system including: first image capturing equipment that is provided on the cab and that captures an image ahead of the distal end part of the cab; inside monitoring equipment to monitor an inside of the boarding bridge; and a remote controller provided corresponding to the gate and configured to be communicable with remote equipment, the remote equipment including an operating unit with which an operator performs an input operation of inputting an operation command for the boarding bridge and an information outputter configured to output information inputted thereto, wherein the remote controller gives an operation command corresponding to the input operation performed with the operating unit of the remote equipment to the boarding bridge to perform remote control of the boarding bridge, obtains image information of the image captured by the first image capturing equipment and monitoring information of monitoring by the inside monitoring equipment, and outputs the obtained image information and the obtained monitoring information to the remote equipment, wherein the boarding bridge is configured to be allowed to start operating after the operator has performed, with the operating unit of the remote equipment, a check operation indicating that it has been checked that no person is present at or around the travel device and that no person is present inside the boarding bridge.

[0031b] According to a sixth aspect of the present invention, there is provided a boarding bridge remote operation program installed on a portable communication terminal, the portable communication terminal including an operating unit with which to perform an input operation and an information outputter configured to output information, the boarding bridge remote operation program causing the portable communication terminal to communicate with a remote controller configured to perform remote control of a boarding bridge, wherein the boarding bridge includes: a rotunda connected to a gate of a terminal building; a tunnel unit whose proximal end is connected to the rotunda, the tunnel unit being configured to be extendable and retractable in a longitudinal direction of the tunnel unit; a cab provided at a distal end of the tunnel unit, the cab including a distal end part to be docked with an entrance of an aircraft;a lifting/lowering device that is mounted to the tunnel unit or the cab and that lifts and lowers the tunnel unit and the cab; a travel device that is mounted under the lifting/lowering device and that travels on a ground; first image capturing equipment that is provided on the cab and that captures an image ahead of the distal end part of the cab; and inside monitoring equipment to monitor an inside of the boarding bridge, the remote controller is configured to obtain image information of the image captured by the first image capturing equipment and monitoring information of monitoring by the inside monitoring equipment, the boarding bridge is configured to be allowed to start operating after an operator has performed, with the operating unit of the portable communication terminal, a check operation indicating that it has been checked that no person is present at or around the travel device and that no person is present inside the boarding bridge, and the boarding bridge remote operation program causes the portable communication terminal to perform: a process of causing a display included in the information outputter to display an operation screen with which to perform remote operation of the boarding bridge; a process of, when the operator has performed the check operation by operating the operating unit on the operation screen displayed by the display, transmitting a signal corresponding to the check operation to the remote controller; a process of, when the operator has performed an input operation of inputting an operation command for the boarding bridge by operating the operating unit on the operation screen displayed by the display, transmitting a signal corresponding to the input operation to the remote controller; and a process of causing the information outputter to output the image information of the image captured by the first image capturing equipment and the monitoring information of the monitoring by the inside monitoring equipment, the image information and the monitoring information being received from the remote controller.

[0031c] According to a seventh aspect of the present invention, there is provided a boarding bridge remote operation program stored in a server that communicates with a portable communication terminal and a remote controller, the portable communication terminal including an operating unit with which to perform an input operation and an information outputter configured to output information, the remote controller being configured to perform remote control of a boarding bridge, wherein the boarding bridge includes: a rotunda connected to a gate

