

DESCRIPTION

Title of Invention: RAIL VEHICLE

Technical Field

[0001]

The present invention relates to a rail vehicle.

Background Art

[0002]

In general, a rail vehicle to be operated along laid tracks has a hexahedral body structure including an underframe forming a floor surface, end body structures erected on both end portions of the underframe in a longitudinal direction, side body structures erected on both end portions of the underframe in a width direction, and a roof body structure placed on the end body structures and upper end portions of the side body structures.

[0003]

In general, the rail vehicle includes an air conditioning device (hereinafter, referred to as an air conditioner) at an upper portion of the roof body structure, and provides a comfortable temperature and humidity environment by supplying conditioned air conditioned in temperature and humidity into a vehicle.

[0004]

PTL 1 discloses a railway vehicle including a railway vehicle air blowing control system capable of improving safety by preventing a passenger from slipping of his or her feet or being pinched in a door when the passenger gets on the railway vehicle during rainfall or snowfall. The railway vehicle air blowing control system includes: a detection unit that detects information on rainfall or snowfall during rainfall or snowfall during running; an output unit that outputs door opening and closing information; a plurality of blowing units that blow air so as to dry at least a floor surface near a plurality of vehicle doors; and an on-vehicle information processing device that generates a control command for controlling the plurality of blowing units based on the information on rainfall or snowfall detected by the detection unit and the door opening and closing information obtained from the output unit, and the detection unit, the output unit, the plurality of blowing units, and the on-vehicle information processing device are connected by an on-vehicle network.

Citation List

Patent Literature

[0005]

PTL 1: JP2006-335298A

Summary of Invention

Technical Problem

[0006]

In general, an air conditioner provided on a roof of a vehicle includes a fresh air intake port including an opening and closing damper and a fresh air fan provided together with the fresh air intake port in order to take fresh air (hereinafter, referred to as fresh air) into the vehicle from the outside of the vehicle.

[0007]

For example, it is desired to close a damper provided in the fresh air intake port to prevent rainwater or the like from entering the inside of a rail vehicle from the fresh air intake port via the air conditioner at the time of heavy rainfall or the like.

[0008]

However, if a crew determines presence or absence of rainfall and performs opening or closing operation of a damper, a burden on the crew is increased. In contrast, if a sensor for detecting the presence or absence of rainfall is newly installed and the opening or closing operation of the damper is performed in accordance with a signal from the sensor, the burden on the crew is reduced, but there is a

concern that manufacturing cost of the air conditioner is increased with an increase in the number of components.

[0009]

An object of the invention is to provide a rail vehicle capable of opening and closing a fresh air damper of a fresh air intake port provided in an air conditioner in response to rainfall without increasing manufacturing cost.

Solution to Problem

[0010]

In order to solve the above problem, one of the typical rail vehicles of the invention is achieved by including:

- a wiper device configured to wipe off a deposit on an outside of a window glass;

- a fresh air damper configured to open and close an introduction path through which fresh air is introduced into the vehicle from outside the vehicle;

- an air conditioning control microcomputer configured to control opening and closing operation of the fresh air damper; and

- a vehicle body wiring configured to transmit information on operation of the wiper device to the air conditioning control microcomputer, in which

- the air conditioning control microcomputer determines whether the wiper device is operating based on the

information from the wiper device, and closes the fresh air damper when it is determined that the wiper device is operating.

Advantageous Effects of Invention

[0011]

According to the invention, it is possible to provide a rail vehicle capable of opening and closing a fresh air damper of a fresh air intake port provided in an air conditioner in response to rainfall without increasing manufacturing cost.

Problems, configurations, and effects other than those described above will be clarified by descriptions of the following embodiments.

Brief Description of Drawings

[0012]

[FIG. 1] FIG. 1 is a side view of a railway vehicle.

[FIG. 2] FIG. 2 is a schematic plan view showing a configuration of an air conditioner mounted on a roof of the railway vehicle.

[FIG. 3] FIG. 3 is a system diagram of the air conditioner mounted on the railway vehicle.

