(12) UK Patent (19) GB (11) 2590001 (13) B

(45) Date of B Publication 16.03.2022

(54) Title of the Invention: Railcar

(51) INT CL: ***B61D 27/00*** (2006.01) ***B60H 1/00*** (2006.01) ***B60H 1/32*** (2006.01) ***F24F 11/72*** (2018.01)

(21) Application No: **2100366.0**

(22) Date of Filing: **13.07.2018**

Date Lodged: **12.01.2021**

(86) International Application Data:
PCT/JP2018/026446 Ja 13.07.2018

(87) International Publication Data:
WO2020/012627 Ja 16.01.2020

(43) Date of Reproduction by UK Office **16.06.2021**

(72) Inventor(s):
Misaki Kon
Tomoo Hayashi
Kazuto Koreishi

(73) Proprietor(s):
Hitachi, Ltd.
6-6, Marunouchi 1-chome, Chiyoda-ku 1008280, Tokyo, Japan

(74) Agent and/or Address for Service:
Mewburn Ellis LLP
Aurora Building, Counterslip, Bristol, BS1 6BX, United Kingdom

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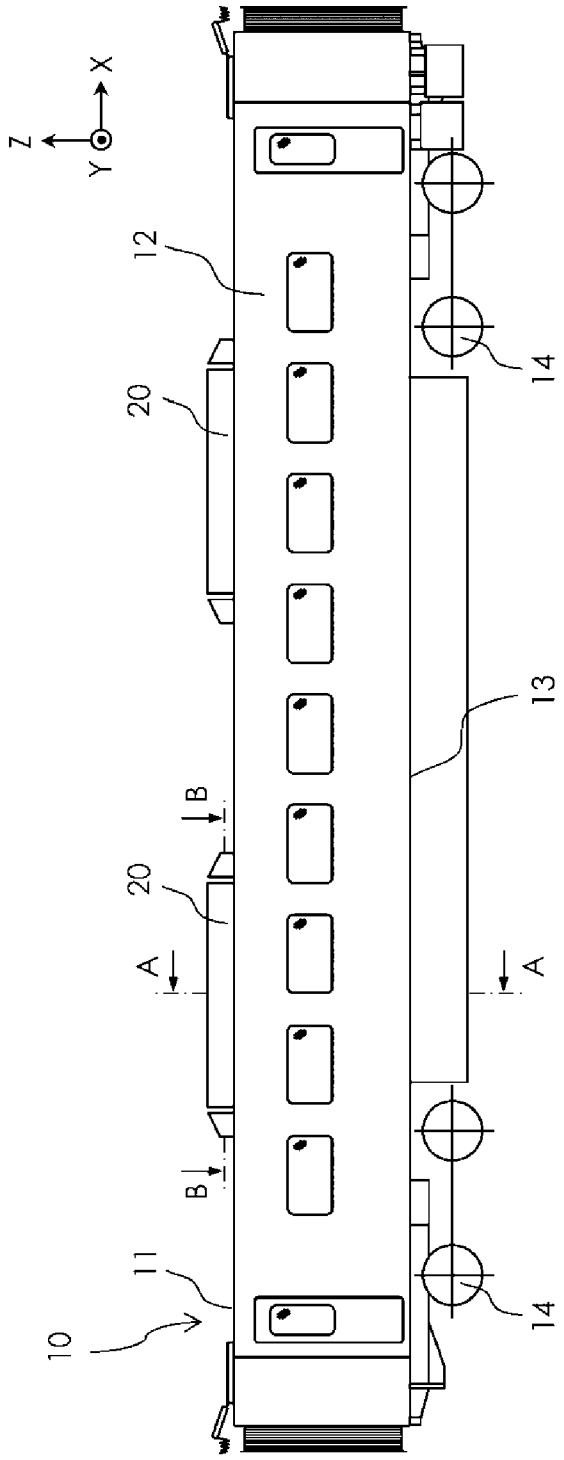
JP H058635
JP S55134240

(58) Field of Search:
As for published application 2590001 A viz:
INT CL **B60H, B61D, F24F**
Other: **Public JP utililty model applns (examined 1922-1996),(unexamined 1971-2018); JP utility models (regst specs 1996-2018),(public regst applns 1994-2018)**
updated as appropriate

