(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 4 047 279 A1

(12) **EUROPEAN PATENT APPLICATION**
published in accordance with Art. 153(4) EPC

(43) Date of publication:
24.08.2022 Bulletin 2022/34

(21) Application number: **19949062.4**

(22) Date of filing: **16.10.2019**

(51) International Patent Classification (IPC):
F24F 11/32 *(2018.01)*

(52) Cooperative Patent Classification (CPC):
F24F 11/32

(86) International application number:
PCT/JP2019/040622

(87) International publication number:
WO 2021/074991 (22.04.2021 Gazette 2021/16)

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR
Designated Extension States:
BA ME
Designated Validation States:
KH MA MD TN

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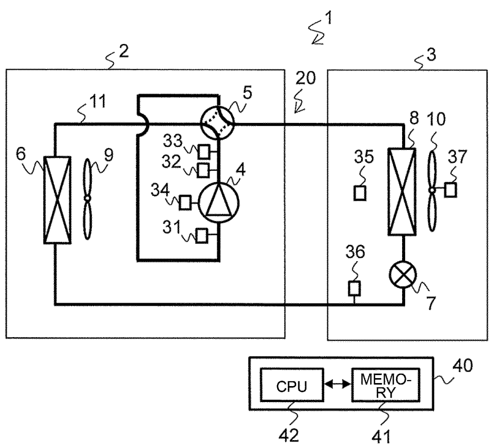
(54) **AIR CONDITIONING APPARATUS**

(57) An air-conditioning apparatus has a detection unit configured to detect an abnormality of a device and a controller configured to, when an abnormality is detected by the detection unit, stop the device and then restart the device. The controller has a time changing unit configured to change, from a reference time that is predetermined, on the basis of a type of an abnormality detected by the detection unit, a restarting time from time when the device is stopped to time when the device is restarted and a restarting unit configured to restart the device when the restarting time set by the time changing unit elapses after the device is stopped.

FIG. 1



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Description

Technical Field

[0001] The present disclosure relates to an air-conditioning apparatus configured to condition air in an air-conditioned space.

Background Art

[0002] Some air-conditioning apparatus monitors an operational state and, when it detects that an abnormality has occurred, stops operation completely and turns on an indicating lamp to notify a user that the abnormality has occurred. In addition, in some air-conditioning system that has a management device that monitors a plurality of air-conditioning apparatuses, an air-conditioning apparatus that has a detected abnormality stops its operation completely and outputs information that the abnormality has occurred to the management device through a communication unit.

[0003] In an air-conditioning apparatus, however, a detected abnormality may be based on false detection in some cases. As an example of false detection, a case is conceivable in which a sensor that detects whether an abnormality has occurred receives an input signal of an abnormal value caused by a noise or other factor instantaneously. As another example, a pressure sensor may falsely detect, as an abnormal state, a state in which refrigerant is unevenly distributed in a refrigerant circuit transiently and a pressure of refrigerant discharged from a compressor thus increases temporarily. In a case in which the sensor receives an input signal of an abnormal value instantaneously, the air-conditioning apparatus normally continues its operation after the air-conditioning apparatus is restarted and then the sensor detects a normal value. In a case in which an abnormality is detected as refrigerant is unevenly distributed, the air-conditioning apparatus normally continues its operation by distributing the refrigerant evenly. Consequently, once an air-conditioning apparatus stops completely even by false detection, efficient air conditioning of an air-conditioned space is disturbed.

[0004] An air-conditioning-apparatus monitoring system has been proposed that stops an air-conditioning apparatus that has a detected abnormality temporarily and restarts the air-conditioning apparatus automatically after predetermined time elapses to prevent the air-conditioning apparatus being stopped completely when a temporal abnormality is detected (see, for example, Patent Literature 1). An air-conditioning apparatus disclosed in Patent Literature 1 has means that stops a compressor in an abnormal state and restarts the compressor automatically after predetermined time elapses and allows restart up to predetermined times.

Citation List

Patent Literature

[0005] Patent Literature 1: Japanese Patent No. 3445904

Summary of Invention

Technical Problem

[0006] In the system disclosed in Patent Literature 1, however, every time an air-conditioning apparatus has an abnormality, operation of the air-conditioning apparatus is stopped for a fixed time irrespective of a type of the abnormality. A problem remains in that, when the fixed time from stop to restart of the air-conditioning apparatus is set long so that many types of an abnormality are covered, stop time during which air-conditioning operation remains stopped is longer than required.

[0007] The present disclosure is made to solve such a problem described above and to provide an air-conditioning apparatus that prevents air-conditioning operation being stopped for longer time than required.

Solution to Problem

[0008] An air-conditioning apparatus according to an embodiment of the present disclosure has a detection unit configured to detect an abnormality of a device and a controller configured to, when an abnormality is detected by the detection unit, stop the device and then restart the device. The controller has a time changing unit configured to change, from a reference time that is predetermined, on the basis of a type of an abnormality detected by the detection unit, a restarting time from time when the device is stopped to time when the device is restarted and a restarting unit configured to restart the device when the restarting time set by the time changing unit elapses after the device is stopped.

Advantageous Effects of Invention

[0009] According to an embodiment of the present disclosure, air-conditioning operation is prevented from being stopped for longer time than required as a restarting time of a device is changed on the basis of a type of an abnormality that occurs at the device.

Brief Description of Drawings

[0010]

[Fig. 1] Fig. 1 is a refrigerant circuit diagram that illustrates an exemplary configuration of an air-conditioning apparatus according to Embodiment 1.

[Fig. 2] Fig. 2 is a functional block diagram that illustrates an exemplary configuration of a controller illustrated in Fig. 1.

[Fig. 3] Fig. 3 is a diagram that illustrates another exemplary configuration of a sensor that detects an abnormality of a compressor illustrated in Fig. 1.

[Fig. 4] Fig. 4 is a flowchart that illustrates an exemplary operational procedure of the air-conditioning apparatus illustrated in Fig. 1.

[Fig. 5] Fig. 5 is a refrigerant circuit diagram that illustrates an exemplary configuration of an air-conditioning apparatus according to Modification 1.

[Fig. 6] Fig. 6 is a functional block diagram that illustrates an exemplary configuration of a controller illustrated in Fig. 5.

[Fig. 7] Fig. 7 is a refrigerant circuit diagram that illustrates an exemplary configuration of an air-conditioning apparatus according to Embodiment 2.

[Fig. 8] Fig. 8 is a functional block diagram that illustrates an exemplary configuration of a controller illustrated in Fig. 7.

[Fig. 9] Fig. 9 is a flowchart that illustrates an exemplary operational procedure of the air-conditioning apparatus according to Embodiment 2.

Description of Embodiments

Embodiment 1

[0011] A configuration of an air-conditioning apparatus according to Embodiment 1 is described below. Fig. 1 is a refrigerant circuit diagram that illustrates an exemplary configuration of an air-conditioning apparatus according to Embodiment 1. Fig. 2 is a functional block diagram that illustrates an exemplary configuration of a controller illustrated in Fig. 1. An air-conditioning apparatus 1 has a heat source-side unit 2 that provides a heat source, a load-side unit 3 that conditions air in an air-conditioned space by use of the heat source, a detection unit 30 (see Fig. 2) that detects an abnormality that occurs at the air-conditioning apparatus 1, and a controller 40. In Embodiment 1, a case is described in which the air-conditioned space is an inside of a room to which the load-side unit 3 is installed.