[FIG. 4] FIG. 4 is a flowchart showing control for opening and closing a fresh air damper of the air conditioner.

Description of Embodiments

[0013]

Hereinafter, embodiments of a rail vehicle according to the invention will be described with reference to the drawings. First, in order to describe a configuration of the rail vehicle, each direction is defined. A longitudinal direction of the rail vehicle is defined as an x direction, a width direction of the rail vehicle is defined as a y direction, and a height direction of the rail vehicle is defined as a z direction. Hereinafter, the directions may be simply referred to as the x direction, the y direction, and the z direction.

[0014]

The rail vehicle is a vehicle to be operated along laid tracks, and indicates a railway vehicle, a monorail vehicle, a new transportation system vehicle, a tram car, and the like. Hereinafter, the railway vehicle will be described as a representative example of the rail vehicle.

[0015]

FIG. 1 is a side view of a railway vehicle. A railway vehicle 1 includes hexahedral (rectangular parallelepiped) body structures 10 and a bogie 12 that supports the body structures 10 and includes wheels that roll along tracks 7. The body structures 10 include, on a roof thereof, a current

collector 40 that collects electric power from an aerial wiring 5, and an air conditioner 20 that supplies fresh air taken in from the outside of the vehicle to the inside of the vehicle together with air conditioned in temperature and humidity.

[0016]

Side body structures forming side surfaces of the body structure 10 include windows 14 and side sliding doors 16 which are getting on and off ports for passengers and the like to get on and off.

[0017]

FIG. 2 is a schematic plan view showing a configuration of an air conditioner mounted on a roof of the railway vehicle. A housing of the air conditioner 20 is divided into an outdoor unit chamber 30 including an outdoor blower 24 and outdoor heat exchangers 23, an indoor unit chamber 32 including indoor blowers 26 and indoor heat exchangers 25, a fresh air chamber 34 including ventilation blowers 27 provided with fresh air dampers, and a machine chamber 36 including compressors and a contactor box 29 in which a plurality of contactors that control on/off of various blowers are housed.

[0018]

The air conditioner 20 includes a refrigeration cycle in which a refrigerant enclosed inside the housing circulates.

The refrigeration cycle is configured such that the compressors 22, the outdoor heat exchangers 23, and the indoor heat exchangers 25 are connected in series via a pipe (not shown) through which the refrigerant can circulate.

[0019]

In the vicinity of the outdoor heat exchangers 23, the outdoor blower 24 is provided which discharges air containing heat generated in a process in which the refrigerant that took in heat in the vehicle is condensed, to the outside of the vehicle. In the vicinity of the indoor heat exchangers 25, the indoor blowers 26 are provided which supply conditioned air conditioned in temperature and humidity in a process of absorbing heat from the inside of the vehicle when the refrigerant evaporates, to the inside of the vehicle.

[0020]

A bottom surface of the indoor unit chamber 32 of the air conditioner 20 (upstream of the indoor heat exchangers 25) is provided with recirculation air intake ports 21 through which recirculation air from the inside of the vehicle is taken into the air conditioner 20. The fresh air chamber 34 is provided with the ventilation blowers 27 provided with the fresh air dampers for taking fresh air outside the vehicle into the vehicle. When the fresh air dampers are opened, an introduction path (not shown) through which fresh air outside the vehicle is taken into the vehicle

is opened, and when the fresh air dampers are closed, the introduction path is closed or restricted. The fresh air dampers are connected to an actuator (not shown) which is driven and controlled by an air conditioning control microcomputer 58, in other words, opening and closing operation of the fresh air dampers is controlled by the air conditioning control microcomputer 58. As the fresh air damper, for example, a damper described in JP2014-73844A can be used.

[0021]

Although FIG. 2 shows an example in which the fresh air chamber 34 is integrally incorporated in the housing of the air conditioner 20, the fresh air chamber 34 including the fresh air dampers and the ventilation blowers may be provided in the railway vehicle 1 as an independent ventilation device that is separate from the housing of the air conditioner 20. Even when the fresh air chamber 34 is provided as the independent ventilation device, as shown in FIG. 3 to be described later, the fresh air dampers or the like of the ventilation device are driven and controlled by the air conditioning control microcomputer 58.