of a terminal building; a tunnel unit whose proximal end is connected to the rotunda, the tunnel unit being configured to be extendable and retractable in a longitudinal direction of the tunnel unit; a cab provided at a distal end of the tunnel unit, the cab including a distal end part to be docked with an entrance of an aircraft; a lifting/lowering device that is mounted to the tunnel unit or the cab and that lifts and lowers the tunnel unit and the cab; a travel device that is mounted under the lifting/lowering device and that travels on a ground; first image capturing equipment that is provided on the cab and that captures an image ahead of the distal end part of the cab; and inside monitoring equipment to monitor an inside of the boarding bridge, the remote controller is configured to obtain image information of the image captured by the first image capturing equipment and monitoring information of monitoring by the inside monitoring equipment, the boarding bridge is configured to be allowed to start operating after an operator has performed, with the operating unit of the portable communication terminal, a check operation indicating that it has been checked that no person is present at or around the travel device and that no person is present inside the boarding bridge, and the boarding bridge remote operation program causes the server to perform: a process of transmitting, to the portable communication terminal, information for causing a display included in the information outputter of the portable communication terminal to display an operation screen with which to perform remote operation of the boarding bridge; a process of, when the operator has performed the check operation by operating the operating unit on the operation screen displayed by the display, receiving a signal corresponding to the check operation from the portable communication terminal and transmitting the received signal corresponding to the check operation to the remote controller; a process of, when the operator has performed an input operation of inputting an operation command for the boarding bridge by operating the operating unit on the operation screen displayed by the display, receiving a signal corresponding to the input operation from the portable communication terminal and transmitting the received signal corresponding to the input operation to the remote controller; and a process of transmitting the image information of the image captured by the first image capturing equipment and the monitoring information of the monitoring by the inside monitoring equipment, the image information and the monitoring information being received from the remote controller, to the portable communication terminal.[0031d] According to an eighth aspect of the present invention, there is provided a boarding bridge remote operation program stored in a remote controller, the remote controller being configured to communicate with a portable communication terminal and to perform remote control of a boarding bridge, the portable communication terminal including an operating unit with which to perform an input operation and an information outputter configured to output information, wherein the boarding bridge includes: a rotunda connected to a gate of a terminal building; a tunnel unit whose proximal end is connected to the rotunda, the tunnel unit being configured to be extendable and retractable in a longitudinal direction of the tunnel unit; a cab provided at a distal end of the tunnel unit, the cab including a distal end part to be docked with an entrance of an aircraft; a lifting/lowering device that is mounted to the tunnel unit or the cab and that lifts and lowers the tunnel unit and the cab; a travel device that is mounted under the lifting/lowering device and that travels on a ground; first image capturing equipment that is provided on the cab and that captures an image ahead of the distal end part of the cab; and inside monitoring equipment to monitor an inside of the boarding bridge, the remote controller is configured to obtain image information of the image captured by the first image capturing equipment and monitoring information of monitoring by the inside monitoring equipment, the boarding bridge is configured to be allowed to start operating after an operator has performed, with the operating unit of the portable communication terminal, a check operation indicating that it has been checked that no person is present at or around the travel device and that no person is present inside the boarding bridge, and the boarding bridge remote operation program causes the remote controller to perform: a process of transmitting, to the portable communication terminal, information for causing a display included in the information outputter of the portable communication terminal to display an operation screen with which to perform remote operation of the boarding bridge; a process of, when the operator has performed the check operation by operating the operating unit on the operation screen displayed by the display, receiving a signal corresponding to the check operation from the portable communication terminal; a process of, when the operator has performed an input operation of inputting an operation command for the

boarding bridge by operating the operating unit on the operation screen displayed by the display, receiving a signal corresponding to the input operation from the portable communication terminal; and a process of transmitting the image information of the image captured by the first image capturing equipment and the monitoring information of the monitoring by the inside monitoring equipment to the portable communication terminal.

Advantageous Effects of Invention

[0032] Embodiments of the present invention have an advantage of being able to provide a boarding bridge remote operation system that makes it possible to perform remote operation of a boarding bridge in improved coordination with persons.

[0033] The above and other aspects, features, and advantages of the present invention will more fully be apparent from the following detailed description of preferred embodiments with accompanying drawings.

Brief Description of Drawings

[0034] FIG. 1 is a schematic plan view showing one example of two boarding bridges that are operated by a boarding bridge remote operation system according to an embodiment of the present invention.

FIG. 2 is a schematic side view showing one example of a boarding bridge according to the present embodiment.

FIG. 3 is a schematic plan view of the boarding bridge as seen from above.

FIG. 4 is a view showing a cab distal end part to be docked with an aircraft, the view being taken from the aircraft side.

FIG. 5 is a block diagram schematically showing a connection relationship between a controller of the boarding bridge and each component of the boarding bridge.

FIG. 6 is a block diagram showing one example of a remote operation system for performing remote operation of the two boarding bridges.

FIG. 7 is a flowchart schematically showing one example of operations performed in the remote operation system of the present embodiment at the time of docking the cab with the aircraft by automatic control.

FIG. 8 is a flowchart schematically showing one example of operations performed in the remote operation system of the present embodiment at the time of docking the cab with the aircraft by manual control.

FIG. 9 is a block diagram showing essential components in a case where a portable communication terminal and a server for the remote operation system are used.

FIG. 10 is a block diagram showing one example of a case where remote equipment is installed in a central monitoring room.

Description of Embodiments

[0035] Hereinafter, preferred embodiments 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 below. The drawings show each component schematically in order to facilitate the understanding thereof. Therefore, in some cases, the drawings may not display accurate shapes, accurate dimensional ratios, etc.