[0012] The heat source-side unit 2 has a compressor 4 that compresses and discharges refrigerant, a four-way valve 5 that switches flow directions of refrigerant, a heat source-side heat exchanger 6 that allows outdoor air and refrigerant to exchange heat with each other, and a fan 9 that supplies outdoor air to the heat source-side heat exchanger 6. The load-side unit 3 has a load-side heat exchanger 8 that allows indoor air and refrigerant to exchange heat with each other, an expansion valve 7 that depressurizes and expands refrigerant, and a fan 10 that supplies indoor air to the load-side heat exchanger 8.

[0013] The compressor 4 is, for example, an inverter-driven compressor whose capacity is changeable. The expansion valve 7 is, for example, an electronic expansion valve. The heat source-side heat exchanger 6 and the load-side heat exchanger 8 are, for example, fin-and-tube heat exchangers. The compressor 4, the four-way valve 5, the heat source-side heat exchanger 6, the expansion valve 7, and the load-side heat exchanger 8 are connected via refrigerant pipes 11 and thus form a refrigerant circuit 20 through which refrigerant is circulated. The compressor 4, the four-way valve 5, the expansion valve 7, the fan 9, and the fan 10 are each connected to the controller 40 via an unillustrated signal line.

[0014] The detection unit 30 has a suction pressure sensor 31, a discharge pressure sensor 32, a discharge temperature sensor 33, an electric abnormality detection sensor 34, a room temperature sensor 35, a pressure sensor 36, and an electric abnormality detection sensor 37. The suction pressure sensor 31, the discharge pressure sensor 32, the discharge temperature sensor 33, the electric abnormality detection sensor 34, the room temperature sensor 35, the pressure sensor 36, and the electric abnormality detection sensor 37 are each connected to the controller 40 via an unillustrated signal line.

[0015] The suction pressure sensor 31 has an unillustrated pressure sensor that detects a suction pressure Pin that is a pressure of refrigerant to be sucked into the compressor 4 and an unillustrated comparison circuit that compares the suction pressure Pin with a predetermined high-pressure threshold value HIth and compares the suction pressure Pin with a predetermined low-pressure threshold value LIth. In addition, the unillustrated comparison circuit of the suction pressure sensor 31 outputs an abnormality signal that indicates that an abnormality has occurred to the controller 40 in a case in which the detected suction pressure Pin is higher than or equal to the high-pressure threshold value HIth. The unillustrated comparison circuit of the suction pressure sensor 31 outputs an abnormality signal to the controller 40 in a case in which the detected suction pressure Pin is lower than or equal to the low-pressure threshold value LIth. The values HIth and LIth have a relation of HIth > LIth.

[0016] The discharge pressure sensor 32 has an unillustrated pressure sensor that detects a discharge pressure Pout that is a pressure of refrigerant discharged from the compressor 4 and an unillustrated comparison circuit that compares the discharge pressure Pout with a predetermined high-pressure threshold value HOth and compares the discharge pressure Pout with a predetermined low-pressure threshold value LOth. The unillustrated comparison circuit of the discharge pressure sensor 32 outputs an abnormality signal to the controller 40 in a case in which the detected discharge pressure Pout is higher than or equal to the high-pressure threshold value HOth. In addition, the unillustrated comparison circuit of the discharge pressure sensor 32 outputs an abnormality signal to the controller 40 in a case in which the detected discharge pressure Pout is lower than or equal to the low-pressure threshold value LOth. The values HOth and LOth have a relation of HOth > LOth.

[0017] The discharge temperature sensor 33 has an unillustrated temperature sensor that detects a discharge temperature Tout that is a temperature of refrigerant discharged from the compressor 4 and an unillustrated comparison circuit that compares the discharge temperature Tout with a predetermined refrigerant temperature threshold value RTth1. The unillustrated comparison circuit of the discharge temperature sensor 33 outputs an abnormality signal to the controller 40 in a case in which the detected discharge temperature Tout is higher than or equal to the refrigerant temperature threshold value RTth1.

[0018] The pressure sensor 36 has an unillustrated pressure sensor that detects a pressure MP of refrigerant that flows through a refrigerant pipe 11 between the heat source-side heat exchanger 6 and the expansion valve 7 and an unillustrated comparison circuit that compares the pressure MP of the refrigerant with a predetermined middle pressure threshold value MPth. The unillustrated comparison circuit of the pressure sensor 36 outputs an abnormality signal to the controller 40 in a case in which the detected pressure MP of the refrigerant is higher than or equal to the middle pressure threshold value MPth.

[0019] The room temperature sensor 35 has an unillustrated temperature sensor that detects a room temperature and an unillustrated comparison circuit that compares the room temperature with a predetermined room temperature threshold value RTth2. The unillustrated temperature sensor of the room temperature sensor 35 detects a room temperature at predetermined intervals and outputs a detected value to the controller 40. In addition, the unillustrated comparison circuit of the room temperature sensor 35 outputs an abnormality signal to the controller 40 in a case in which the room temperature is higher than or equal to the room temperature threshold value RTth2.

[0020] The electric abnormality detection sensor 34 has an unillustrated current sensor that detects a current CI that flows through a winding wire of an unillustrated motor provided to the compressor 4 and an unillustrated voltage sensor that detects a voltage CV applied to the winding wire. In addition, the electric abnormality detection sensor 34 has an unillustrated current comparison circuit that compares the current CI with a predetermined current threshold value Ith1 and an unillustrated voltage comparison circuit that compares the voltage CV with a predetermined voltage threshold value Vth1. The unillustrated current comparison circuit of the electric abnormality detection sensor 34 outputs an abnormality signal to the controller 40 in a case in which the detected current CI is higher than or equal to the current threshold value Ith1. The unillustrated voltage comparison circuit of the electric abnormality detection sensor 34 outputs an abnormality signal to the controller 40 in a case in which the detected voltage CV is higher than or equal to the voltage threshold value Vth1.

[0021] The electric abnormality detection sensor 37 has an unillustrated current sensor that detects a current FI that flows through a winding wire of an unillustrated motor provided to the fan 10 and an unillustrated voltage sensor that detects a voltage FV applied to the winding wire. In addition, the electric abnormality detection sensor 37 has an unillustrated current comparison circuit that compares the current FI with a predetermined current threshold value Ith2 and an unillustrated voltage comparison circuit that compares the voltage CV with a predetermined voltage threshold value Vth2. The unillustrated current comparison circuit of the electric abnormality detection sensor 37 outputs an abnormality signal to the controller 40 in a case in which the detected current FI is higher than or equal to the current threshold value Ith2. The unillustrated voltage comparison circuit of the electric abnormality detection sensor 37 outputs an abnormality signal to the controller 40 in a case in which the detected voltage FV is higher than or equal to the voltage threshold value Vth2.

[0022] Fig. 3 is a diagram that illustrates another exemplary configuration of a sensor that detects an abnormality of the compressor illustrated in Fig. 1. The detection unit 30 illustrated in Fig. 1 may have a pressure difference sensor 38 illustrated in Fig. 3 in place of the suction pressure sensor 31 and the discharge pressure sensor 32. The pressure difference sensor 38 is connected to the controller 40 via an unillustrated signal line.

[0023] The pressure difference sensor 38 has an unillustrated pressure sensor that detects a pressure difference ΔP between a suction pressure and a discharge pressure and an unillustrated comparison circuit that compares the pressure difference ΔP with a predetermined high threshold value PDHth and compares the pressure difference ΔP with a predetermined low threshold value PDLth. The unillustrated comparison circuit of the pressure difference sensor 38 outputs an abnormality signal to the controller 40 in a case in which the pressure difference ΔP is larger than or equal to the high threshold value PDHth. The unillustrated comparison circuit of the pressure difference sensor 38 outputs an abnormality signal to the controller 40 in a case in which the pressure difference ΔP is smaller than or equal to the low threshold value PDLth. The values PDHth and PDLth have a relation of PDHth > PDLth.