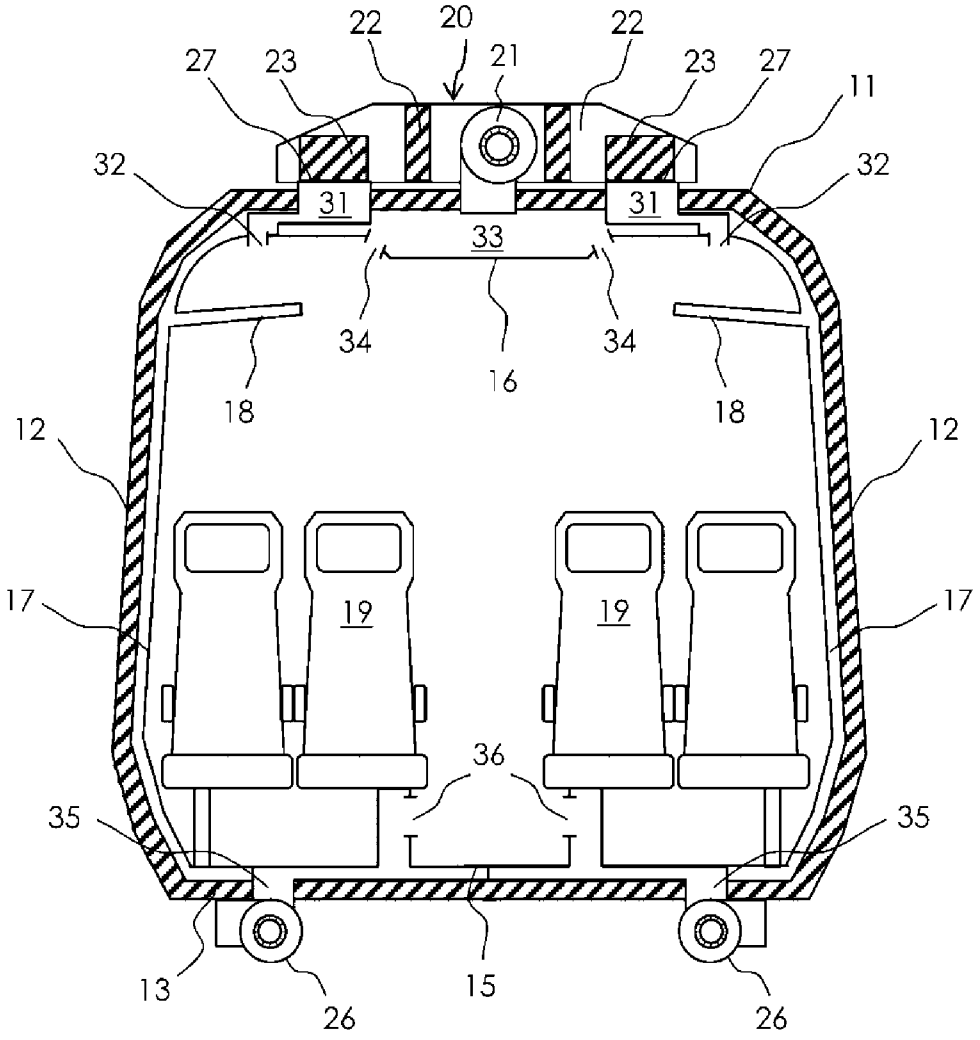
Additional Fields
Other: **None**

GB 2590001 B

[FIG. 1]



[FIG. 2]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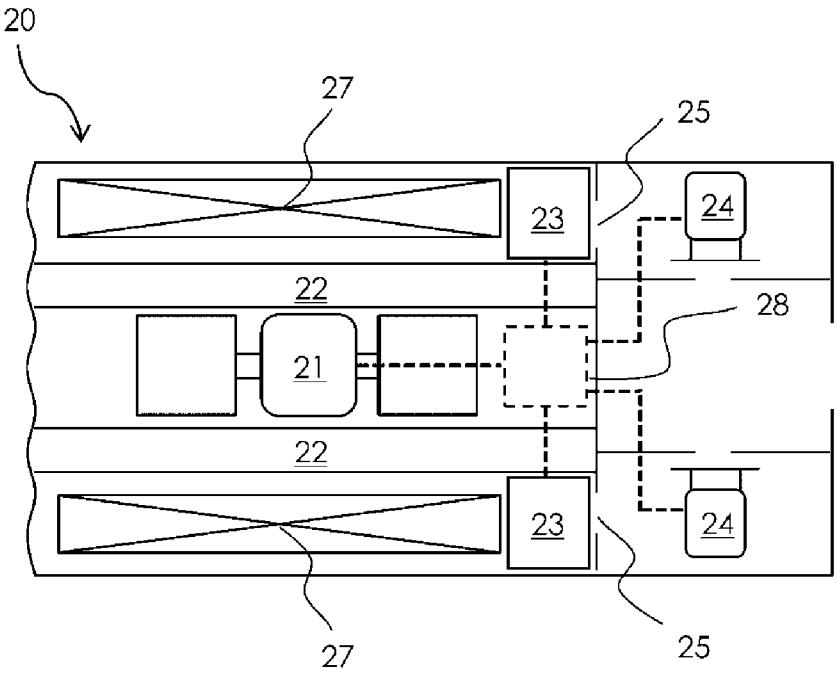
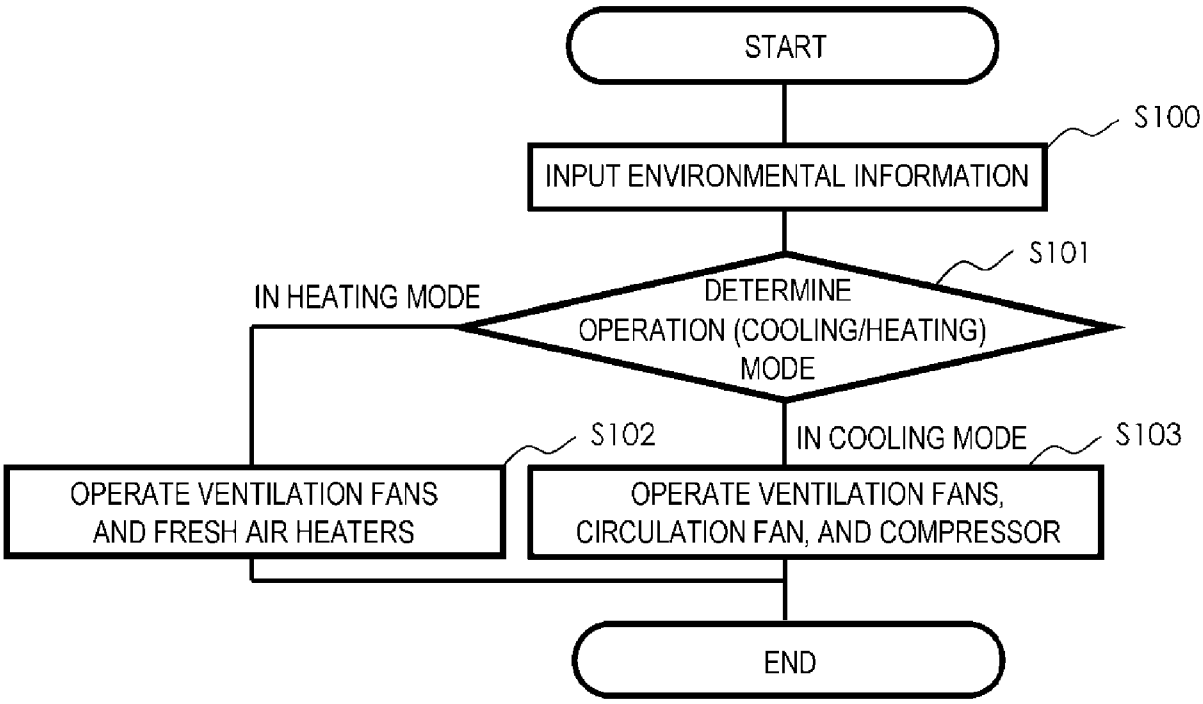
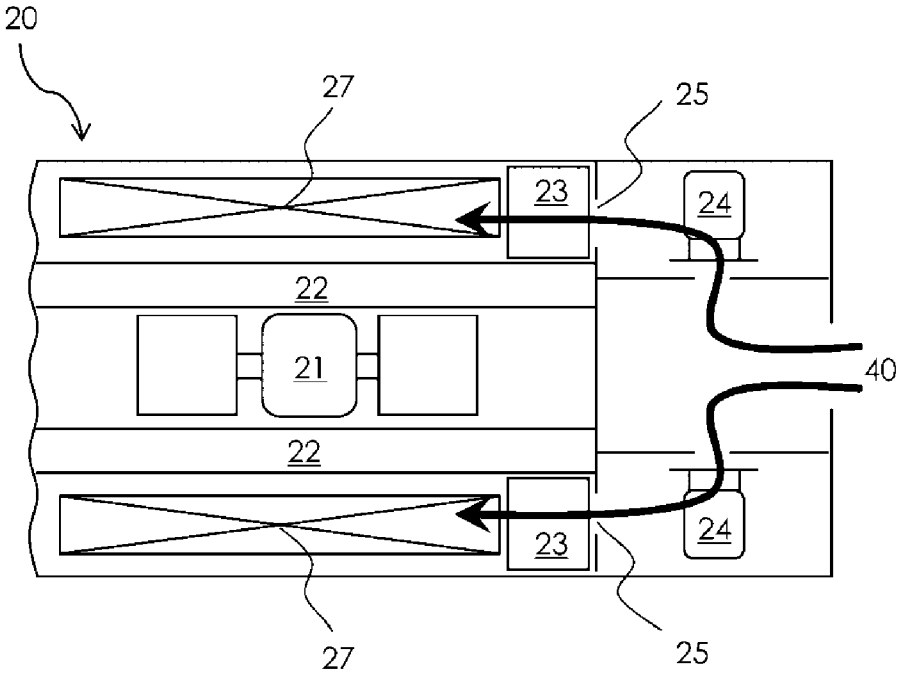
[FIG. 3]



