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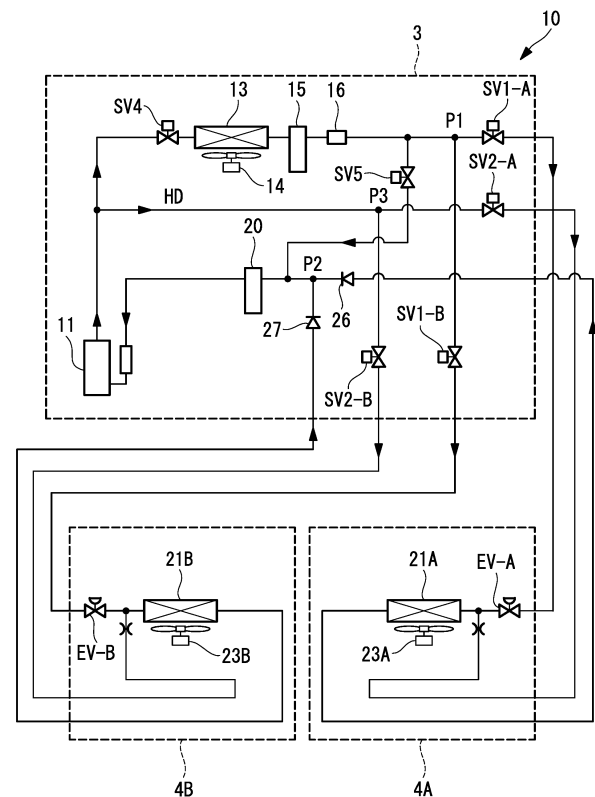
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(54) **CONTROL SYSTEM, MOVING UNIT, CONTROL METHOD, AND CONTROL PROGRAM**

(57) An object is to provide a control system, a moving unit, a control method, and a control program that can suppress mold growth. The control system applied to a refrigerating machine provided to a truck (1) includes: a refrigeration control unit configured to perform a refrigerating operation on a cargo space (2) provided with an evaporator of the refrigerating machine; a detection unit configured to detect completion of the refrigerating operation; and a drying control unit configured to perform a drying operation to increase a surface temperature of a heat exchanging part of the evaporator of an evaporator unit (4A) when the refrigerating operation is completed.

FIG. 2



Description

BACKGROUND

1. TECHNICAL FIELD

[0001] The present disclosure relates to a control system, a moving unit, a control method, and a control program.

2. DESCRIPTION OF RELATED ART

[0002] To transport a cargo to a destination while controlling the temperature state of a cargo space, a transport vehicle is equipped with a refrigerating machine used for transportation (for example, Japanese Patent Application Laid-Open No. 2020-106204).

[0003] Japanese Patent Application Laid-Open No. 2020-106204 is an example of the related art.

[0004] However, when the refrigerating machine is stopped when no cargo is in the cargo space, such as after the cargo is unloaded at the destination, a heat exchanging part of the refrigerating machine will get wet. If the wet state continues, mold or the like will propagate, which may cause a foul smell or the like. In the field of transport refrigerating machines, these machines have not been equipped with a function of preventing mold propagation when a refrigerating machine is stopped.

BRIEF SUMMARY

[0005] The present disclosure has been made in view of such circumstances and intends to provide a control system, a moving unit, a control method, and a control program that can suppress mold growth.

[0006] The first aspect of the present disclosure is a control system applied to a refrigerating machine provided to a moving unit, and the control system includes: a refrigeration control unit configured to perform a refrigerating operation on a cargo space provided with an evaporator of the refrigerating machine; a detection unit configured to detect completion of the refrigerating operation; and a drying control unit configured to perform a drying operation to increase a surface temperature of a heat exchanging part of the evaporator when the refrigerating operation is completed.

[0007] The second aspect of the present disclosure is a control method applied to a refrigerating machine provided to a moving unit, and the control method includes: performing a refrigerating operation on a cargo space provided with an evaporator of the refrigerating machine; detecting completion of the refrigerating operation; and performing a drying operation to increase a surface temperature of a heat exchanging part of the evaporator when the refrigerating operation is completed.

[0008] The third aspect of the present disclosure is a control program applied to a refrigerating machine provided to a moving unit, and the control program causes

a computer to perform: a process of performing a refrigerating operation on a cargo space provided with an evaporator of the refrigerating machine; a process of detecting completion of the refrigerating operation; and a process of performing a drying operation to increase a surface temperature of a heat exchanging part of the evaporator when the refrigerating operation is completed.

[0009] According to the present disclosure, an advantageous effect of being able to suppress mold growth is achieved.

BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWINGS

[0010]

Fig. 1 is a perspective view illustrating a general configuration of a truck according to one embodiment of the present disclosure.

Fig. 2 is a diagram illustrating an example of a refrigerant circuit of a refrigerating machine according to one embodiment of the present disclosure.

Fig. 3 is a front view of a condenser unit according to one embodiment of the present disclosure.

Fig. 4 is a diagram illustrating an example of a hardware configuration of a control system according to one embodiment of the present disclosure.

Fig. 5 is a function block illustrating functions of the control system according to one embodiment of the present disclosure.

Fig. 6 is a side view of an evaporator unit according to one embodiment of the present disclosure.

Fig. 7 is a diagram illustrating a configuration example of warm water supply according to one embodiment of the present disclosure.

Fig. 8 is a side view of the evaporator unit according to one embodiment of the present disclosure.

Fig. 9 is a flowchart illustrating an example of a procedure of a dry control process according to one embodiment of the present disclosure.

DETAILED DESCRIPTION

[0011] One embodiment of a control system, a moving unit, a control method, and a control program according to the present disclosure will be described below with reference to the drawings.

[0012] Fig. 1 is a diagram (perspective view) illustrating a general configuration of a truck 1 according to one embodiment of the present disclosure. Although the truck 1 that is a vehicle is illustrated as an example of the moving unit for description in the present embodiment, any moving unit may be employed without being limited to the truck 1. As illustrated in Fig. 1, the truck 1 has a cargo space 2. A cargo can be loaded in the cargo space 2, and the temperature therein can be controlled by a refrigerating machine. In the present embodiment, the car-

go space 2 of the truck 1 is segmented into a region 5A and a region 5B, and cargos can be loaded in respective regions. Further, temperature can be controlled for respective regions.

[0013] The truck 1 is equipped with a condensing unit (condenser unit) 3, an evaporation unit (evaporator unit) 4A in the region 5A, and an evaporation unit (evaporator unit) 4B in the region 5B. The driver's cab of the truck 1 is provided with a cabin controller 6, and the refrigeration states of the region 5A and the region 5B can be operated.

[0014] The truck 1 may be equipped with a battery 8. The battery 8 may be able to be charged or discharged via a connector unit 9, for example. For example, a Li-ion battery, a Ni-MH battery, a capacitor, a lead storage battery, or the like may be employed for the battery 8. The battery 8 may be provided on the truck 1 side, may be provided on the refrigerating machine side, or may be provided to other vehicle attachments.

[0015] The truck 1 may be equipped with a device that can generate power, such as an alternator 7.