[0024] Next, a configuration of the controller 40 illustrated in Fig. 1 is described below. As illustrated in Fig. 1, the controller 40 includes a memory 41 and a central processing unit (CPU) 42. The memory 41 has a read only memory (ROM) that stores a program and a random access memory (RAM) that stores data of a calculation process of the CPU 42. The CPU 42 is also referred to as a processor, a microprocessor, a microcomputer, and a digital signal processor (DSP). The CPU 42 reads out a program stored in a ROM and executes a process in accordance with the program.

[0025] As illustrated in Fig. 2, the controller 40 includes a refrigeration cycle control unit 51, a time changing unit 52, a restarting unit 53, and a timer 54. The timer 54 measures time and transmits information of the measured time to the restarting unit 53.

[0026] The refrigeration cycle control unit 51 controls the four-way valve 5 according to an operation mode such as cooling operation and heating operation of the load-side unit 3. The refrigeration cycle control unit 51 controls a refrigeration cycle of the refrigerant circuit 20 on the basis of a room temperature and a set temperature. Specifically, the refrigeration cycle control unit 51 controls an operation frequency of the compressor 4, an opening degree of the expansion valve 7, and rotation frequencies of the fans 9 and 10 so that the room temperature and the set temperature are in the same predetermined range. The set temperature is set by a user with the controller 40 via an unillustrated remote controller.

[0027] The time changing unit 52 judges whether the detection unit 30 has detected an abnormality at predetermined intervals. When the time changing unit 52 receives an abnormality signal from the detection unit 30, the time changing unit 52 changes, from a predetermined reference time tref, on the basis of a type of a detected abnormality, a restarting time tret from time when a device that has the abnormality is stopped to time when the device is restarted. In addition, when the time changing unit 52 receives an abnormality signal from the detection unit 30, the time changing unit 52 identifies a target device of which the restarting time tret is to be changed on the basis of a type of an abnormality. The time changing unit 52 transmits information of the target device to be restarted and the restarting time tret to the restarting unit 53.

[0028] For example, in a case where the device is the compressor 4, the time changing unit 52 may use, to judge whether the compressor 4 has an abnormality, any one of a discharge temperature Tin, the suction pressure Pin, and the discharge pressure Pout. In addition, the time changing unit 52 may use, to judge whether the compressor 4 has an abnormality, the pressure difference ΔP between the suction pressure Pin and the discharge pressure Pout.

[0029] A specific example is described below in which the restarting time tret is changed on the basis of a type of an abnormality. As the specific example, a case is described below in which a device to be restarted on the basis of a type of a detected abnormality is the compressor 4. First, a case is described below in which a pressure difference ΔP detected by the pressure difference sensor 38 illustrated in Fig. 3 is used to set the restarting time tret.

[0030] In a case in which the time changing unit 52 receives, from the pressure difference sensor 38, an abnormality signal that indicates that a pressure difference ΔP is larger than or equal to the high threshold value PDHth, the time changing unit 52 sets the restarting time tret longer than the reference time tref. Such a restarting time tret in a case in which a pressure difference ΔP is larger than or equal to the high threshold value PDHth is defined as a restarting time tret1. On the other hand, in a case in which the time changing unit 52 receives, from the pressure difference sensor 38, an abnormality signal that indicates that a pressure difference ΔP is smaller than or equal to the low threshold value PDLth, the time changing unit 52 sets the restarting time tret shorter than the reference time tref. Such a restarting time tret in a case in which a pressure difference ΔP is smaller than or equal to the low threshold value PDLth is defined as a restarting time tret2. This is because, in a case in which the compressor 4 actually has an abnormality and a pressure difference ΔP is thus not sufficiently obtained, the compressor 4 has be restarted earlier than in a case in which a pressure difference ΔP is sufficient and whether the compressor 4 has an abnormality has to be conclusively determined in an early stage. The low threshold value PDLth is, for example, 0.2 MPa.

[0031] Next, a case is described below in which a discharge pressure Pout detected by the discharge pressure sensor 32 illustrated in Fig. 1 is used to set the restarting time tret. The high-pressure threshold value HOth is, for example, 2.0 MPa. The low-pressure threshold value LOth is, for example, 0.3 MPa. In a case in which the time changing unit 52 receives, from the discharge pressure sensor 32, an abnormality signal that indicates that a discharge pressure Pout is higher than or equal to the high-pressure threshold value HOth, the time changing unit 52 sets the restarting time tret longer than the reference time tref. Such a restarting time tret in a case in which a discharge pressure Pout is higher than or equal to the high-pressure threshold value HOth is defined as a restarting time tret3. In addition, in a case in which the time changing unit 52 receives, from the discharge pressure sensor 32, an abnormality signal that indicates that a discharge pressure Pout is lower than or equal to the low-pressure threshold value LOth, the time changing unit 52 sets the restarting time tret longer than the reference time tref. Such a restarting time tret in a case in which a discharge pressure Pout is lower than or equal to the low-pressure threshold value LOth is defined as a restarting time tret4.

[0032] In a case in which an abnormality is in a discharge pressure Pout, when the restarting time tret is short, the possibility is high that the compressor 4 may fail to be restarted, and the restarting time tret thus has to be long. As one example of factors that cause a discharge pressure Pout to be outside an allowable range between the high-pressure threshold value HOth and the low-pressure threshold value LOth, a case is conceivable in which refrigerant is unevenly distributed in the refrigerant circuit 20. In a case in which refrigerant is unevenly distributed in the refrigerant circuit 20, an amount of refrigerant sucked into the compressor 4 per unit time is unstable, the discharge pressure Pout is temporarily outside the allowable range. In this case, by setting the restarting time tret long, such an uneven distribution of the refrigerant in the refrigerant circuit 20 is reduced and the discharge pressure Pout after the compressor 4 is restarted is thus also stable.

[0033] Next, a case is described below in which a discharge temperature Tout detected by the discharge temperature sensor 33 illustrated in Fig. 1 is used to set the restarting time tret. The refrigerant temperature threshold value RTth1 is, for example, 95 degrees C. In a case in which the time changing unit 52 receives, from the discharge temperature sensor 33, an abnormality signal that indicates that a discharge temperature Tout is higher than or equal to the refrigerant temperature threshold value RTth1, the time changing unit 52 sets the restarting time tret longer than the reference time tref. Such a restarting time tret in a case in which a discharge temperature Tout is higher than or equal to the refrigerant temperature threshold value RTth1 is defined as a restarting time tret5.

[0034] Furthermore, the restarting time has a relation of tret3 < tret1. In a case in which a discharge pressure Pout is higher than or equal to the high-pressure threshold value HOth, a pressure difference ΔP may also increase. In a case in which a discharge pressure Pout is higher than or equal to the high-pressure threshold value HOth and a pressure difference ΔP is larger than or equal to the high threshold value PDHth, the time changing unit 52 may thus set the restarting time tret to the restarting time tret1. In addition, the restarting time has a relation of tret4 < tret1. In a case in which a discharge pressure Pout is lower than or equal to the low-pressure threshold value LOth, a pressure difference ΔP may also increase. In a case in which a discharge pressure Pout is lower than or equal to the low-pressure threshold value LOth and a pressure difference ΔP is larger than or equal to the high threshold value PDHth, the time changing unit 52 may thus set the restarting time tret to the restarting time tret1. In addition, the restarting time has a relation of tret5 < tret1. In a case in which a discharge temperature Tout is higher than or equal to the refrigerant temperature threshold value RTth1, a pressure difference ΔP may also increase. In a case in which a discharge temperature Tout is higher than or equal to the refrigerant temperature threshold value RTth and a pressure difference ΔP is larger than or equal to the high threshold value PDHth, the time changing unit 52 may thus set the restarting time tret to the restarting time tret1. The restarting time may have a relation of tret3 = tret4 = tret5. In a case where a discharge pressure Pout is high, the possibility exists that the compressor 4 may be broken, and, to secure the compressor 4, the restarting time tret is thus desirable to have a relation of tret3 > tret5 > tret4.