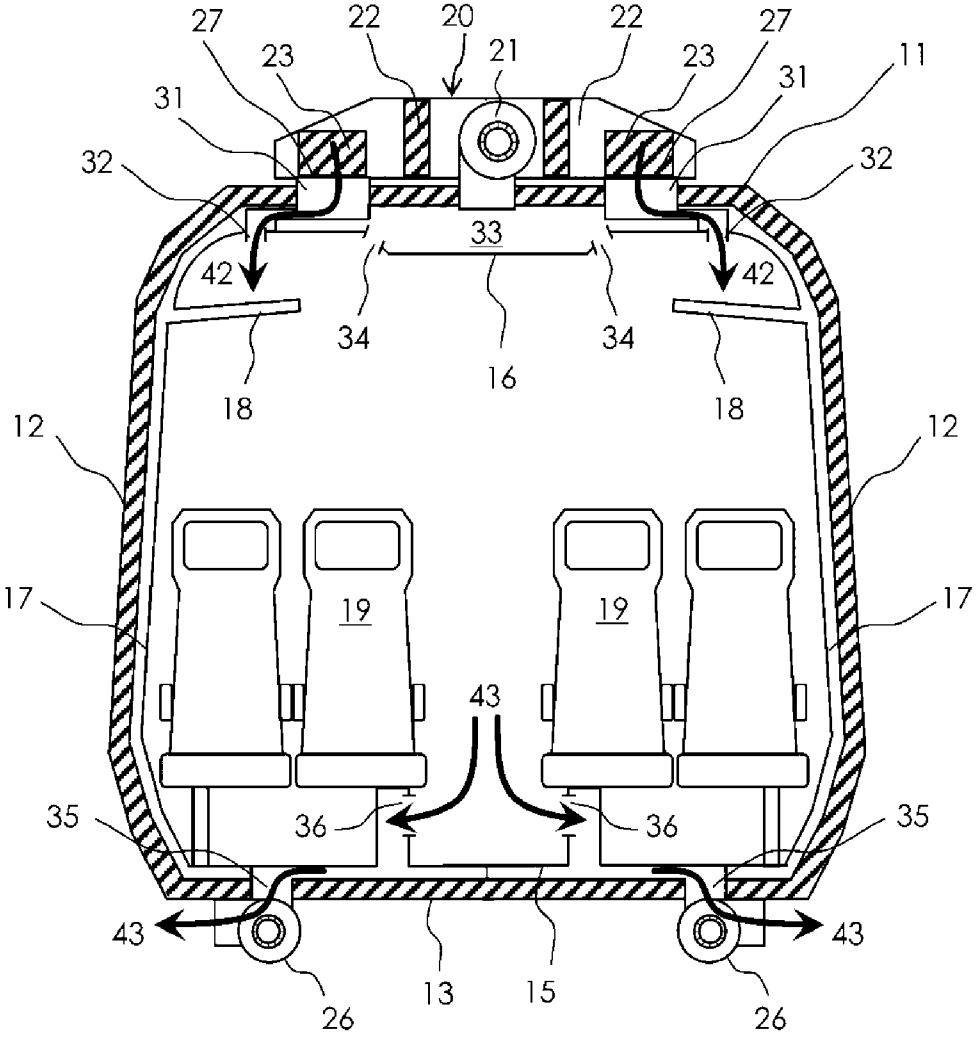
[FIG. 4]


START
S100
INPUT ENVIRONMENTAL INFORMATION
S101
DETERMINE OPERATION (COOLING/HEATING) MODE
IN HEATING MODE
IN COOLING MODE
S102
OPERATE VENTILATION FANS AND FRESH AIR HEATERS
S103
OPERATE VENTILATION FANS, CIRCULATION FAN, AND COMPRESSOR
END

[FIG. 5]