[0016] Fig. 2 is a diagram illustrating an example of a refrigerant circuit 10 of the refrigerating machine equipped on the truck 1. The refrigerant circuit 10 of Fig. 2 is only an example, and a refrigerant circuit 10 of another configuration may be equipped on the truck 1.

[0017] As illustrated in Fig. 2, two evaporator units 4A and 4B are connected to the condenser unit 3.

[0018] In the condenser unit 3, a refrigerant at a high temperature and a high pressure compressed by a compressor 11 is supplied to a condenser 13 via a valve SV4. In the condenser 13, the refrigerant dissipates heat and is condensed through heat exchange with air circulated by a fan 14. The refrigerant is branched at P1 via a receiver 15 and a dryer 16. One refrigerant branched at P1 is supplied to the evaporator unit 4A installed in the region 5A via a valve SV1-A. In the evaporator unit 4A, the refrigerant is expanded to be at a low temperature and a low pressure by an expansion valve EV-A. The refrigerant is supplied to an evaporator 21A. In the evaporator 21A, the refrigerant absorbs heat and is evaporated through heat exchange with air circulated by a fan 23A. Accordingly, the air in the region 5A is cooled. The evaporated refrigerant merges at P2 with the refrigerant from the evaporator unit 4B of the region 5B via a check valve 26 and flows into the compressor 11 via an accumulator 20.

[0019] On the other hand, the other refrigerant branched at P1 is supplied to the evaporator unit 4B installed in the region 5B via a valve SV1-B. In the evaporator unit 4B, the refrigerant is expanded to be at a low temperature and a low pressure by an expansion valve EV-B. The refrigerant is supplied to an evaporator 21B. In the evaporator 21B, the refrigerant absorbs heat and is evaporated through heat exchange with air circulated by a fan 23B. Accordingly, the air in the region 5B is cooled. The evaporated refrigerant merges at P2 with the refrigerant from the evaporator unit 4A of the region 5A via a check valve 27 and flows into the compressor

11 via the accumulator 20.

[0020] In such a way, a refrigerating cycle is configured, and the air in the cargo space 2 is cooled. Fig. 3 is a front view of the condenser unit 3. As illustrated in Fig. 3, when viewed from the front, the condenser 13 is arranged on the center side of the condenser unit 3, and the compressor 11 is arranged aside the condenser 13.

[0021] As illustrated in Fig. 2, a line that bypasses a path between the upstream of P1 and the downstream of P2 and a valve SV5 provided on the line may be arranged. A drain pan heater, which uses a part of a refrigerant at a high temperature and a high pressure compressed by the compressor 11, of the evaporator unit may be arranged. Specifically, a part of a refrigerant at a high temperature and a high pressure compressed by the compressor 11 is caused to flow in a line HD and branched at P3. One refrigerant branched at P3 is supplied to a drain pan heater of the evaporator unit 4A of the region 5A via a valve SV2-A. The drain pan heater heats a drain pan. The refrigerant is then supplied upstream of the evaporator 21A. The other refrigerant branched at P3 is supplied to the drain pan heater of the evaporator unit 4B of the region 5B via a valve SV2-B. The refrigerant is then supplied upstream of the evaporator 21B.

[0022] Next, a control system 50 will be described.

[0023] The control system 50 is applied to a refrigerating machine provided to the truck 1 and controls the refrigerating machine. In particular, the control system 50 performs drying control in order to suppress mold growth in the evaporator 21. The control system 50 may be equipped on the cabin controller 6, for example.

[0024] Fig. 4 is a diagram illustrating an example of the hardware configuration of the control system 50 according to the present embodiment.

[0025] As illustrated in Fig. 4, the control system 50 is a computer system (calculator system) and, for example, includes a CPU 1100, a read only memory (RAM) 1200 for storing a program or the like executed by the CPU 1100, a random access memory (RAM) 1300 functioning as a work field during execution of each program, a hard disk drive (HDD) 1400 as a mass storage device, and a communication unit 1500 for a connection to a network or the like. Note that a solid state drive (SSD) may be used as the mass storage device. These components are connected to each other via a bus 1800.

[0026] The control system 50 may include an input unit formed of a keyboard, a mouse, or the like, a display unit formed of a liquid crystal display or the like for displaying data, or the like.

[0027] A storage medium for storing a program or the like executed by the CPU 1100 is not limited to the ROM 1200 and may be, for example, another auxiliary storage device such as a magnetic disk, a magneto-optical disk, a semiconductor memory, or the like.

[0028] Details of a series of processes for implementing respective functions described later are stored in a hard disk drive 1400 or the like in a form of a program,

and when the CPU 1100 loads the program into the RAM 1300 or the like and performs a processing and calculation process on information, respective functions described later are implemented. An applicable form of the program may be a form in which a program is installed in advance in a ROM 1200 or another storage medium, a form in which a program is provided in a state of being stored in a computer readable storage medium, a form in which a program is delivered via a wired or wireless communication scheme, or the like. The computer readable storage medium may be a magnetic disk, a magneto-optical disk, a CD-ROM, a DVD-ROM, a semiconductor memory, or the like.

[0029] Fig. 5 is a function block diagram illustrating functions of the control system 50. As illustrated in Fig. 5, the control system 50 includes a refrigeration control unit 51, a detection unit 52, a determination unit 53, and a drying control unit 54 as main units.

[0030] The refrigeration control unit 51 performs a refrigerating operation on the cargo space 2 provided with the evaporator 21 of the refrigerating machine. That is, the refrigeration control unit 51 performs control to maintain the cargo space 2 at a set temperature in order to suitably adjust the temperature of a cargo in the cargo space 2 and transport the cargo. That is, a refrigeration circuit illustrated in Fig. 2 is activated to cool the air in the cargo space 2.

[0031] The detection unit 52 detects completion of a refrigerating operation. Specifically, based on the state of a refrigerating operation being performed by the refrigeration control unit 51, the detection unit 52 detects that the refrigerating operation was completed. A refrigerating operation being completed means cooling of the air in the cargo space 2 being completed. In other words, completion of a refrigerating operation may correspond to stop of a flow of a refrigerant of the evaporator 21.

[0032] The determination unit 53 performs determination of a start condition of a drying operation. If the start condition is satisfied (in a case of positive determination), a drying operation is started. If the start condition is not satisfied (in a case of negative determination), no drying operation may be started.

[0033] The start condition is that the amount of electric power available for a drying operation is present in the truck 1. That is, the determination unit 53 determines whether or not the amount of electric power available for a drying operation is present in the truck 1. Accordingly, it is possible to perform a drying operation after confirming that electric power required for the drying operation can be maintained.

[0034] The amount of electric power available for a drying operation may be electric power that has been stored or may be electric power that is generated. That is, any electric power that can be maintained in the truck 1 can be used without limitation.

[0035] When generated electric power is used, the determination unit 53 determines whether or not the amount of electric power available for a drying operation is

present in accordance with the operation state of a generator (alternator 7) provided to the truck 1. Specifically, the truck 1 is equipped with the alternator 7, and if the alternator 7 is not in use, it is determined that electric power generated by the alternator 7 is available for a drying operation to be started. Since the electric power generated by the alternator 7 is only required to be available for a drying operation to be performed, it may be determined that the amount of electric power available for a drying operation is present not only if the alternator 7 is not in use but also if there is an enough margin to perform a drying operation even if the alternator 7 is in use.