[0035] The restarting unit 53 and the timer 54 illustrated in Fig. 2 are described below. The restarting unit 53 refers to time measured by the timer 54 and judges whether an elapsed time t that has elapsed after a device is stopped is longer than or equal to the set restarting time tret. When the restarting unit 53 receives information of the target device to be restarted and the restarting time tret from the time changing unit 52, the restarting unit 53 stops the target device to be restarted and then, when the restarting time tret received from the time changing unit 52 has elapsed, restarts the stopped device.

[0036] In addition, the restarting unit 53 counts the number of times of restart Cret that is the number of times of restart of the device and judges whether the counted number of times of restart Cret has reached a predetermined reference number of times Cref. The reference number of times Cref is, for example, two to five times. When the number of times of restart Cret has reached the reference number of times Cref, the restarting unit 53 conclusively determines that the abnormality is not falsely detected and the target device to be restarted actually has the abnormality. When the restarting unit 53 conclusively determines that the device has an abnormality, the restarting unit 53 stops restart of the target device.

[0037] A case is described above with reference to Fig. 1 in which the controller 40 and components such as the compressor 4 are each connected to each other via an unillustrated signal line. Furthermore, a communication connection means is not limited to cable communications and may be radio communications and may be a means obtained by combining cable communications and radio communications. A communication connection means between the controller 40 and each sensor is also not limited to cable communications and may be radio communications and may be a means obtained by combining cable communications and radio communications. Furthermore, each sensor of the suction pressure sensor 31, the discharge pressure sensor 32, and the discharge temperature sensor 33 may output a detected value to the controller 40 not only in a case in which an abnormality signal is output but also at predetermined intervals. In this case, the refrigeration cycle control unit 51 may use at least one value of the suction pressure, the discharge pressure, and the discharge temperature to control the refrigeration cycle.

[0038] Furthermore, the detection unit 30 does not have to have all of the suction pressure sensor 31, the discharge pressure sensor 32, the discharge temperature sensor 33, the electric abnormality detection sensor 34, the room temperature sensor 35, the pressure sensor 36, and the electric abnormality detection sensor 37. The detection unit 30 is only required to have one or more of the suction pressure sensor 31, the discharge pressure sensor 32, the discharge temperature sensor 33, the electric abnormality detection sensor 34, the room temperature sensor 35, the pressure sensor 36, and the electric abnormality detection sensor 37.

[0039] Next, operation of the air-conditioning apparatus 1 according to Embodiment 1 is described below. Fig. 4 is a flowchart that illustrates an exemplary operational procedure of the air-conditioning apparatus according Embodiment 1. The time changing unit 52 judges whether the detection unit 30 has detected an abnormality at predetermined intervals (step S101). When the time changing unit 52 receives an abnormality signal from the detection unit 30, the time changing unit 52 set the restarting time tret on the basis of a type of the abnormality (step S102). In addition, the time changing unit 52 identifies a target device of which the restarting time tret is to be changed on the basis of the type of the abnormality.

[0040] In step S102 illustrated in Fig. 4, when the time changing unit 52 sets the restarting time tret, the time changing unit 52 transmits information of the set restarting time tret to the restarting unit 53. The restarting unit 53 stops a device on the basis of the type of the abnormality (step S103). Specifically, the restarting unit 53 stops electric power supply to the device. The restarting unit 53 refers to time measured by the timer 54 and judges whether an elapsed time t that has elapsed after the device is stopped is longer than or equal to the set restarting time tret (step S104).

[0041] When the elapsed time t has reached the restarting time tret, the restarting unit 53 restarts the stopped device (step S105). Specifically, the restarting unit 53 restarts electric power supply to the stopped device. The restarting unit 53 counts the number of times of restart Cret and judges whether the counted number of times of restart Cret is larger than or equal to the reference number of times Cref (step S106). In a case in which the number of times of restart Cret has not reached the reference number of times Cref, the controller 40 returns to step S101. In a case in which the number of times of restart Cret has reached the reference number of times Cref, the restarting unit 53 conclusively determines that an abnormality has occurred (step S107).

[0042] A case is described above with reference to Fig. 4 in which a value that indicates an abnormality that occurs at the compressor 4 is the discharge pressure Pout, the pressure difference ΔP, or the discharge temperature Tout. Furthermore, the value that indicates a type of an abnormality is not limited to these detected value. For example, in a case in which the time changing unit 52 receives, from the electric abnormality detection sensor 34, an abnormality signal that indicates that an over-current flows, the time changing unit 52 makes the restarting time tret shorter than the reference time tref. As one example of factors that cause an over-current to flow through the winding wire of the unillustrated motor provided to the compressor 4, a case is conceivable in which liquid-state refrigerant stagnates in a refrigerant pipe 11 that is at a refrigerant-suction side of the compressor 4. In such an abnormal state, even when time elapses, an abnormality is continuously detected. To secure the compressor 4, it is more important to repeat restart many times in an early stage than to make the restarting time tret longer for the compressor 4. For this reason, the time changing unit 52 makes the restarting time tret shorter than the reference time tref, as described above.

[0043] In addition, a case is described above with reference to Fig. 4 in which a device related to a detected abnormality is the compressor 4. Furthermore, a device related to a detected abnormality is not limited to the compressor 4. A device related to a detected abnormality may be the fan 10. A sensor equivalent to the electric abnormality detection sensor 37 may be provided to the fan 9. In addition, a target to be monitored for whether an abnormality has occurred may be a control board on which a circuit that controls devises such as the compressor 4 and may be an unillustrated motor provided to devises such as the compressor 4. For example, in a case in which the time changing unit 52 receives an abnormality signal from the electric abnormality detection sensor 37, the time changing unit 52 judges that the abnormality is an abnormality that has occurred at the fan 10. As the fan 10 is less dangerous than the compressor 4, which operates to compress refrigerant, in a case in which the time changing unit 52 receives an abnormality signal from the electric abnormality detection sensor 37, the time changing unit 52 may set the restarting time tret longer than the reference time tref.

[0044] Furthermore, in a case in which a communication abnormality may occur, the time changing unit 52 may change the restarting time tret. The communication abnormality is, for example, an abnormality in a case in which the refrigeration cycle control unit 51 does not receive a response signal from the compressor 4 to a control signal transmitted to the compressor 4. In this case, the refrigeration cycle control unit 51 transmits an abnormality signal that an abnormality has occurred in commutation between the refrigeration cycle control unit 51 and the compressor 4 to the time changing unit 52. In a case in which a cause of the communication abnormality is a short circuit that has occurred in an unillustrated communication circuit, even when time elapses, an abnormality state remains. It is thus more effective to perform restart in an early stage than to make the restarting time tret longer. For this reason, the time changing unit 52 makes the restarting time tret shorter than the reference time tref. The detection unit 30 may have an unillustrated sensor that detects a communication abnormality in each of the devices that communicate with the controller 40.