[FIG. 6]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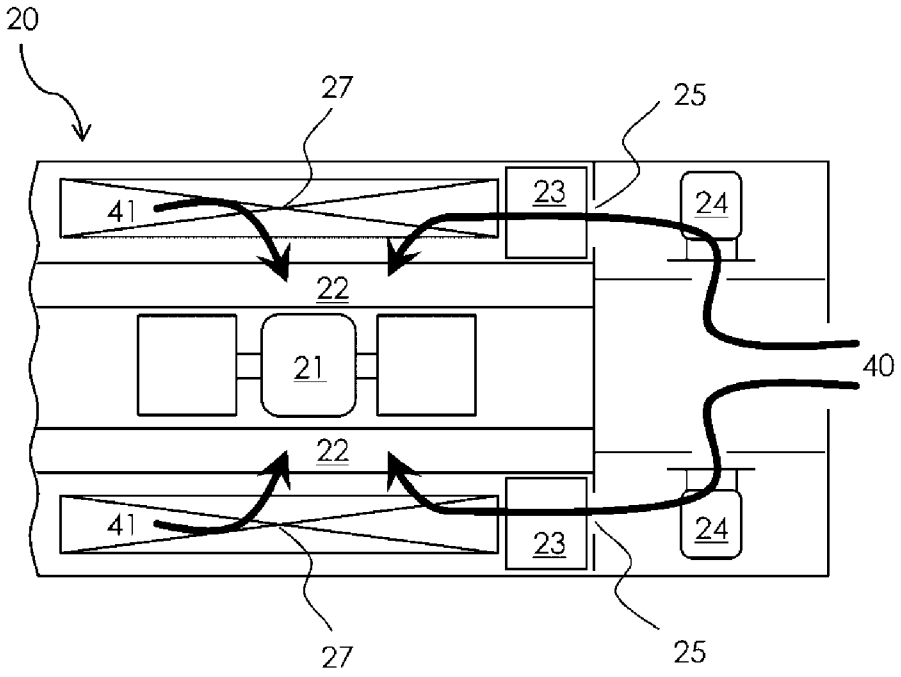
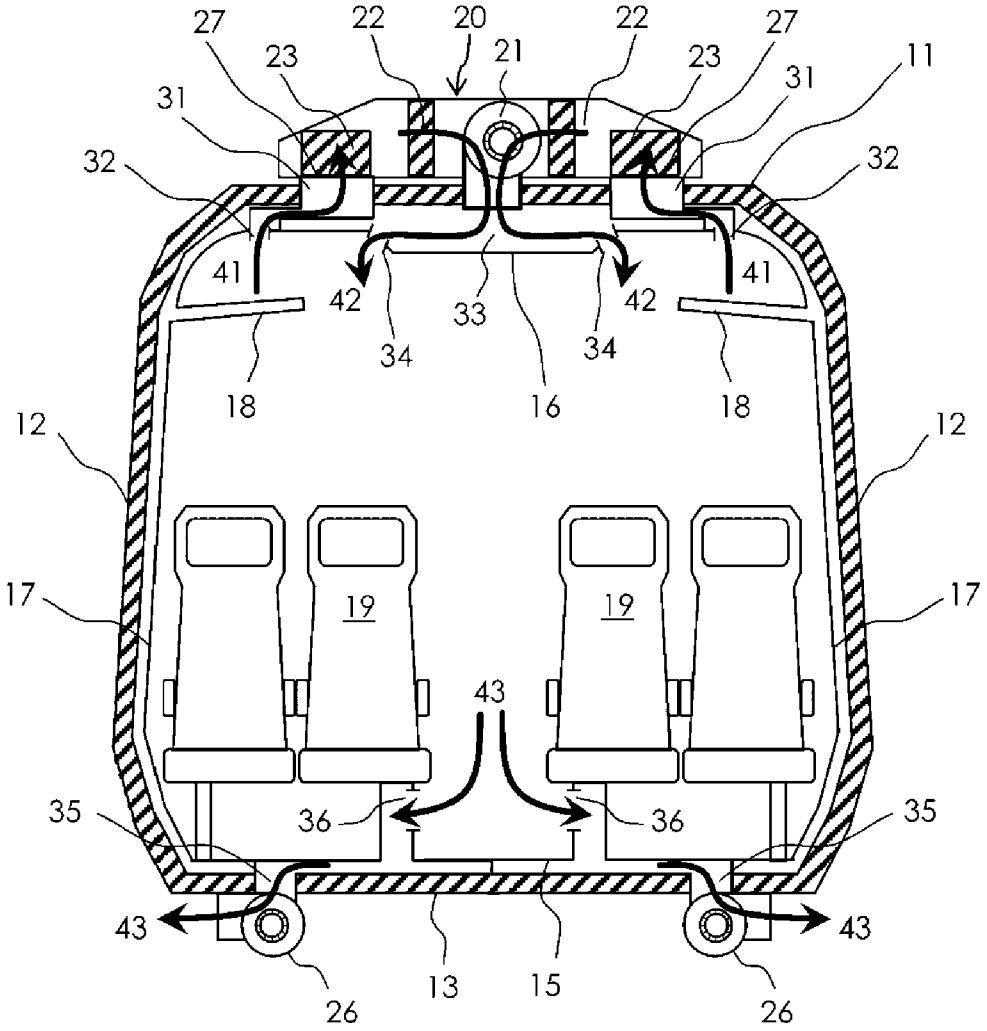
[FIG. 7]



[FIG. 8]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DESCRIPTION

Title of Invention: RAILCAR

Technical Field

[0001]

The present invention relates to a railcar.

Background Art

[0002]

For a railcar, it is important to improve a comfort of a vehicle interior. In particular, in Europe, standards for a temperature variation (temperature distribution) in a compartment and a wind speed felt by passengers in passenger seats are set in specifications related to the comfort of the railcar.

[0003]

PTL 1 describes an air conditioning ventilation system for a railcar that can secure a vehicle interior heating capacity without significantly changing a configuration of a compartment air conditioning means of a railcar in the related art.

[0004]

According to the air conditioning ventilation system described in PTL 1, a heater installed in a return path and

adjacent to a return air suction port is operated and controlled by a control means so as to operate in cooperation with a cooling device. Therefore, air returned to the cooling device through the return path is warmed to an appropriate temperature by the heater installed in the return path, and then, the warmed air is blown into an air blowing path due to an air blowing function of the cooling device, and is blown into the vehicle interior from air blowing ports arranged at a plurality of places in the vehicle interior, and thereby, the vehicle interior is warmed up.