[0036] When stored electric power is used, the determination unit 53 determines whether or not the amount of electric power available for a drying operation is present in accordance with the storage state of the battery 8 provided to the truck 1. Specifically, the charge level of the battery 8 is higher than or equal to a threshold (for example, 50%), it is determined that the electric power stored in the battery 8 is available for a drying operation to be started. Since electric power stored in the battery 8 is only required to be available for a drying operation to be performed, it may be determined that the electric power is available if the battery 8 is charged.

[0037] That is, in both of the case where generated electric power is used and the case where stored electric power is used, the start condition is positively determined if electric power used for a drying operation to be performed in the truck 1 can be maintained.

[0038] Furthermore, since the start condition is only required to trigger start of a drying operation, the start condition may be that there is an instruction to start a drying operation from the driver of the truck 1. In such a case, a drying operation may be started regardless of the available amount of electric power, or the above determination on the amount of electric power may be performed after an instruction to start a drying operation is provided.

[0039] Any start condition may be employed without being limited to the above as long as it triggers start of a drying operation.

[0040] When a refrigerating operation is completed, the drying control unit 54 performs a drying operation to increase the surface temperature of a heat exchanging part of the evaporator 21. Once the refrigerating operation is stopped, the evaporator 21 arranged in the cargo space 2 will get wet. In particular, if a heat exchanging part (for example, a heat transfer tube or a fin) that performs heat exchange between a refrigerant and air gets wet and the wet state continues, mold may propagate. Accordingly, the drying control unit 54 performs a drying operation after a refrigerating operation is completed (stopped). The drying operation is intended to suppress the heat exchanging part of the evaporator 21 from getting wet and therefore is performed so as to increase the surface temperature of the heat exchanging part.

[0041] Specifically, when the detection unit 52 detects

that a refrigerating operation is completed and the determination unit 53 determines that the start condition for a drying operation is positively determined, the drying control unit 54 starts the drying operation. The determination unit 53 may be omitted, and the drying control unit 54 may perform control of start of a drying operation regardless of a determination result from the determination unit 53.

[0042] The drying operation is performed for a predetermined time (for example, 5 minutes), for example. The predetermined time may be set in accordance with the temperature of the cargo space 2 (that is, the ambient temperature of the evaporator 21). For example, when the temperature is low, the predetermined time is set longer. The drying operation may be performed until the cargo space 2 (that is, the ambient temperature of the evaporator 21) reaches a predetermined temperature. Alternatively, the drying operation may be performed until the cargo space 2 (that is, the ambient humidity of the evaporator 21) reaches a predetermined humidity.

[0043] Specifically, the drying operation is performed by hot gas defrost or heat pump heating. The hot gas defrost is a method of heating the evaporator 21 by guiding thereto a part of a hot gas ejected from the compressor 11 that is to be fed to the condenser 13. As long as the hot gas defrost is possible, the configuration of the refrigerant circuit 10 is not limited. The heat pump heating is a method of heating the evaporator 21 by controlling the flow in the refrigerant circuit 10 to cause a gas from the compressor 11 to flow to the evaporator 21. As long as the heat pump heating is possible, the configuration of the refrigerant circuit 10 is not limited.

[0044] For the drying operation, at least any one of heating by a heater, sending air by a fan, heating by warm water using heat of an engine, and sending air heated by an engine may be used.

[0045] In the heating by a heater, the heater is provided to a heat exchanging part and may be, for example, an electric heater. Fig. 6 illustrates a side view of the evaporator unit 4A. Note that the same applies to the evaporator unit 4B. The air of the cargo space 2 is passed through the evaporator 21A and returned to the cargo space 2 by the fan 23A. In such a configuration, heaters are arranged between the fan 23A and the evaporator 21A (a heater 31) and arranged on the exit side of the evaporator 21A (a heater 32), for example. The sending air by the fan 23A may or may not be performed. The example of heater arrangement and the number of arranged heaters of Fig. 6 are one example, and the configuration is not limited to that of Fig. 6 as long as the heat exchanging part can be dried.

[0046] In the sending air by a fan, the fan is a fan that supplies air outside the cargo space 2 to the evaporator 21. In a refrigerating operation, the evaporator 21 is in a low temperature state. Thus, it is also possible to dry the heat exchanging part of the evaporator 21 by sending the external air by a fan. Note that a fan may be used when it is also possible to send air by a fan provided

inside the evaporator unit 4A to dry the heat exchanging part of the evaporator 21.

[0047] In the heating by warm water using heat of an engine, the warm water is warm water warmed by the engine before cooled by a radiator 36 provided to the engine, for example. Fig. 7 is a diagram illustrating a configuration example of warm water supply. Fig. 7 is a diagram of the truck 1 when viewed from above. Since an engine 35 is provided to a cabin 38 including a driver's seat, the radiator 36 is provided for cooling the engine 35. Thus, a part of warm water before supplied to the radiator 36 after warmed by the engine 35 is supplied to a warm water coil 33 provided to the evaporator unit 4A via a valve 37 and a pump 34. Fig. 8 illustrates a side view of the evaporator unit 4A. The same applies to the evaporator unit 4B. The air of the cargo space 2 is passed through the evaporator 21A and returned to the cargo space 2 by the fan 23A. In such a configuration, the warm water coil 33 is arranged on the exit side of the evaporator 21A, for example. Warm water is supplied to the warm water coil 33, and thereby the heat exchanging part of the evaporator 21A is dried. The sending air by the fan 23A may or may not be performed. The example of heater arrangement and the number of arranged heaters of Fig. 8 are one example, and the configuration is not limited to that of Fig. 8 as long as the heat exchanging part can be dried. Further, as illustrated in Fig. 7, the warm water cooled by the warm water coil 33 is returned to the engine side.

[0048] For the sending air heated by an engine, residual heat of the engine is used. That is, air warmed by the engine is supplied to the heat exchanging part of the evaporator 21, and thereby the heat exchanging part is dried.

[0049] A drying method is not limited to the above as long as it is possible to dry the heat exchanging part of the evaporator 21.

[0050] One example of a drying control process performed by the above control system 50 will be described with reference to Fig. 9. Fig. 9 is a flowchart illustrating an example of a procedure of the drying control process according to the present embodiment. The flow illustrated in Fig. 9 is repeatedly performed at a predetermined control cycle when the refrigerating machine is running, for example. It is assumed that a cooler operation is being performed in the refrigerating machine.

[0051] First, it is detected that the cooler operation being performed is stopped (S101).

[0052] Next, it is determined whether or not the amount of electric power available for a drying operation is present (S102). For example, it is determined whether or not the remaining level of the battery 8 is higher than or equal to a threshold. If the amount of electric power available for a drying operation is not present (S102, NO), the process ends. The determination in S102 is determination for the start condition and may be omitted, or another start condition may be applied.

[0053] If the amount of electric power available for a

drying operation is present (S102, YES), the drying operation is performed (S103) In the drying operation, the surface temperature of the heat exchanging part of the evaporator is increased. The drying method is not limited.