[0022]

FIG. 3 is a system diagram of the air conditioner mounted on the railway vehicle. In a general formation vehicle composed of a plurality of railway vehicles 1,

leading vehicles including crew's rooms in which a driver or a conductor works are disposed at both end portions thereof, and intermediate vehicles including no crew's room are disposed in a form of being sandwiched between the leading vehicles at both end portions.

[0023]

The crew's room (driver's room) of the leading railway vehicle 1 is provided with a wiper device 52 that includes wipers for wiping off deposits on the outside of a window glass in a traveling direction and improves visibility in rainy weather. As the wiper device 52, a type in which wiper operation is started and stopped by manual operation of a driver is used, but for example, a type in which wipers are automatically operated by sensing raindrops may be used.

[0024]

Further, in the formation vehicle, a vehicle body wiring 50 for signal transmission is drawn through all the vehicles from a leading vehicle at one end portion to a leading vehicle at the other end portion. The air conditioning control microcomputer (air conditioner control device) 58 of each railway vehicle 1 is connected to the vehicle body wiring 50. The air conditioning control microcomputer 58 is connected to an in-vehicle temperature sensor 56 that detects temperature inside the vehicle, and is also connected to the contactor box 29 that houses a

plurality of contactors for turning on/off the compressors 22 or the outdoor blower 24, the indoor blowers 26, the fresh air dampers and the ventilation blowers 27, which constitute the air conditioner 20.

[0025]

An out-of-vehicle temperature sensor 54 is provided upstream of the outdoor blower 24, detects temperature of air taken in from the outside of the vehicle, for example, and outputs a signal corresponding to the detected temperature, and is connected to the air conditioning control microcomputer 58 via the contactor box 29. Information on operation status (stop, low mode operation, and high mode operation) of the wiper device 52 is transmitted to the air conditioning control microcomputer 58 provided in each railway vehicle 1 via the vehicle body wiring 50. For example, it may be determined that the wiper device 52 is stopped when the air conditioning control microcomputer 58 does not input a signal corresponding to the low mode operation or the high mode operation from the wiper device 52.

[0026]

Although not described in detail, the fresh air dampers and the ventilation blowers 27 also serve to control an amount of ventilation of each railway vehicle 1, and the air conditioning control microcomputer 58 adjusts an opening and

closing degree of the fresh air dampers and controls the operation and stop of the ventilation blower, for example, in accordance with vehicle occupancy.

[0027]

FIG. 4 is a flowchart showing control for opening and closing the fresh air damper of the air conditioner. Hereinafter, each step constituting the flowchart will be described.

[0028]

In step 10 (S10), the air conditioning control microcomputer 58 activates (starts) the air conditioner 20. The air conditioning control microcomputer 58 may detect that a master key is inserted into a driver's cab of the railway vehicle 1 by transmission of the vehicle body wiring 50, and activate the air conditioner 20.

[0029]

In step 20 (S20), the air conditioning control microcomputer 58 determines whether there is a wiper operation based on a wiper operation signal (information related to operation) transmitted from the wiper device 52 and indicating the operation. Specifically, when the air conditioning control microcomputer 58 receives a wiper operation signal indicating the low mode operation or the high mode operation, the air conditioning control microcomputer 58 determines that wipers are operating, and

otherwise determines that the wipers are not operating. When the wiper operation signal is present (received), the air conditioning control microcomputer 58 advances a control flow to step 30 (S30). In contrast, when the wiper operation signal is not present (not received), the air conditioning control microcomputer 58 advances the control flow to step 70 (S70).

[0030]

In step 30 (S30), the air conditioning control microcomputer 58 determines whether the wiper operation signal is continuously input (received) for a predetermined time. When the wiper operation signal is continuously input for the predetermined time, the air conditioning control microcomputer 58 advances the control flow to step 40 (S40). In contrast, when the wiper operation signal is not continuously input for the predetermined time, the air conditioning control microcomputer 58 returns the control flow to step 20 (S20).