[0005]

According to such an air conditioning ventilation system, by increasing or decreasing an amount of air blown by the cooling device according to increase or decrease in an amount of heat generated by the heater, a flow rate of the air returned to the cooling device reaches an appropriate flow rate corresponding to the amount of heat radiated from the heater, and the air returned to the cooling device is warmed to an appropriate temperature. Therefore, it is possible to uniformly warm the vehicle interior by blowing out warm air having an appropriate amount of heat from the air blowing ports.

Citation List

Patent Literature

[0006]

PTL 1: JP-A-2017-7466

Summary of Invention

Technical Problem

[0007]

In the air conditioning ventilation system for a railcar described in Patent Literature 1, since conditioned air warmed by the heater installed in the return path is blown into a vehicle compartment using a blower, in order to make the temperature distribution in the vicinity of and away from a conditioned air outlet in the vehicle compartment uniform, it is necessary to increase an air volume of the conditioned air, and thus there is a concern that a wind speed in passenger seats will increase. In order to prevent this, it is desirable to reduce the air volume of the conditioned air, but on the other hand, if the air volume of the conditioned air in a cooling mode is reduced, there is a problem that the capacity of a heat exchanger cannot be effectively utilized.

[0008]

An object of the invention is to provide a comfortable air conditioning ventilation system for a railcar in which temperature distribution in a vehicle compartment is made uniform while reducing a wind speed in passenger seats in a heating mode and maintaining a sufficient air conditioning capacity in a cooling mode by switching a blowing method of

conditioned air between the cooling mode and the heating mode.

Solution to Problem

[0009]

In order to solve the above problems, as one of typical railcars of the invention, a railcar includes:

a ventilation fan configured to supply air from a vehicle exterior to a vehicle compartment and discharge air from the vehicle compartment to the vehicle exterior;

a circulation fan connected to an air supply portion through which return air from the vehicle compartment is suctioned and an air discharge portion through which conditioned air is blown out to the vehicle compartment;

a heat exchanger configured to perform cooling;

a heater configured to perform heating;

an air conditioning controller configured to selectively set a heating mode and a cooling mode;

a first duct configured to connect the vehicle compartment and the air supply portion of the circulation fan; and

a second duct configured to connect the vehicle compartment and the air discharge portion of the circulation fan, wherein

the air conditioning controller performs control such that:

in the heating mode, the circulation fan is stopped, and

air taken in from the vehicle exterior by the ventilation fan is heated by the heater and blown into the vehicle compartment through the first duct, and

in the cooling mode, the circulation fan is operated, air taken in from the vehicle exterior by the ventilation fan and air taken in from the vehicle compartment through the first duct by the circulation fan is cooled by the heat exchanger and blown into the vehicle compartment through the second duct.

Advantageous Effect

[0010]

According to the invention, it is possible to provide a comfortable air conditioning ventilation system for a railcar in which the temperature distribution in the vehicle compartment is made uniform while reducing a wind speed in the passenger seats in the heating mode and maintaining a sufficient air conditioning capacity in the cooling mode.

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

Brief Description of Drawings

[0011]

[FIG. 1] FIG. 1 is a side view of a railcar according to an embodiment of the invention.

[FIG. 2] FIG. 2 is a cross-sectional view taken along a line A-A of FIG. 1 and showing a configuration of the railcar shown in FIG. 1.

[FIG. 3] FIG. 3 is a cross-sectional view taken along a line B-B of FIG. 1 and showing a configuration inside an air conditioner of the railcar shown in FIG. 1.

[FIG. 4] FIG. 4 is a control flowchart of the air conditioner for the railcar according to Embodiment 1 of the invention.

[FIG. 5] FIG. 5 is a schematic view showing air flows in a heating mode in the air conditioner of the railcar equipped with the invention.

[FIG. 6] FIG. 6 is a schematic view showing air flows in the heating mode in the railcar equipped with the invention.

[FIG. 7] FIG. 7 is a schematic view showing air flows in a cooling mode in the air conditioner of the railcar equipped with the invention.

[FIG. 8] FIG. 8 is a schematic view showing air flows in the cooling mode in the railcar equipped with the invention.

Description of Embodiments

[0012]

Hereinafter, embodiments of the invention will be described with reference to the drawings. First, each direction to be described is defined. A longitudinal direction of a

railcar or a rail direction is referred to as an X direction, a width direction of the railcar or a sleeper direction is referred to as a Y direction, and a height direction of the railcar is referred to as a Z direction, and hereinafter, the directions are simply referred to as the X direction, the Y direction, and the Z direction. A single term "up" means an upper side along the Z direction and a single term "down" means a lower side along the Z direction.

[0013]

The railcar is a vehicle that moves along laid rails, and includes a railcar, a monorailcar, a tramcar, a new traffic vehicle, and the like. As a representative example of the railcar, an embodiment of the invention will be described with reference to the railcar.

[0014]

[Embodiment 1]

FIG. 1 is a side view showing a railcar according to an embodiment of the invention. In FIG. 1, a railcar 10 is configured as a housing in which a dimension in the X direction is larger than a dimension in the Y direction.

[0015]

The railcar 10 includes a roof structure body 11, a pair of side structure bodies 12, an underframe 13, and an end construction body (not shown) erected at both ends of the underframe 13 in the X direction, and the roof structure body

11, the pair of side structure bodies 12, and the underframe 13 are integrated to configure a substantially tubular vehicle housing. The roof structure body 11 and the underframe 13 are arranged substantially horizontally along the X direction, each side structure body 12 is arranged substantially perpendicular to the roof structure body 11 and the underframe 13 (in the Z direction) along the X direction, and a pair of wheels 14 are arranged on a lower portion side of the underframe 13.

[0016]

FIG. 2 is a cross-sectional view taken along a line A-A and showing a configuration of the railcar 10 shown in FIG. 1. In FIG. 2, an air conditioner 20 is arranged on an upper portion side of the roof structure body 11, and ventilation fans (also referred to as air discharge fans) 26 for discharging air from a vehicle compartment are arranged at the lower portion side of the underframe 13. Inside the vehicle housing, a floor 15 is arranged at a lower portion, a ceiling panel 16 is arranged at an upper portion, and a pair of side panels 17 are arranged on lateral sides, and the ceiling panel 16, the pair of side panels 17 and the floor 15 are integrated to configure a substantially tubular vehicle compartment.