[0054] In such a way, the drying control is performed in a transport refrigerating machine, and this can suppress mold from growing after completion of a refrigerating operation.

[0055] Although a pre-set drying method is performed in the flow of Fig. 9, a drying method may be selectable. For example, a drying method may be selected by an operator.

[0056] Further, a drying method may be selected in accordance with the available amount of electric power. In such a case, the control system 50 includes a selection unit configured to select a drying method in accordance with the amount of electric power available for a drying operation. That is, in the selection unit, multiple patterns of amounts of electric power and drying methods are associated with each other in advance, and a drying method is selected in accordance with the available amount of electric power when a drying operation is to be started. The drying control unit 54 performs the drying operation in accordance with the selected drying method. For example, drying may be performed by hot gas bypass if the amount of electric power is high (if it is greater than or equal to a threshold), and drying may be performed by sending air by a fan if the amount of electric power is low (if it is less than the threshold). The association between an amount of electric power and a drying method can be set as appropriate.

[0057] Although the condition for starting a drying operation has been described above, a drying operation may be performed based on another condition. For example, when the truck 1 is a transport vehicle that transports a cargo to a destination on an outward route, a drying operation is performed if the truck 1 travels on a return route where it is assumed that no cargo is loaded. In such a case, the control system 50 may include a return route detection unit configured to detect that the transport vehicle is on a return route after completion of transportation of a cargo to a destination. The drying control unit 54 then performs a drying operation if it is detected that the transport vehicle is on the return route. For return route detection, position information from GPS or the like may be used for determination, or an instruction indicating completion of cargo transportation (that is, traveling on a return route) may be received from the driver or the like. The detection method is not limited as long as it is possible to detect that a vehicle is on a return route.

[0058] When transportation of cargos is scheduled, a drying operation may be performed by using a timer at a predetermined time after completion of delivery.

[0059] The detection unit 52 is only required to detect that the refrigerating operation is completed and therefore may detect completion of the refrigerating operation based on position information (GPS) on the vehicle or information as to whether or not the operator is present

inside the vehicle. With respect to the information as to whether or not the operator is present, Bluetooth communication may be used, and when the communication with the driver is disconnected, it may be determined that no operator is present. Further, position information from GPS or the like may be used to detect that the vehicle returned to a delivery center, and a drying operation may then be performed.

[0060] With respect to the drying method, a drying agent may be provided, and drying may be performed by heating the drying agent or the like. When a movable louver is provided, the wind direction may be adjusted by the louver to facilitate the drying.

[0061] The truck 1 may have a deodorant device, which may be activated simultaneously with or independently of a drying operation.

[0062] As described above, according to a control system, a moving unit, a control method, and a control program of the present embodiment, in a refrigerating machine provided to the truck 1 (so-called transport refrigerating machine), by performing a drying operation to increase the surface temperature of a heat exchanging part of the evaporator 21 when a refrigerating operation of the cargo space 2 by the evaporator 21 is completed, it is possible to suppress the situation that the heat exchanging part is left wet and mold or the like grow.

[0063] With determination as to whether or not the amount of electric power available for a drying operation is present in the truck 1, it is possible to reliably perform a drying operation. The amount of electric power available for a drying operation in the truck 1 may be electric power stored in the truck 1 or may be electric power obtained by power generation. By relying on the operation state of a generator provided to the truck 1, it is possible to determine whether or not the available amount of electric power is present. By relying on the storage state of a storage battery provided to the truck 1, it is possible to determine whether or not the available amount of electric power is present.

[0064] When the truck 1 is a transport vehicle that transports a cargo to a destination on an outward route, it is assumed that no cargo is in the cargo space 2 on the return route because the transportation of the cargo to the destination was completed. Thus, a drying operation is performed when it is detected that the transport vehicle is on the return route, and thereby the drying operation can be performed without affecting the cargo.

[0065] The present disclosure is not limited to only the embodiment described above, and various modified embodiments are possible within the scope not departing from the spirit of the invention. Note that it is also possible to combine respective embodiments.

[0066] The control system, the moving unit, the control method, and the control program according to respective embodiments described above are recognized as follows, for example.

[0067] A control system (50) according to the present disclosure is a control system applied to a refrigerating

machine provided to a moving unit (1), and the control system includes: a refrigeration control unit (51) configured to perform a refrigerating operation on a cargo space (2) provided with an evaporator (21) of the refrigerating machine; a detection unit (52) configured to detect completion of the refrigerating operation; and a drying control unit (54) configured to perform a drying operation to increase a surface temperature of a heat exchanging part of the evaporator when the refrigerating operation is completed.

[0068] According to the control system of the present disclosure, in a refrigerating machine provided to the moving unit (so-called transport refrigerating machine), by performing a drying operation to increase the surface temperature of a heat exchanging part of the evaporator when a refrigerating operation of the cargo space by the evaporator is completed, it is possible to suppress the situation that the heat exchanging part is left wet and mold or the like grow.

[0069] The control system according to the present disclosure may include a determination unit (53) configured to determine whether or not an amount of electric power available for the drying operation is present in the moving unit, and the drying control unit may perform the drying operation when the amount of electric power available for the drying operation is present.

[0070] According to the control system of the present disclosure, with determination as to whether or not the amount of electric power available for a drying operation is present in the moving unit, it is possible to reliably perform a drying operation. The amount of electric power available for a drying operation in the moving unit may be electric power stored in the moving unit or may be electric power obtained by power generation.

[0071] In the control system according to the present disclosure, the determination unit may determine whether or not the amount of electric power available for the drying operation is present in accordance with an operation state of a generator provided to the moving unit.

[0072] According to the control system of the present disclosure, it is possible to determine whether or not the available amount of electric power is present by relying on the operation state of a generator provided to the moving unit. The operation state of the generator provided to the moving unit may be, for example, an active/stop state, the status of usage for another device, or the like.

[0073] In the control system according to the present disclosure, the determination unit may determine whether or not the amount of electric power available for the drying operation is present in accordance with a storage state of a storage battery (8) provided to the moving unit.

[0074] According to the control system of the present disclosure, it is possible to determine whether or not the available amount of electric power is present by relying on the storage state of a storage battery provided to the moving unit.

[0075] In the control system according to the present disclosure, the moving unit may be a transport vehicle

configured to transport a cargo to a destination on an outward route, the control system may include a return route detection unit configured to detect that the transport vehicle is on a return route after completion of transportation of the cargo to the destination, and the drying control unit may perform the drying operation when it is detected that the transport vehicle is on the return route.

[0076] According to the control system of the present disclosure, when the moving unit is a transport vehicle that transports a cargo to a destination on an outward route, it is assumed that no cargo is in the cargo space on the return route because the transportation of the cargo to the destination was completed. Thus, a drying operation is performed when it is detected that the transport vehicle is on the return route, and thereby the drying operation can be performed without affecting the cargo.

[0077] In the control system according to the present disclosure, the drying operation may be at least any one of heating by a heater, sending air by a fan, heating by warm water using heat of an engine, and sending air heated by an engine.

[0078] According to the control system of the present disclosure, the drying operation can be performed by heating by a heater, sending air by a fan, heating by warm water using heat of an engine, or sending air heated by an engine.