[0045] A restarting time is considered below in a case in which an abnormality of, for example, a compressor that is among a plurality of devises provided to some air-conditioning apparatus has been detected. When the detected abnormality related to the compressor is falsely detected, no more abnormality is detected after the compressor is stopped for a short time such as several seconds and then the compressor is restarted. However, in a case in which the abnormality is not falsely detected and the compressor has an actual abnormality, longer restarting time is required than one in the case of false detection. While the compressor is stopped, however, operation of the air-conditioning apparatus is also stopped. Once a restarting time matched to a serious abnormality that requires long restarting time is set to all detected abnormalities at the compressor among a plurality of types of abnormalities that may occur at the compressor, operation of the air-conditioning apparatus has to be stopped longer than required even in a case of a minor abnormality.

[0046] The air-conditioning apparatus according to Embodiment 1 has the detection unit 30 configured to detect an abnormality of a device such as the compressor 4 and the controller 40 configured to, when an abnormality is detected by the detection unit 30, stop the device and then restart the device. The controller 40 includes the time changing unit 52 and the restarting unit 53. The time changing unit 52 changes, from the predetermined reference time tref, on the basis of a type of an abnormality detected by the detection unit 30, the restarting time tret from time when the device is stopped to time when the device is restarted. The restarting unit 53 stops the device and then, when the restarting time tret set by the time changing unit 52 has elapsed, restarts the device.

[0047] According to Embodiment 1, the restarting time of a device is changed on the basis of a type of an abnormality that occurs at the device. Air-conditioning operation is therefore prevented from being stopped for longer time than required. For example, in a case in which the type of the abnormality is an abnormality that the pressure difference ΔP between a suction pressure and a discharge pressure at the compressor 4 is high, the restarting time tret is set shorter than the reference time tref. For this reason, non-operation time during which operation of the compressor 4 is stopped is shorter than one in the case in which the restarting time tret is equal to the reference time tref, so that stop time during which air-conditioning operation remains stopped is reduced.

(Modification 1)

[0048] An air-conditioning apparatus according to Modification 1 has an auxiliary devise provided to at least one of a plurality of devices provided to the air-conditioning apparatus 1 and the auxiliary device supports operation of the at least one device. Modification 1 is described below with a case in which the auxiliary devise of the compressor 4 is provided to the air-conditioning apparatus 1.

[0049] A configuration of an air-conditioning apparatus 1a according to Modification 1 is described below. Fig. 5 is a refrigerant circuit diagram that illustrates an exemplary configuration of an air-conditioning apparatus according to Modification 1. Fig. 6 is a functional block diagram that illustrates an exemplary configuration of a controller illustrated in Fig. 5. The heat source-side unit 2 of the air-conditioning apparatus 1a according to Modification 1 has a compressor 4a and a compressor 4b. The compressors 4a and 4b are arranged in parallel to each other and connected to the four-way valve 5. The compressor 4b operates as an auxiliary device to support operation of the compressor 4a. The compressor 4b stops while the compressor 4a is in operation. Furthermore, the compressor 4b may also be in operation while the compressor 4a is in operation. In this case, the refrigeration cycle control unit 51 controls the compressors 4a and 4b such that a load on the compressor 4b is lighter than a load on the compressor 4a.

[0050] When the time changing unit 52 receives an abnormality signal related to the compressor 4a from the detection unit 30, the time changing unit 52 sets the restarting time tret shorter than the reference time tref. This is because, by shortening time to judge whether an abnormality has occurred at the compressor 4a, in a case in which an abnormality has occurred at the compressor 4a, restarts the compressor 4b, which is the auxiliary devise, in an early stage so that air-conditioning operation is allowed to continue.

[0051] Furthermore, as the compressors 4a and 4b in Modification 1 each have the same configuration of the compressor 4 described with reference to Fig. 1, their detailed description is omitted. In addition, as the suction pressure sensors 31a and 31b each have the same configuration of the suction pressure sensor 31 described with reference to Fig. 1, their detailed description is omitted. As the discharge pressure sensors 32a and 32b each have the same configuration of the discharge pressure sensor 32 described with reference to Fig. 1, their detailed description is omitted. As the discharge temperature sensors 33a and 33b each have the same configuration of the discharge temperature sensor 33 described with reference to Fig. 1, their detailed description is omitted. As the electric abnormality detection sensors 34a and 34b each have the same configuration of the electric abnormality detection sensor 34 described with reference to Fig. 1, their detailed description is omitted.

[0052] Next, operation of the air-conditioning apparatus 1a according to Modification 1 is described below with reference to Fig. 4. A case is described below in which the compressor 4a is in operation and the compressor 4b stops. As step S101 is the same process described with reference to Fig. 4, its description is omitted.

[0053] In step S102, the time changing unit 52 receives an abnormality signal from the detection unit 30 and, in a case in which a type of the abnormality is related to the compressor 4a, sets the restarting time tret shorter than the reference time tref. The time changing unit 52 transmits information of the set restarting time tret to the restarting unit 53. The restarting unit 53 stops the compressor 4a (step S103). The restarting unit 53 refers to time measured by the timer 54 and judges whether an elapsed time t that has elapsed after the compressor 4a is stopped is longer than or equal to the restarting time tret (step S104).

[0054] When the elapsed time t has reached the restarting time tret, the restarting unit 53 restarts the compressor 4a (step S105). The restarting unit 53 counts the number of times of restart Cret and judges whether the counted number of times of restart Cret is larger than or equal to the reference number of times Cref (step S106). When the number of times of restart Cret has reached the reference number of times Cref, the restarting unit 53 conclusively determines that an abnormality has occurred (step S107). The restarting unit 53 then performs emergency operation in which the compressor 4b, which is the auxiliary devise, is made to operate in place of the compressor 4a. Specifically, the restarting unit 53 stops restart of the compressor 4a and start the compressor 4b. Furthermore, the restarting unit 53 transmits information that the compressor 4a is stopped and the compressor 4b is started to the refrigeration cycle control unit 51.

[0055] The air-conditioning apparatus 1a according to Modification 1 has the compressor 4b, which backs up operation of the compressor 4a. According to Modification 1, the air-conditioning apparatus 1a conclusively determines in short time whether a detected abnormality is falsely detected and whether an abnormality has occurred at the compressor 4a and shifts in short time to the emergency operation, in which the compressor 4b, which is the auxiliary device, is made to operate in place of the compressor 4a. Time during which the air-conditioning apparatus 1a has to be stopped is thus shortened. As a result, comfortable air-conditioned environment remains inside a room and comfort of a user is not impaired.

[0056] A case is described above in Modification 1 in which an auxiliary device provided to the air-conditioning apparatus 1a is the compressor 4b. Furthermore, a device to which an auxiliary device is provided is not limited to the compressor. In the air-conditioning apparatus 1a, an auxiliary device may be provided to one or each of the fans 9 and 10.

Embodiment 2

[0057] An air-conditioning apparatus according to Embodiment 2 has a plurality of heat source-side units. In Embodiment 2, the same reference signs are added to the same components as those described in Embodiment 1 and detailed description of these components is omitted.

[0058] A configuration of an air-conditioning apparatus according to Embodiment 2 is described below. Fig. 7 is a refrigerant circuit diagram that illustrates an exemplary configuration of an air-conditioning apparatus according to Embodiment 2. Fig. 8 is a functional block diagram that illustrates an exemplary configuration of a controller illustrated in Fig. 7.