[0017]

The vehicle compartment is configured as a tubular body in which a dimension in the X direction is larger than a dimension in the Y direction of the railcar 10. The floor 15

and the ceiling panel 16 are arranged substantially horizontally along the X direction, each side panel 17 is arranged substantially perpendicular to the floor 15 and the ceiling panel 16 along the X direction, a luggage rack 18 is arranged on an inner wall surface of an upper portion of each side panel 17, and chairs 19 are fixed below the luggage racks 18 and on an upper surface of the floor 15.

[0018]

Between the roof structure body 11 and the ceiling panel 16, conditioned/return air ducts (first ducts) 31 are provided along the X direction over substantially the entire length of the vehicle compartment. The conditioned/return air ducts 31 communicate with the air conditioner 20 via openings 27 provided in the air conditioner 20 and communicate with the vehicle compartment via conditioned/return air ports (air supply portions) 32 provided in the ceiling panel 16. The conditioned/return air port 32 is provided as an opening or slit provided along the X direction of the ceiling panel 16 over substantially the entire length of the vehicle compartment.

[0019]

In addition, FIG. 2 illustrates the conditioned/return air duct 31 in which all of surfaces are configured by a combination of a plurality of thin plates, but a structure in which a part of the surfaces constituting the duct are the roof structure body 11 or the ceiling panel 16 may be adopted.

[0020]

Between the roof structure body 11 and the ceiling panel 16, a conditioned air duct (a second duct) 33 is provided along the X direction (longitudinal direction) over substantially the entire length of the vehicle compartment. The conditioned air duct 33 communicates with the air conditioner 20 via a circulation fan 21 arranged in the air conditioner 20, and communicates with the vehicle compartment via conditioned air ports (air discharge portions) 34 provided in the ceiling panel 16. The conditioned air port 34 is provided as an opening or slit provided along the X direction of the ceiling panel 16 over substantially the entire length of the vehicle compartment.

[0021]

In addition, FIG. 2 illustrates the conditioned air duct 33 in which the roof structure body 11 and the ceiling panel 16 form a part of the surfaces, but a structure in which all of the surfaces are composed of a combination of a plurality of thin plates, or a structure in which a part of the surfaces are the roof structure body 11 or the ceiling panel 16 may be adopted.

[0022]

Between the underframe 13 and the floor 15, air discharge ducts 35 are provided along the X direction over substantially the entire length of the vehicle compartment. The air discharge ducts 35 communicate with the vehicle compartment through air discharge ports 36 provided in or in the vicinity of a floor

surface of the vehicle compartment, and communicate with a vehicle exterior via the ventilation fans 26 for air discharge arranged at lower portions of the underframe 13.

[0023]

In addition, FIG. 2 illustrates the air discharge duct 35 in which the underframe 13 and the floor 15 form a part of surfaces, but a structure in which all of the surfaces are composed of a combination of a plurality of thin plates, or a structure in which a part of the surfaces are the underframe 13 or the floor 15 may be adopted. In addition, the positions of the air discharge ducts 35 are not limited to between the underframe 13 and the floor 15, and may be the lower portions of the underframe 13. In this case, the air discharge duct 35 has a structure in which all of the surfaces are a combination of a plurality of thin plates, or a structure in which a part of the surfaces are the underframe 13.

[0024]

In order to make the temperature distribution in the vehicle compartment uniform, it is desirable to arrange the ventilation fan 26 and the air discharge duct 35 directly below optimum positions of the air discharge port 36 in order to reduce the pressure loss. However, due to arrangement of underfloor equipment, the ventilation fan 26 cannot always be arranged directly below the air discharge duct 35 located in the vicinity of the air discharge port 36, and may have to be

provided away from the air discharge port 36, and thus the air discharge duct 35 needs to be extended.

[0025]

In this case, an upper surface of the air discharge duct 35 connecting the air discharge port 36 and the ventilation fan 26 may be configured by a lower surface of the floor 15, and a lower surface of the air discharge duct 35 may be configured by an upper surface of the underframe 13, and both vertical surfaces of the air discharge duct 35 may be configured by end surfaces of a heat insulating member (sound insulating member) provided between the underframe 13 and the floor 15. With this configuration, the air discharge duct 35 can be configured without increasing the number of parts, so that a vehicle compartment having a uniform temperature distribution can be realized with a small manufacturing man-hour.

[0026]

FIG. 3 is a cross-sectional view taken along a line B-B of FIG. 1 and showing a configuration of the air conditioner of the railcar shown in FIG. 1. In FIG. 3, the air conditioner 20 arranged on the roof structure body 11 includes the circulation fan 21 for suctioning return air from the vehicle compartment and blowing out conditioned air to the vehicle compartment, heat exchangers 22 for cooling, fresh air heaters 23 for heating, fresh air valves 24 for adjusting an amount of fresh air taken in from the vehicle exterior, fresh air intake ports 25 through

which the fresh air is taken into the air conditioner 20, and an air conditioning controller 28 that controls these parts. As shown in FIG. 3, the fresh air heater 23 is arranged at a position close to (adjacent to) the fresh air intake port 25 in the air conditioner 20. In addition, the air conditioning controller 28 is not necessarily installed inside the air conditioner 20 and can be installed at any place inside the vehicle. Therefore, in FIG. 3, the air conditioning controller 28 and wirings are shown by dotted lines for convenience.

[0027]

When the railcar passes through a tunnel at a speed faster than a predetermined speed, an air pressure in the tunnel may fluctuate greatly between a positive side and a negative side with respect to an atmospheric pressure at a tunnel entrance. Therefore, for example, when the air pressure in the tunnel fluctuates significantly to the negative side, air of the vehicle interior flows back through flow paths through which the fresh air is taken into the vehicle interior and flows to the vehicle exterior, as a result, a pressure of the vehicle interior may drop sharply and passengers may feel uncomfortable with hearing.

[0028]

In order to prevent the discomfort, the fresh air valves 24 are closed immediately before entering the tunnel when the railcar is to pass through the tunnel at a predetermined speed

or higher. At this time, although not shown, discharge air valves which are installed in the ventilation fans 26 and close discharge flow paths also close the discharge flow paths in synchronization with the closing of the fresh air valves 24.