[0079] In the control system according to the present disclosure, the detection unit may detect completion of the refrigerating operation based on at least any one of position information on the moving unit and information as to whether or not an operator is present inside the moving unit.

[0080] According to the control system of the present disclosure, it is possible to estimate the state of the cargo space, such as delivery completion of a cargo from the cargo space, for example, by relying on the position information on the moving unit, and it is thus possible to detect completion of the refrigerating operation. It is possible to estimate the state of the cargo space, such as delivery completion of a cargo from the cargo space, for example, also by relying on the information as to whether or not the operator is present in the moving unit, and it is thus possible to detect the completion of the refrigerating operation.

[0081] The control system according to the present disclosure may include a selection unit configured to select a drying method in accordance with the amount of electric power available for the drying operation, and the drying control unit may perform the drying operation in accordance with the selected drying method.

[0082] According to the control system of the present disclosure, it is possible to perform a drying operation flexibly in accordance with the amount of electric power by selecting a drying method in accordance with the available amount of electric power. For example, drying may be performed by hot gas bypass if the amount of electric power is high, and drying may be performed by sending air by a fan if the amount of electric power is low.

[0083] A moving unit according to the present disclosure includes: a cargo space; a refrigerating machine provided to the cargo space; and the control system of any one of the above.

[0084] A control method according to the present disclosure is a control method applied to a refrigerating machine provided to a moving unit, and the control method includes steps of: performing a refrigerating operation on a cargo space provided with an evaporator of the refrigerating machine; detecting completion of the refrigerating operation; and performing a drying operation to increase a surface temperature of a heat exchanging part of the evaporator when the refrigerating operation is completed.

[0085] A control program according to the present disclosure is a control program applied to a refrigerating machine provided to a moving unit, and the control program is configured to cause a computer to perform: a process of performing a refrigerating operation on a cargo space provided with an evaporator of the refrigerating machine; a process of detecting completion of the refrigerating operation; and a process of performing a drying operation to increase a surface temperature of a heat exchanging part of the evaporator when the refrigerating operation is completed.

[List of Reference Symbols]

[0086]

1: truck (moving unit)
 2: cargo space
 3: condenser unit
 4A: evaporator unit
 4B: evaporator unit
 6: cabin controller
 7: alternator
 8: battery (storage battery)
 9: connector unit
 10: refrigerant circuit
 11: compressor
 13: condenser
 14: fan
 15: receiver
 16: dryer
 20: accumulator
 21A: evaporator
 21B: evaporator
 23A: fan
 23B: fan
 26: check valve
 27: check valve
 31: heater
 32: heater
 33: warm water coil
 34: pump
 35: engine
 36: radiator

37: valve
 38: cabin
 50: control system
 51: refrigeration control unit
 52: detection unit
 53: determination unit
 54: drying control unit
 1100: CPU
 1200: ROM
 1300: RAM
 1400: hard disk drive
 1500: communication unit
 1800: bus
 EV-A: expansion valve
 EV-B: expansion valve
 HD: line
 SV1-A: valve
 SV1-B: valve
 SV2-A: valve
 SV2-B: valve
 SV4: valve
 SV5: valve

25 Claims

1. A control system applied to a refrigerating machine provided to a moving unit, the control system comprising:

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a refrigeration control unit configured to perform a refrigerating operation on a cargo space provided with an evaporator of the refrigerating machine;

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a detection unit configured to detect completion of the refrigerating operation; and
 a drying control unit configured to perform a drying operation to increase a surface temperature of a heat exchanging part of the evaporator when the refrigerating operation is completed.

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2. The control system according to claim 1 further comprising a determination unit configured to determine whether or not an amount of electric power available for the drying operation is present in the moving unit, wherein the drying control unit performs the drying operation when the amount of electric power available for the drying operation is present.

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3. The control system according to claim 2, wherein the determination unit determines whether or not the amount of electric power available for the drying operation is present in accordance with an operation state of a generator provided to the moving unit.

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4. The control system according to claim 2, wherein the determination unit determines whether or not the amount of electric power available for the drying op-

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eration is present in accordance with a storage state of a storage battery provided to the moving unit.

5. The control system according to any one of claims 1 to 4, wherein the moving unit is a transport vehicle configured to transport a cargo to a destination on an outward route,

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the control system further comprising a return route detection unit configured to detect that the transport vehicle is on a return route after completion of transportation of the cargo to the destination,

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wherein the drying control unit performs the drying operation when it is detected that the transport vehicle is on the return route.

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6. The control system according to any one of claims 1 to 5, wherein the drying operation is at least any one of heating by a heater, sending air by a fan, heating by warm water using heat of an engine, and sending air heated by an engine.

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7. The control system according to any one of claims 1 to 6, wherein the detection unit detects completion of the refrigerating operation based on at least any one of position information on the moving unit and information as to whether or not an operator is present inside the moving unit.

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8. The control system according to any one of claims 2 to 4 further comprising a selection unit configured to select a drying method in accordance with the amount of electric power available for the drying operation,

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wherein the drying control unit performs the drying operation in accordance with the selected drying method.
9. A moving unit comprising:

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a cargo space;
a refrigerating machine provided to the cargo space; and
the control system according to any one of claims 1 to 8.

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10. A control method applied to a refrigerating machine provided to a moving unit, the control method comprising:

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performing a refrigerating operation on a cargo space provided with an evaporator of the refrigerating machine;
detecting completion of the refrigerating operation;

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and
performing a drying operation to increase a surface temperature of a heat exchanging part of

the evaporator when the refrigerating operation is completed.

11. A control program applied to a refrigerating machine provided to a moving unit, the control program being configured to cause a computer to perform:

a process of performing a refrigerating operation on a cargo space provided with an evaporator of the refrigerating machine;
a process of detecting completion of the refrigerating operation; and
a process of performing a drying operation to increase a surface temperature of a heat exchanging part of the evaporator when the refrigerating operation is completed.