[0059] As illustrated in Fig. 7, an air-conditioning apparatus 1b has heat source-side units 2a and 2b and the load-side unit 3. The heat source-side units 2a and 2b are arranged in parallel to each other and connected to the load-side unit 3. In Embodiment 2, the heat source-side unit 2b operates as an auxiliary device to support operation of the heat source-side unit 2a. The heat source-side unit 2b stops while the heat source-side unit 2a is in operation. The heat source-side unit 2b may also be in operation while the heat source-side unit 2a is in operation. In this case, the refrigeration cycle control unit 51 controls the heat source-side units 2a and 2b such that a load on the heat source-side unit 2b is lighter than a load on the heat source-side unit 2a.

[0060] When the time changing unit 52 receives an abnormality signal related to a device provided to the heat source-side unit 2a from the detection unit 30, the time changing unit 52 sets the restarting time tret shorter than the reference time tref. This is because, by shortening time to judge whether an abnormality has occurred at the heat source-side unit 2a, in a case in which an abnormality has occurred at the heat source-side unit 2a, restarts the heat source-side unit 2b, which is the auxiliary devise, in an early stage so that air-conditioning operation is allowed to continue.

[0061] Furthermore, as the four-way valves 5a and 5b in Embodiment 2 each have the same configuration of the four-way valve 5 described with reference to Fig. 1, their detailed description is omitted. As the heat source-side heat exchangers 6a and 6b each have the same configuration of the heat source-side heat exchanger 6 described with reference to Fig. 1, their detailed description is omitted. As the fans 9a and 9b each have the same configuration of the fan 9 described with reference to Fig. 1, their detailed description is omitted. As the refrigerant pipes 11a and 11b each have the same configuration of the refrigerant pipes 11 described with reference to Fig. 1, their detailed description is omitted.

[0062] In addition, a case is described in Embodiment 2 in which the controller 40 controls the heat source-side units and 2a and 2b. Furthermore, the controller 40 may be provided to each of the heat source-side units 2a and 2b. Furthermore, a case is described in Embodiment 2 in which the air-conditioning apparatus 1b has one heat source-side unit 2b as the auxiliary device of the heat source-side unit 2a. Furthermore, the air-conditioning apparatus 1b may have two or more auxiliary devices.

[0063] Next, operation of the air-conditioning apparatus 1b according to Embodiment 2 is described below. Fig. 9 is a flowchart that illustrates an exemplary operational procedure of the air-conditioning apparatus according Embodiment 2. As step S201 is the same process of step S101 described with reference to Fig. 4, its description is omitted from Embodiment 2.

[0064] In step S202, the time changing unit 52 receives an abnormality signal from the detection unit 30 and, in a case in which a type of an abnormality is related to the heat source-side unit 2a, sets the restarting time tret shorter than the reference time tref. The time changing unit 52 transmits information of the set restarting time tret to the restarting unit 53. The restarting unit 53 stops the heat source-side unit 2a (step S203). The restarting unit 53 refers to time measured by the timer 54 and judges whether an elapsed time t that has elapsed after the heat source-side unit 2a is stopped is longer than or equal to the restarting time tret (step S204).

[0065] When the elapsed time t has reached the restarting time tret, the restarting unit 53 restarts the heat source-side unit 2a (step S205). The restarting unit 53 counts the number of times of restart Cret of the heat source-side unit 2a and judges whether the counted number of times of restart Cret is larger than or equal to the reference number of times Cref (step S206). When the number of times of restart Cret has reached the reference number of times Cref, the restarting unit 53 conclusively determines that an abnormality has occurred (step S207). The restarting unit 53 then performs emergency operation in which the heat source-side unit 2b, which is the auxiliary device of the heat source-side unit 2a, is made to operate in place of the heat source-side unit 2a (step S208). Specifically, the restarting unit 53 stops restart of the heat source-side unit 2a and start the heat source-side unit 2b. Furthermore, the restarting unit 53 transmits information that the heat source-side unit 2a is stopped and the heat source-side unit 2b is started to the refrigeration cycle control unit 51.

[0066] The air-conditioning apparatus 1b according to Embodiment 2 has the heat source-side unit 2b, which backs up operation of the heat source-side unit 2a. According to Embodiment 2, the air-conditioning apparatus 1b conclusively determines in short time whether a detected abnormality is falsely detected and whether an abnormality has occurred at the heat source-side unit 2a and shifts in short time to the emergency operation, in which the heat source-side unit 2b, which is the auxiliary device, is made to operate in place of the heat source-side unit 2a. Time during which the air-conditioning apparatus 1b has to be stopped is thus shortened. As a result, comfortable air-conditioned environment remains inside a room and comfort of a user is not impaired.

[0067] A case is described in Embodiments 1 and 2 in which the air-conditioning apparatus 1, 1a, and 1b are each a split model that has a heat source-side unit and a load-side unit split from each other. Furthermore, the air-conditioning apparatus may be a remote model in which a compressor is mounted to an indoor unit. In addition, a case is described in Embodiments 1 and 2 in which the detection unit 30 judges whether an abnormality occurs. Furthermore, the time changing unit 52 may judge whether an abnormality occurs by comparing a detected value of each sensor with a threshold value set for the detected value.

Reference Signs List

[0068] 1, 1a, 1b: air-conditioning apparatus, 2, 2a, 2b: heat source-side unit, 3: load-side unit, 4, 4a, 4b: compressor, 5, 5a, 5b: four-way valve, 6, 6a, 6b: heat source-side heat exchanger, 7: expansion valve, 8: load-side heat exchanger, 9, 9a, 9b: fan, 10: fan, 11, 11a, 11b: refrigerant pipe, 20: refrigerant circuit, 30: detection unit, 31, 31a, 31b: suction pressure sensor, 32, 32a, 32b: discharge pressure sensor, 33, 33a, 33b: discharge temperature sensor, 34, 34a, 34b: electric abnormality detection sensor, 35: room temperature sensor, 36: pressure sensor, 37: electric abnormality detection sensor, 38: pressure difference sensor, 40: controller, 41: memory, 42: CPU, 51: refrigeration cycle control unit, 52: time changing unit, 53: restarting unit, 54: timer

Claims

1. An air-conditioning apparatus comprising:

a detection unit configured to detect an abnormality of a device; and
a controller configured to, when an abnormality is detected by the detection unit, stop the device and then restart the device,
the controller having
a time changing unit configured to change, from a reference time that is predetermined, based on a type of an abnormality detected by the detection unit, a restarting time from time when the device is stopped to time when the device is restarted, and
a restarting unit configured to restart the device when the restarting time set by the time changing unit elapses after the device is stopped.

2. The air-conditioning apparatus of claim 1, wherein

the device comprises a compressor,
the detection unit has a pressure sensor configured to detect a discharge pressure that is a pressure of refrigerant discharged from the compressor, and
the time changing unit is configured to make the restarting time longer than the reference time in a case in which the discharge pressure is higher than or equal to a high-pressure threshold value that is predetermined or in a case in which the discharge pressure is lower than or equal to a low-pressure threshold value that is smaller than the high-pressure threshold value.

3. The air-conditioning apparatus of claim 1, wherein

the device comprises a compressor,
the detection unit has a pressure sensor configured to detect a pressure difference between a suction pressure that is a pressure of refrigerant to be sucked into the compressor and a discharge pressure that is a pressure of refrigerant discharged from the compressor, and
the time changing unit is configured to make the restarting time longer than the reference time in a case in which the pressure difference is larger than or equal to a high threshold value that is predetermined and make the restarting time shorter than the reference time in a case in which the pressure difference is smaller than or equal to a low threshold value that is smaller than the high threshold value.

4. The air-conditioning apparatus of claim 1, wherein

the device comprises a compressor,
the detection unit has a temperature sensor configured to detect a discharge temperature that is a temperature of refrigerant discharged from the compressor, and
the time changing unit is configured to make the restarting time shorter than the reference time in a case in which the discharge temperature is higher than or equal to a refrigerant temperature threshold value that is predetermined.