[0029]

FIG. 4 is a control flowchart of the air conditioner of the railcar according to the present embodiment. Operations of the circulation fan 21, the heat exchangers 22, and the fresh air heaters 23 provided in the air conditioner 20, and operations of the ventilation fans 26 for air discharge are controlled by the air conditioning controller 28 as shown in FIG. 4.

[0030]

First, in step S100, the air conditioning controller 28 inputs environmental information (a calendar, an occupancy rate, etc.). Next, in step S101, the air conditioning controller 28 inputs a temperature inside a compartment and determines an operation (cooling/heating) mode according to the temperature inside the compartment. A set temperature and an air volume in the operation mode can be changed according to the environmental information.

[0031]

When the temperature inside the compartment is below a threshold value, in step S102, the air conditioning controller 28 sets a heating mode, takes the air into the air conditioner

20 by operating the ventilation fans 26 for air discharge without operating the circulation fan 21, and adjusts a temperature of the air by operating the fresh air heaters 23.

[0032]

On the other hand, when the temperature inside the compartment is higher than the threshold value, in step S103, the air conditioning controller 28 sets a cooling mode, takes air into the air conditioner 20 by operating the ventilation fans 26 for air discharge and the circulation fan 21, and adjusts the temperature of the air by the heat exchangers 22 by operating a compressor (not shown).

[0033]

FIG. 5 is a schematic view showing air flows in the heating mode in the air conditioner 20. By executing the control flow shown in FIG. 4, fresh air 40 taken into the air conditioner 20 from the vehicle exterior by operating the ventilation fans 26 for air discharge, is heated by passing through the fresh air heaters 23 in the air conditioner 20 as shown in FIG. 5.

[0034]

FIG. 6 is a schematic view showing air flows in the heating mode in the railcar according to the present embodiment. As shown in FIG. 6, conditioned air 42 heated in the air conditioner 20 is taken into the vehicle compartment by the ventilation fans 26 for air discharge from the conditioned/return air ports 32 to the luggage racks 18 through the conditioned/return air ducts

31, further passes below the chairs 19 from the air discharge ports 36 and becomes discharged air 43 to the vehicle exterior through the air discharge ducts 35. Therefore, a flow is formed in which heated conditioned air 42 blown out from an upper portion of the vehicle compartment is taken to a lower portion of the vehicle compartment, and the temperature in the vehicle compartment can be made uniform.

[0035]

In addition, the control of the air conditioning controller 28 in FIG. 6 is not limited to stopping the circulation fan 21 in the heating mode, and when the circulation fan 21 operates at a low speed at which air flows from the vehicle compartment to the air conditioner 20 are not formed, the air flows similar to those shown in FIG. 6 are formed in the vehicle compartment.

[0036]

FIG. 7 is a schematic view showing air flows in the cooling mode in the air conditioner 20. By executing the control flow shown in FIG. 4, the fresh air 40 taken into the air conditioner 20 from the vehicle exterior by operating the ventilation fans 26 for air discharge and return air 41 taken by the circulation fan 21 from the vehicle compartment into the air conditioner 20 through the conditioned/return air ducts 31 from the conditioned/return air ports 32 (FIG. 8) above the luggage racks 18, is cooled by passing through the heat exchangers 22 in the

air conditioner 20 as shown in FIG. 7.

[0037]

FIG. 8 is a schematic view showing air flows in the cooling mode in the railcar according to the present embodiment. As shown in FIG. 8, the conditioned air 42 cooled in the air conditioner 20 is blown by the circulation fan 21 diagonally into the vehicle compartment from the conditioned air ports 34 through the conditioned air duct 33 so as to avoid the luggage racks 18 and to be directed to the chairs 19, and is discharged by the ventilation fans 26 for air discharge from the air discharge ports 36 to the vehicle exterior through the air discharge ducts 35 to form the discharged air 43. Therefore, it is possible to prevent the cooled conditioned air 42 from staying at the lower portion of the vehicle compartment and to make the temperature in the vehicle compartment uniform. A part of the air in the vehicle compartment is taken in by the circulation fan 21 as the return air 41 from the conditioned/return air ports 32 (FIG. 8) above the luggage racks 18, and flows back into the air conditioner 20.

[0038]

As mentioned above, the blowing method of the conditioned air 42 is switched between the cooling mode and the heating mode to reduce the air volume of the conditioned air 42 and reduce the wind speed in the passenger seats since only the fresh air 40 is used for heating in the heating mode. On the other hand,

in the cooling mode, the fresh air 40 and the return air 41 that has been cooled to some extent are cooled for cooling, so that a sufficient air volume of the conditioned air 42 can be secured and the capacity of the heat exchangers 22 can be effectively utilized.

[0039]

Although FIGS. 1 and 2 show the case where the air conditioner 20 is arranged on an upper portion of the roof structure body 11, the air conditioner 20 may be arranged at the lower portion of the underframe 13. In this case, connecting ducts (not shown) communicating with the conditioned/return air ducts 31 and the conditioned air duct 33 are erected from the air conditioner 20 along the Z direction. At this time, the air conditioner 20 can be integrated with the ventilation fans 26 for air discharge provided in the lower portions of the underframe 13, or configured to communicate with the ventilation fans 26 for air discharge through the connecting ducts (not shown).

[0040]

According to the present embodiment, it is possible to provide a comfortable air conditioning ventilation system for the railcar in which the temperature distribution in the vehicle compartment is made uniform while maintaining the sufficient air conditioning capacity in the cooling mode without generating an uncomfortable wind speed in the passenger seats in the

heating mode. As a result, it is possible to realize the air conditioning ventilation system for the railcar in which the temperature distribution in the vehicle compartment is made uniform without deteriorating a draft feeling in the passenger seats.

[0041]

[Embodiment 2]

Since Embodiment 2 is the same as Embodiment 1 except that ventilation fans for air supply (not shown) are provided instead of the ventilation fans 26 for air discharge that are arranged at the lower portions of the underframe 13, the drawings for explanation are commonly used.