FIG. 1

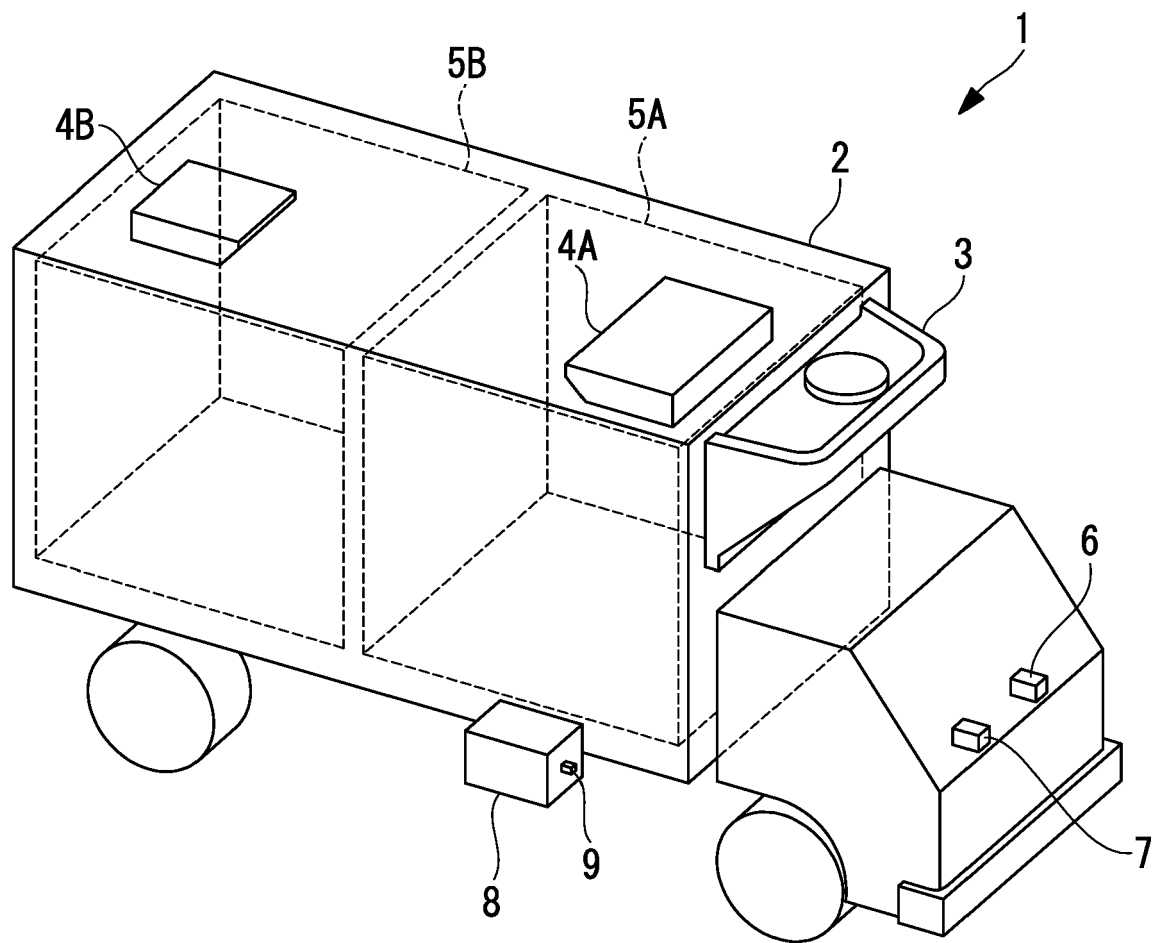


FIG. 2

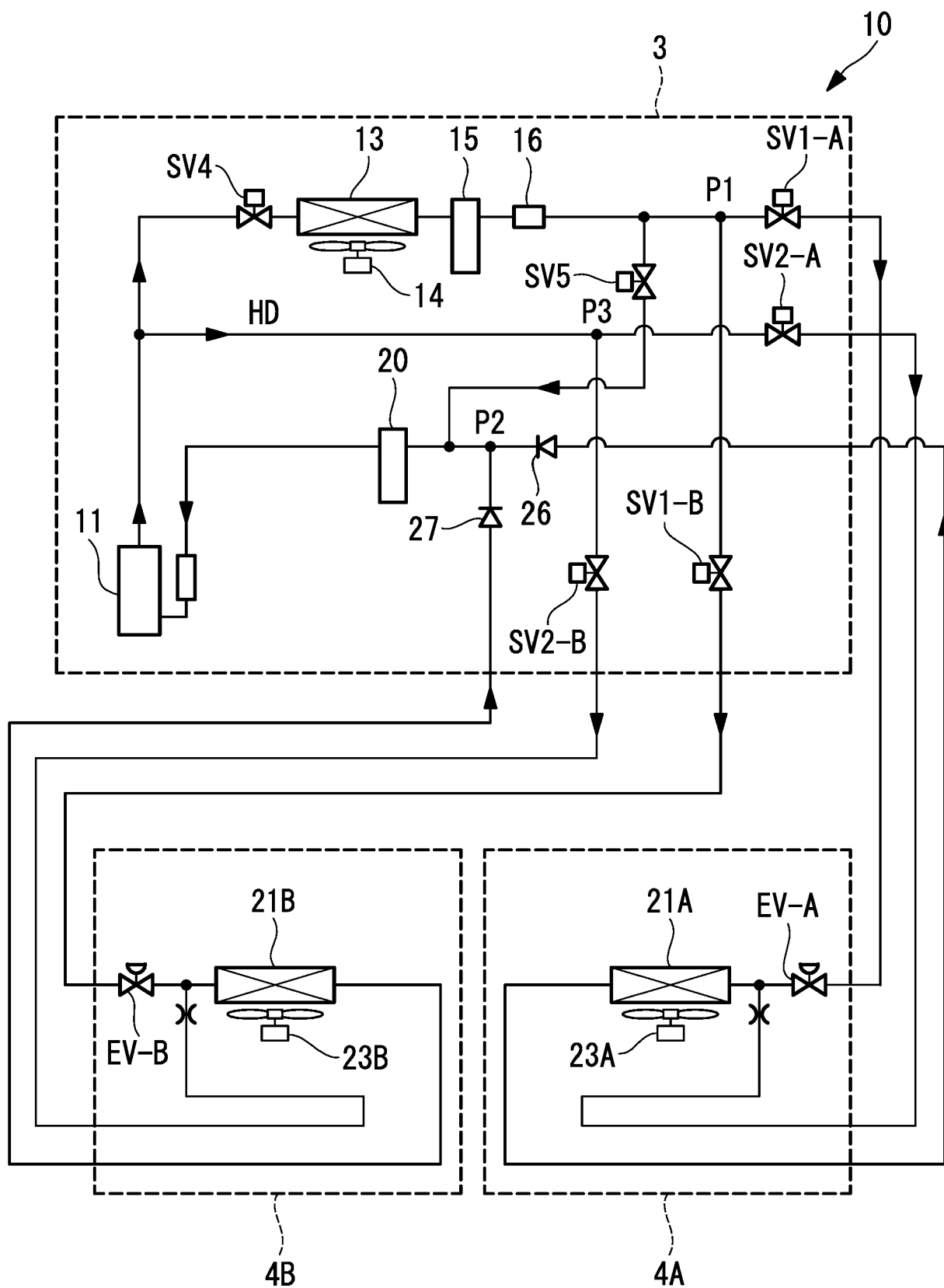


FIG. 3

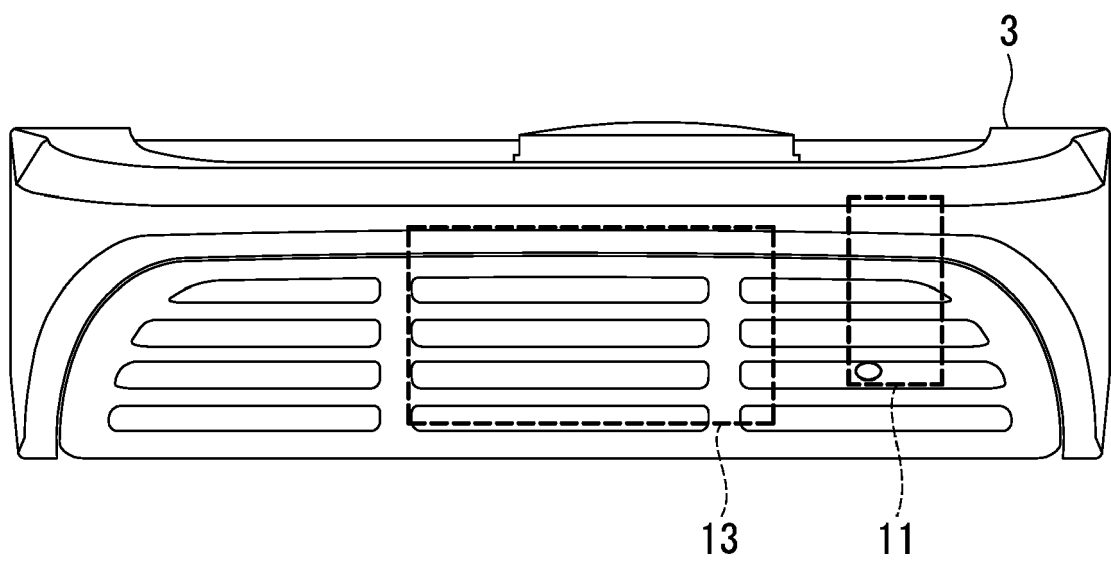


FIG. 4