[0031]

It should be noted that in step 30 (S30), the air conditioning control microcomputer 58 may determine that the wiper operation signal is present (received) only when a wiper operation mode of the wiper operation signal is a high-frequency mode (high mode: mode in which a wiper reciprocating operation cycle is shorter than that in the

low mode operation and the wipers wipe a window more times per unit time).

[0032]

When the presence (reception) of the wiper operation signal is continuously input for a predetermined time, it can be estimated that there will be some heavy rainfall, and thus, in step 40 (S40), the air conditioning control microcomputer 58 closes the fresh air dampers and stops the ventilation blowers 27.

[0033]

Further, in step 50 (S50), the air conditioning control microcomputer 58 determines whether the operation of the railway vehicle 1 is stopped based on information input via the vehicle body wiring 50. When it is determined that the operation of the railway vehicle 1 is stopped, the air conditioning control microcomputer 58 stops the control of the air conditioner 20 in step 100 (S100). In contrast, when it is determined that the operation of the railway vehicle 1 is to be continued, the air conditioning control microcomputer 58 advances the control flow to step 60 (S60).

[0034]

Further, in step 60 (S60), the air conditioning control microcomputer 58 determines whether the wiper operation signal is input (received). If the wiper operation signal is input, the air conditioning control microcomputer 58

returns the control flow to step 30 (S30). In contrast, if the wiper operation signal is not input, the air conditioning control microcomputer 58 advances the control flow to step 70 (S70).

[0035]

After the driver determines that rain has passed and stops the wiper device 52, rain may suddenly fall. In addition, the driver may stop the wiper device 52 only while passing through a short tunnel when it is raining. Therefore, when the wiper operation signal is not input after the wiper operation signal is input, the air conditioning control microcomputer 58 can measure a time by a built-in timer, and advance the control flow to step 70 (S70) only when the wiper operation signal is not input again while a specified time (for example, 3 to 5 minutes) elapses from a time when the wiper operation signal is not input.

[0036]

In step 70 (S70), the air conditioning control microcomputer 58 opens the fresh air dampers and operates the ventilation blowers, and advances the control flow to step 80 (S80).

[0037]

In step 80 (S80), the air conditioning control microcomputer 58 determines whether the operation of the railway vehicle 1 is stopped based on the information input

via the vehicle body wiring 50. When it is determined that the operation is stopped, the air conditioning control microcomputer 58 advances the control flow to step 90 (S90). In contrast, when it is determined that the operation is to be continued, the air conditioning control microcomputer 58 returns the control flow to step 20 (S20).

[0038]

In step 90 (S90), the air conditioning control microcomputer 58 closes the fresh air dampers and stops the ventilation blowers.

[0039]

In step 100 (S100), the air conditioning control microcomputer 58 stops the control of the air conditioner 20.

[0040]

<Effects>

The air conditioning control microcomputer 58 can take in information of the wiper operation signal (S20) and perform control to close the fresh air dampers (S40). Therefore, it is possible to prevent rainwater or the like from entering into the vehicle via the air conditioner 20 by quickly closing the fresh air dampers at the time of rainfall without newly adding a sensor that detects presence or absence of rainfall or newly adding a switch or the like that manually opens and closes the dampers according to the

presence or absence of rainfall by a crew of the railway vehicle 1.

[0041]

Further, the air conditioning control microcomputer 58 can determine whether the wiper operation signal is continuously transmitted for a predetermined time (S30). Accordingly, it is possible to prevent the fresh air dampers from performing closing operation by wiper operation that is not intended by a driver or wiper operation that merely wipes off dirt on the front glass. Therefore, only when there is a risk of rainfall entering into the vehicle, the fresh air dampers can be caused to perform the closing operation, and intake of fresh air can be sufficiently ensured. The predetermined time is preferably, for example, any of 10 to 60 seconds.