[0042]

The ventilation fans for air supply are arranged at the upper portion of the roof structure body 11. In this configuration, discharged air from the vehicle compartment is pushed out of the vehicle through the air discharge ducts 35 by operating the ventilation fans for air supply. At this time, the ventilation fans for air supply are configured to be integrated with the air conditioner 20 provided at the upper portion of the roof structure body 11 or to be communicated with the air conditioner 20 through ducts (not shown).

[0043]

By applying the control flow shown in FIG. 4 as in Embodiment 1, the air flows shown in FIGS. 6 and 7 can be formed

in the vehicle compartment.

[0044]

According to Embodiment 2, the same effect as that of Embodiment 1 can be obtained, and the air conditioner 20 and the ventilation fans for air supply can be integrated at the upper portion of the roof structure body 11 to improve the maintainability.

[0045]

[Embodiment 3]

Since Embodiment 3 is the same as Embodiments 1 and 2, except that the ventilation fans 26 provided only for air discharge or air supply are provided on each of an air supply side and an air discharge side, the drawings for explanation are commonly used.

[0046]

At this time, ventilation fans for air supply (not shown) are arranged at the upper portion of the roof structure body 11, and the ventilation fans 26 for air discharge are arranged at the lower portions of the underframe 13, and other configurations are the same as those in the above embodiments, and therefore, by applying the control flow shown in FIG. 4, the air flows shown in FIGS. 6 and 7 can be formed in the vehicle compartment.

[0047]

In addition, a ventilation device (not shown) that

integrates ventilation fans for air supply and air discharge may be provided. When the ventilation device is arranged at the lower portion of the underframe 13, connecting ducts (not shown) that communicate with the air conditioner 20 provided at the upper portion of the roof structure body 11 and through which the fresh air 40 taken in by the ventilation fans for air supply is sent to the air conditioner 20, can be erected along the Z direction from the ventilation device. The other configurations are the same as those in Embodiment 1, and by applying the control flow shown in FIG. 4, the air flows shown in FIGS. 6 and 7 can be formed in the vehicle compartment.

[0048]

Further, in the above configuration, the air conditioner 20 provided at the upper portion of the roof structure body 11 may be arranged at the lower portion of the underframe 13. In this case, the connecting ducts (not shown) respectively communicating with the conditioned/return air ducts 31 and the conditioned air duct 33 can be erected along the Z direction from the air conditioner 20. The other configurations are the same as those in Embodiment 1, and by applying the control flow shown in FIG. 4, the air flows shown in FIGS. 6 and 7 can be formed in the vehicle compartment. The air conditioner 20 and the ventilation device may be integrated.

[0049]

The ventilation device is operated so as to prevent a

pressure fluctuation in the vehicle compartment by interlocking the ventilation fans for air supply and air discharge.

[0050]

According to the present embodiment, the same effect as that of Embodiment 1 can be obtained, and a comfortable vehicle interior environment can be provided in which a sudden pressure fluctuation in the vehicle compartment is prevented by controlling the ventilation fans for air supply and air discharge independently.

[0051]

In addition, the invention is not limited to the embodiments described above, and includes various modifications. For example, the embodiments described above are described in detail for easy understanding of the invention, and the invention is not necessarily limited to those including all the configurations described above. Further, a part of the configuration of one embodiment can be replaced with configurations of other embodiments, and the configurations of one embodiment can be added to the configuration of another embodiment. In addition, a part of the configuration of each embodiment may be added, deleted, or replaced with another configuration.

Reference Sign List

[0052]

10: railcar

20: air conditioner

21: circulation fan

22: heat exchanger

23: fresh air heater

24: fresh air valve

25: fresh air intake port

26: ventilation fan

28: air conditioning controller

31: conditioned/return air duct

32: conditioned/return air port

33: conditioned air duct

34: conditioned air port

35: air discharge duct

36: air discharge port

40: fresh air

41: return air

42: conditioned air

43: discharged air

CLAIMS

[Claim 1]

A railcar comprising:

a ventilation fan configured to supply air from a vehicle exterior to a vehicle compartment and discharge air from the vehicle compartment to the vehicle exterior;

a circulation fan connected to an air supply portion through which return air from the vehicle compartment is suctioned and an air discharge portion through which conditioned air is blown out to the vehicle compartment;

a heat exchanger configured to perform cooling;

a heater configured to perform heating;

an air conditioning controller configured to selectively set a heating mode and a cooling mode;

a first duct configured to connect the vehicle compartment and the air supply portion of the circulation fan; and

a second duct configured to connect the vehicle compartment and the air discharge portion of the circulation fan, wherein

the air conditioning controller performs control such that:

in the heating mode, the circulation fan is stopped, and air taken in from the vehicle exterior by the ventilation fan is heated by the heater and blown into the vehicle compartment

through the first duct, and

in the cooling mode, the circulation fan is operated, air taken in from the vehicle exterior by the ventilation fan and air taken in from the vehicle compartment through the first duct by the circulation fan is cooled by the heat exchanger and blown into the vehicle compartment through the second duct.

[Claim 2]

The railcar according to Claim 1, wherein

the first duct is provided along a longitudinal direction of the railcar over substantially an entire length of the vehicle compartment.

[Claim 3]

The railcar according to Claim 1 or 2, wherein

the ventilation fan is an air discharge fan provided below the vehicle compartment, and

air in the vehicle compartment is discharged by the air discharge fan to the vehicle exterior through an air discharge port provided below the vehicle compartment.

[Claim 4]

The railcar according to Claim 3, wherein

an upper surface of an air discharge duct connecting the air discharge port and the air discharge fan is configured by a

lower surface of a floor of the railcar, a lower surface of the air discharge duct is configured by an upper surface of an underframe of the railcar, and both side surfaces of the air discharge duct are configured by end surfaces of a heat insulating member or a sound insulating member provided between the underframe and the floor.

[Claim 5]

The railcar according to any one of Claims 1 to 4, wherein

in the heating mode, air heated by the heater is supplied to the vehicle compartment through the air supply portion above a luggage rack.

[Claim 6]

The railcar according to any one of Claims 1 to 5, wherein

in the cooling mode, air cooled by the heat exchanger is supplied from the air discharge portion toward a chair below the luggage rack, and

air in the vehicle compartment is collected through the air supply portion above the luggage rack.