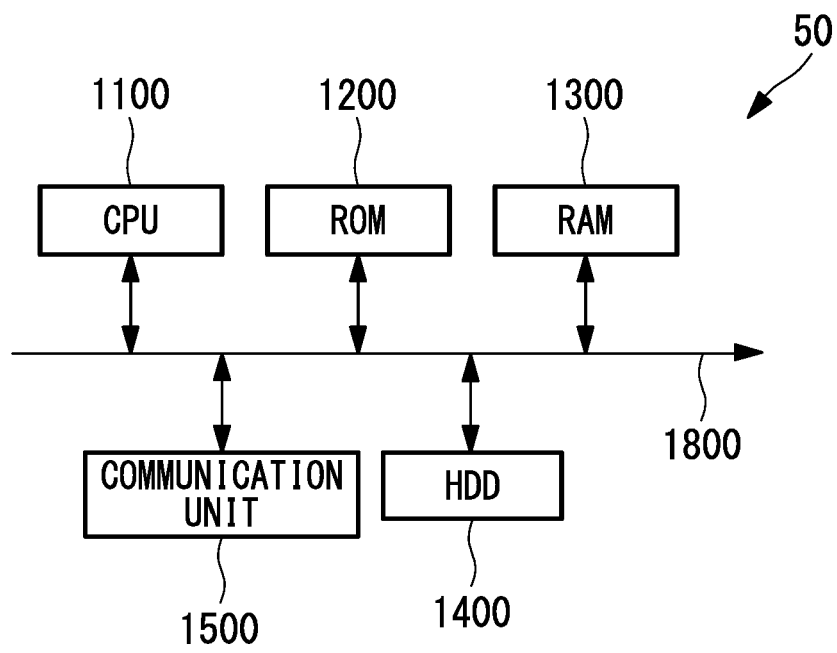


FIG. 5

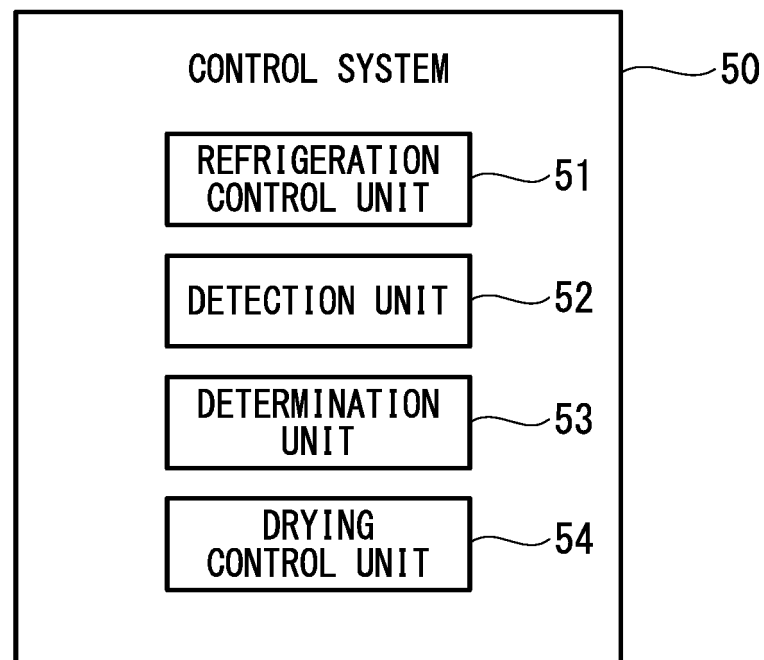


FIG. 6

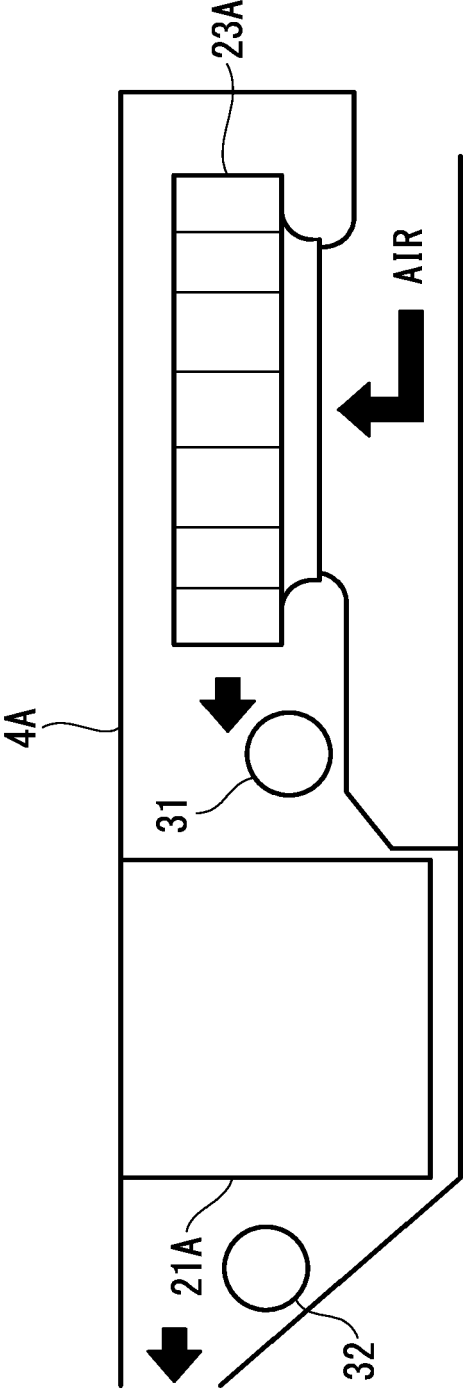


FIG. 7

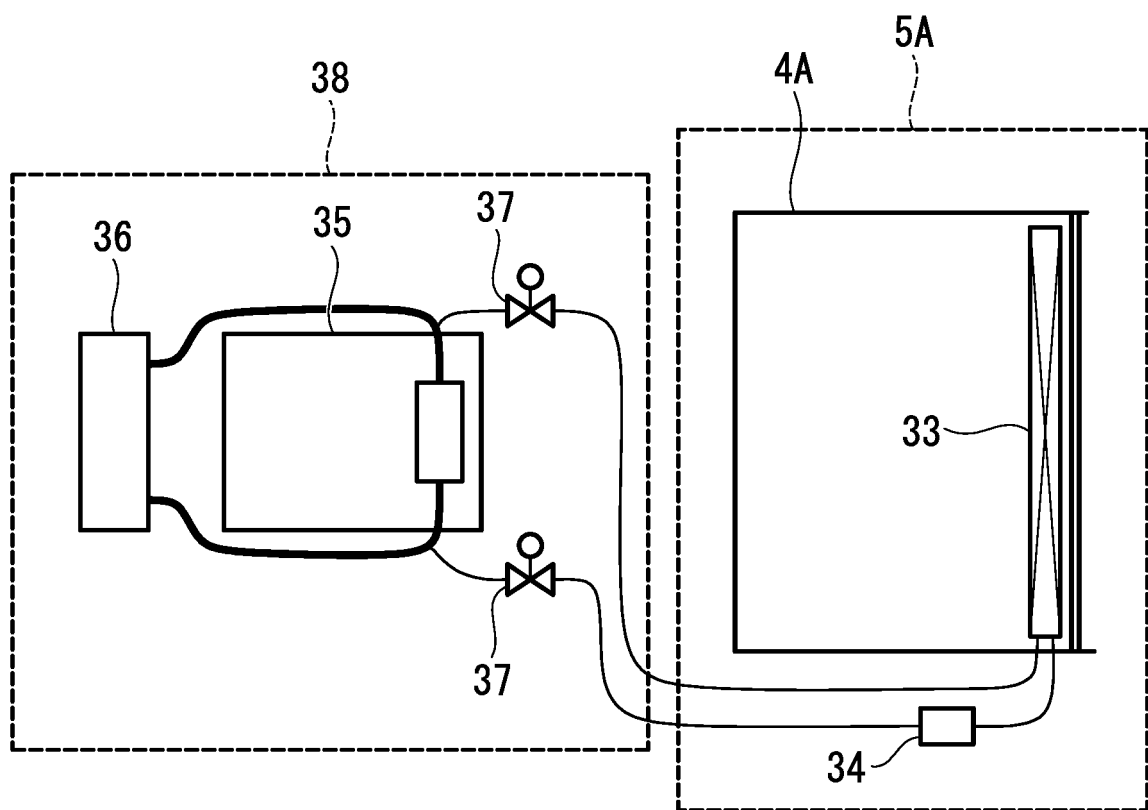