5. The air-conditioning apparatus of claim 1, further comprising

an auxiliary device configured to support operation related to the device, wherein
the time changing unit is configured to make the restarting time of the device shorter than the reference time in a case in which the type of the abnormality is an abnormality related to the device, and
the restarting unit is configured to restart the device the number of times that is predetermined and then, when the restarting unit conclusively determines that the device has an abnormality, stop restart of the device and start the auxiliary device.

6. The air-conditioning apparatus of claim 1, further comprising a plurality of heat source-side units that each have a compressor that corresponds to the device, wherein

the time changing unit is configured to set the restarting time shorter than the reference time of which a heat source-side unit of the plurality of heat source-side units that has a device that has the detected abnormality is a target device to be restarted, and
the restarting unit is configured to restart the heat source-side unit that is the target device to be restarted the number of times that is predetermined and then, when the restarting unit conclusively determines that the heat source-side unit that is the target device to be restarted has an abnormality, stop restart of the heat source-side unit that is the target device to be restarted and start at least one heat source-side unit of the plurality of heat source-side units that is not the heat source-side unit that is the target device.

FIG. 1

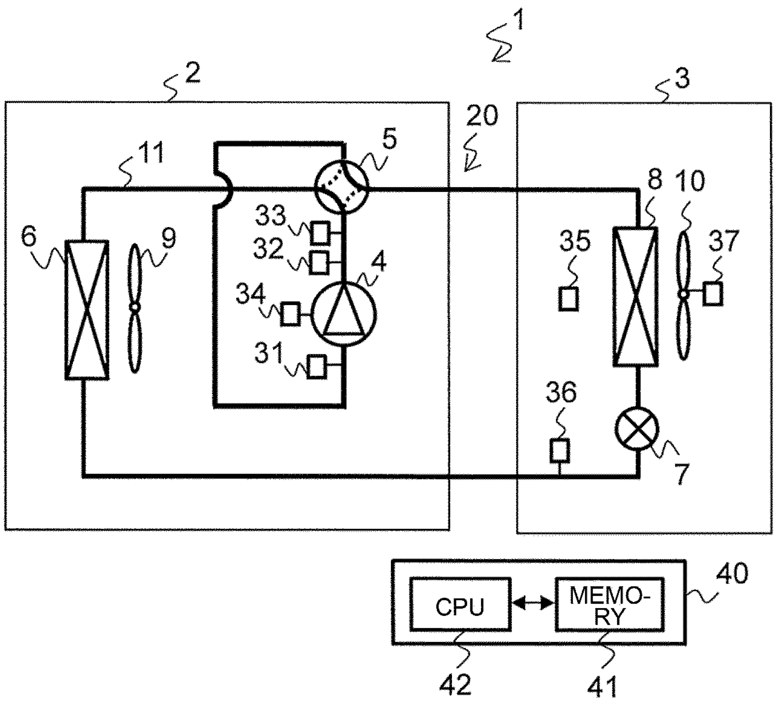

1
2
3
20
11
5
6
9
33
32
4
34
31
8
10
35
37
36
7
CPU
MEMO-RY
40
42
41

FIG. 2

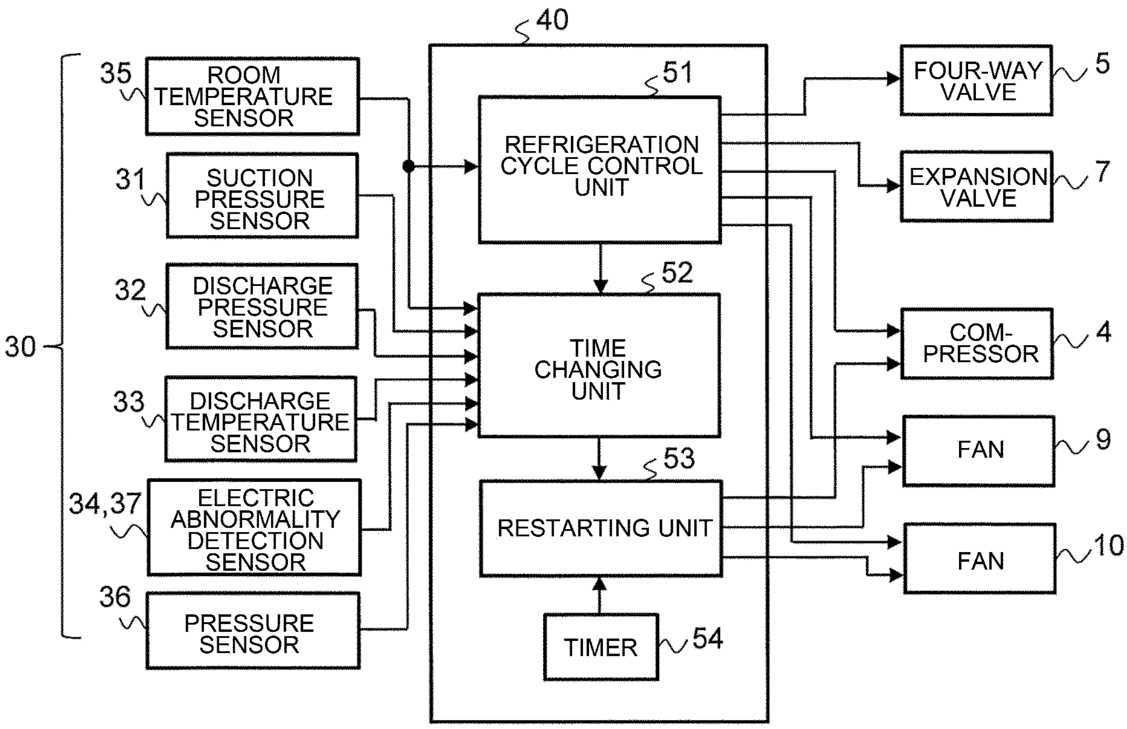

40
30
35
ROOM TEMPERATURE SENSOR
31
SUCTION PRESSURE SENSOR
32
DISCHARGE PRESSURE SENSOR
33
DISCHARGE TEMPERATURE SENSOR
34,37
ELECTRIC ABNORMALITY DETECTION SENSOR
36
PRESSURE SENSOR
51
REFRIGERATION CYCLE CONTROL UNIT
52
TIME CHANGING UNIT
53
RESTARTING UNIT
TIMER
54
FOUR-WAY VALVE
5
EXPANSION VALVE
7
COM-PRESSOR
4
FAN
9
FAN
10