[0042]

Further, the air conditioning control microcomputer 58 can perform control to open the fresh air dampers (S70) by detecting the stop of the wiper operation based on the wiper operation signal. Therefore, introduction of fresh air into the vehicle can be resumed to ensure a comfortable temperature and humidity environment without newly adding the sensor that detects the presence or absence of rainfall or newly adding the switch or the like that manually opens

and closes the dampers according to the presence or absence of rainfall by the crew of the railway vehicle 1.

[0043]

Further, the air conditioning control microcomputer 58 determines that the operation of the railway vehicle 1 is stopped (S80) and closes the fresh air dampers (S90) by detecting that the master key is pulled out from the driver's cab of the railway vehicle 1, for example. Therefore, even when it is raining while the operation of the railway vehicle 1 is stopped (in particular, when the railway vehicle 1 is indwelled outdoors), it is possible to prevent rainwater, dust, and the like from entering into the vehicle.

[0044]

According to the present embodiment, it is possible to provide a rail vehicle capable of opening and closing a fresh air damper of a fresh air intake port provided in an air conditioner in response to rainfall without increasing manufacturing cost.

[0045]

The invention is not limited to the above embodiment. For example, there is also a railway vehicle having an intermittent mode in which the wiper device 52 intermittently drives wipers. When the air conditioning control microcomputer 58 receives a wiper operation signal indicating that the intermittent mode (or the low frequency

mode (low mode)) of the wipers is set, the air conditioning control microcomputer 58 may perform control to close fresh air dampers only when a vehicle speed is higher than a predetermined speed based on a signal from a sensor that detects the vehicle speed provided with a general railway vehicle.

[0046]

When the intermittent mode of the wipers is set, the air conditioning control microcomputer 58 may periodically repeat opening and closing of the dampers.

Reference Signs List

[0047]

- 1: railway vehicle
- 5: aerial wiring
- 7: track
- 10: body structure
- 12: bogie
- 14: window
- 16: side sliding door
- 20: air conditioner
- 21: recirculation air intake port
- 22: compressor
- 23: outdoor heat exchanger
- 24: outdoor blower

25: indoor heat exchanger
26: indoor blower
27: ventilation blower including fresh air damper
28: fresh air intake port
29: contactor box
30: outdoor unit chamber
32: indoor unit chamber
34: fresh air chamber
36: machine chamber
40: current collector
50: vehicle body wiring
52: wiper device
54: out-of-vehicle temperature sensor
56: in-vehicle temperature sensor
58: air conditioning control microcomputer
x: longitudinal direction (rail direction)
y: width direction (sleeper direction)
z: height direction

CLAIMS

[Claim 1]

A rail vehicle comprising:

a wiper device configured to wipe off a deposit on an outside of a window glass;

a fresh air damper configured to open and close an introduction path through which fresh air is introduced into the vehicle from outside the vehicle;

an air conditioning control microcomputer configured to control opening and closing operation of the fresh air damper; and

a vehicle body wiring configured to transmit information on operation of the wiper device to the air conditioning control microcomputer, wherein

the air conditioning control microcomputer determines whether the wiper device is operating based on the information from the wiper device, and closes the fresh air damper when it is determined that the wiper device is operating.

[Claim 2]

The rail vehicle according to claim 1, wherein

the air conditioning control microcomputer closes the fresh air damper when it is determined that operating time

of the wiper device is equal to or longer than a predetermined time.

[Claim 3]

The rail vehicle according to claim 2, wherein
the air conditioning control microcomputer closes the fresh air damper when it is determined that the wiper device is operating in a high-frequency mode.

[Claim 4]

The rail vehicle according to claim 1, wherein
the air conditioning control microcomputer opens the fresh air damper when it is determined that the operation of the wiper device is stopped based on the information from the wiper device.

[Claim 5]

The rail vehicle according to claim 4, wherein
the air conditioning control microcomputer opens the fresh air damper when it is determined that the operation of the wiper device is stopped for a specified time.

[Claim 6]

The rail vehicle according to claim 1, wherein

the air conditioning control microcomputer determines whether operation of the rail vehicle is ended, and closes the fresh air damper when it is determined that the operation of the rail vehicle is ended.