FIG. 8

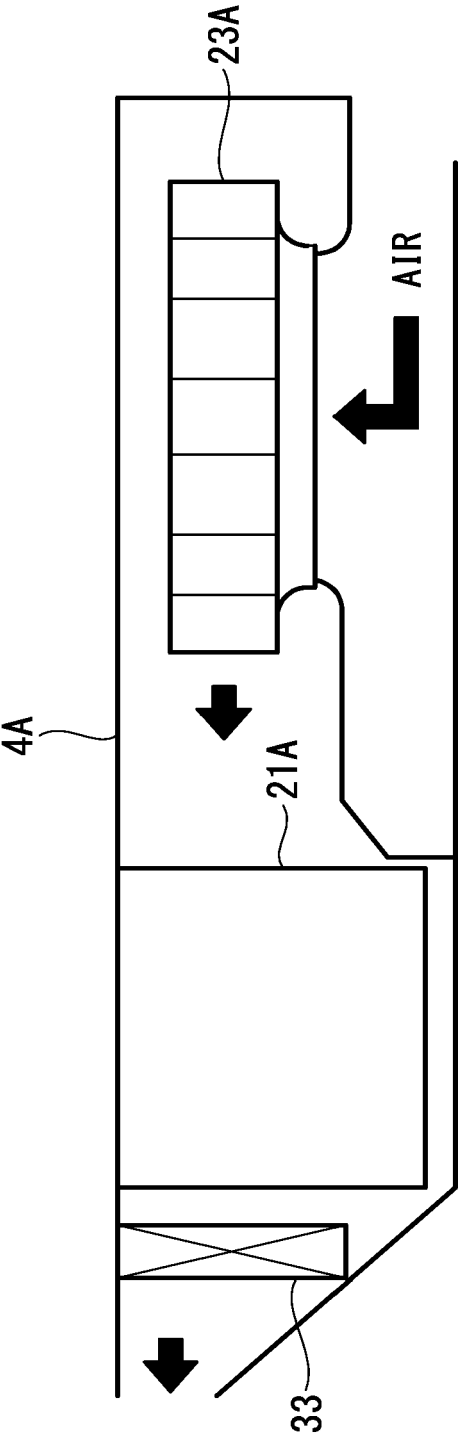
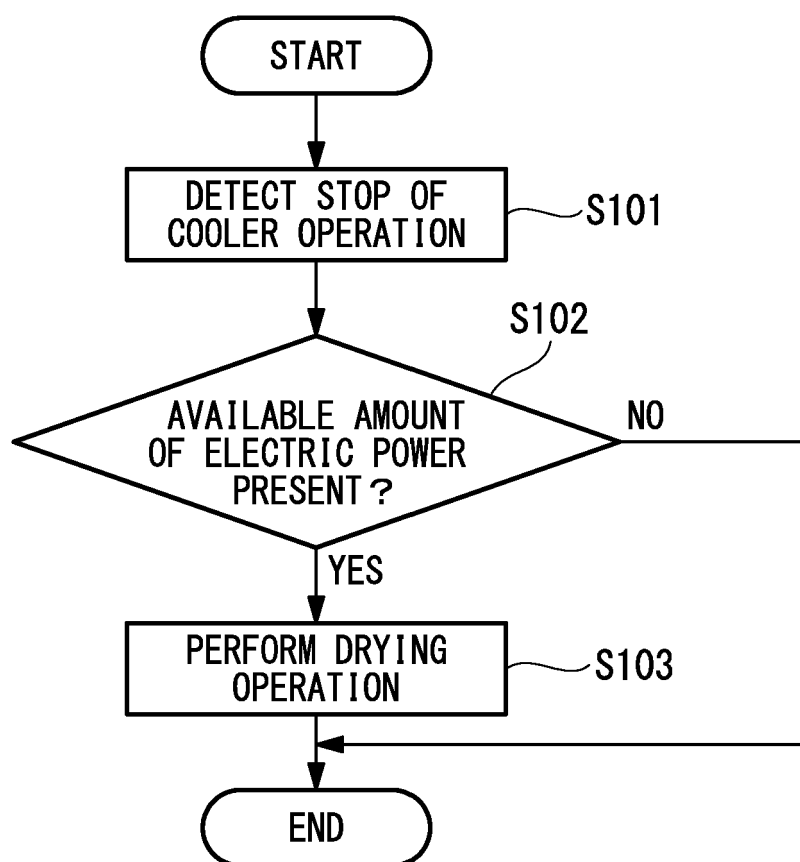


FIG. 9





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