FIG. 3

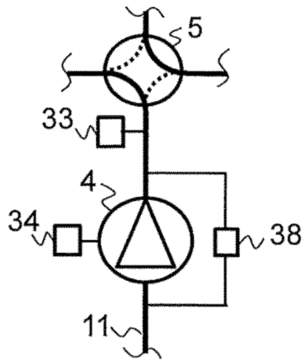

5
33
4
34
38
11

FIG. 4

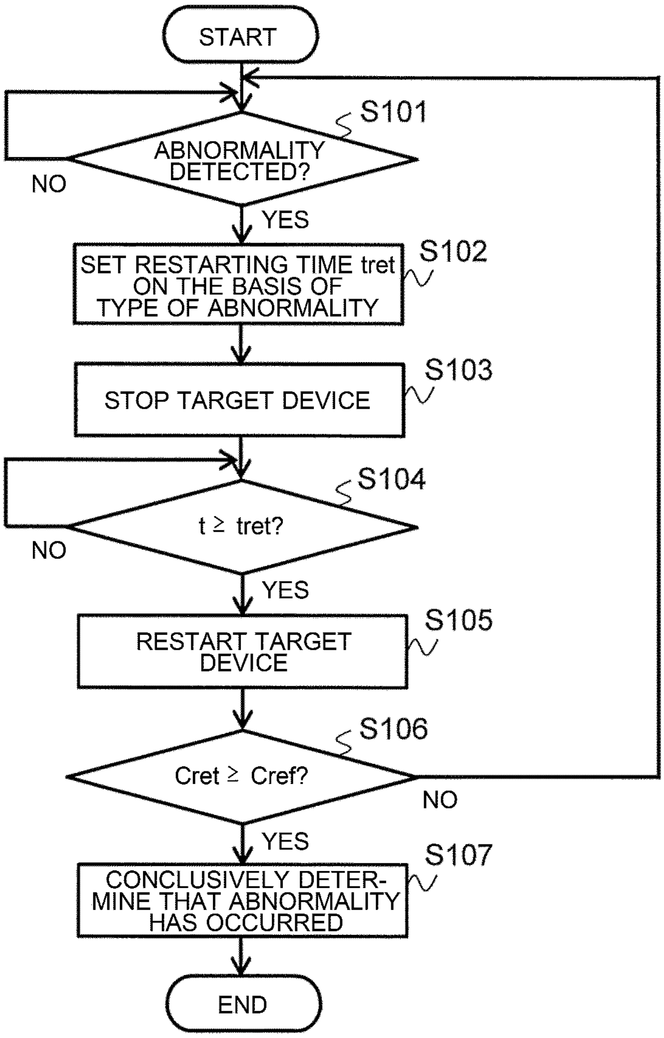

START
S101
ABNORMALITY DETECTED?
NO
YES
S102
SET RESTARTING TIME tret ON THE BASIS OF TYPE OF ABNORMALITY
S103
STOP TARGET DEVICE
S104
t ≥ tret?
NO
YES
S105
RESTART TARGET DEVICE
S106
Cret ≥ Cref?
NO
YES
S107
CONCLUSIVELY DETERMINE THAT ABNORMALITY HAS OCCURRED
END

FIG. 5

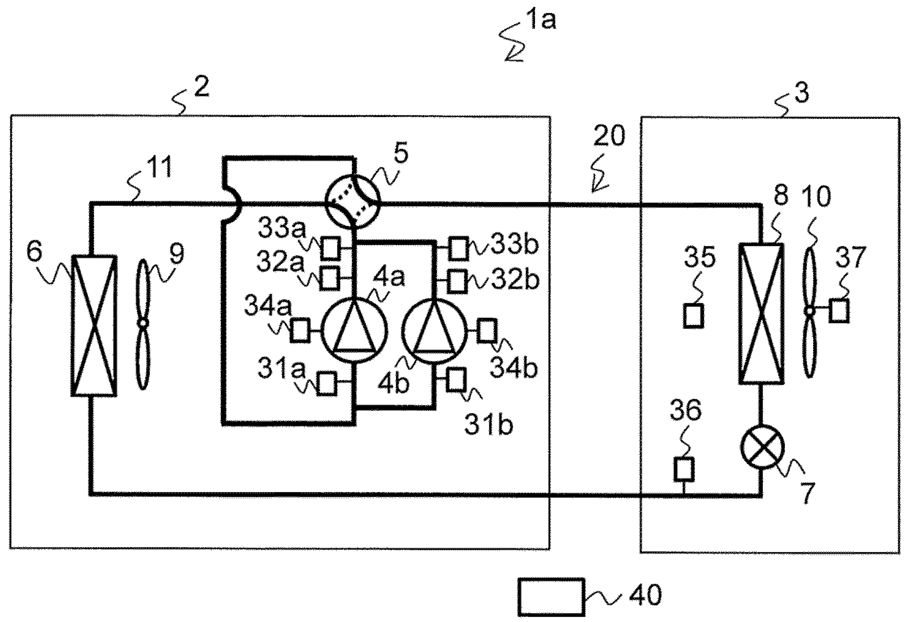

1a
2
3
20
11
5
8 10
33a
33b
32a
32b
4a
6
9
35
37
34a
34b
31a
4b
31b
36
7
40

FIG. 6

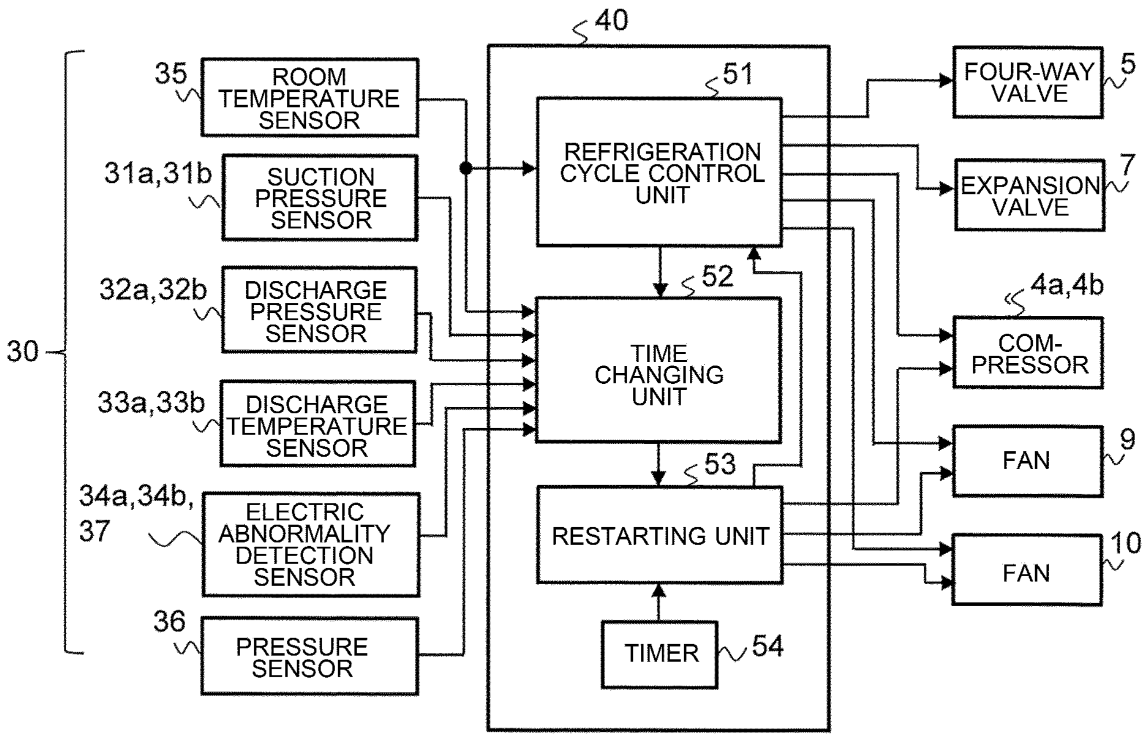

40
35
ROOM TEMPERATURE SENSOR
51
REFRIGERATION CYCLE CONTROL UNIT
FOUR-WAY VALVE
5
31a,31b
SUCTION PRESSURE SENSOR
EXPANSION VALVE
7
32a,32b
DISCHARGE PRESSURE SENSOR
52
TIME CHANGING UNIT
4a,4b
COM-PRESSOR
30
33a,33b
DISCHARGE TEMPERATURE SENSOR
FAN
9
53
34a,34b, 37
ELECTRIC ABNORMALITY DETECTION SENSOR
RESTARTING UNIT
FAN
10
36
PRESSURE SENSOR
TIMER
54

FIG. 7

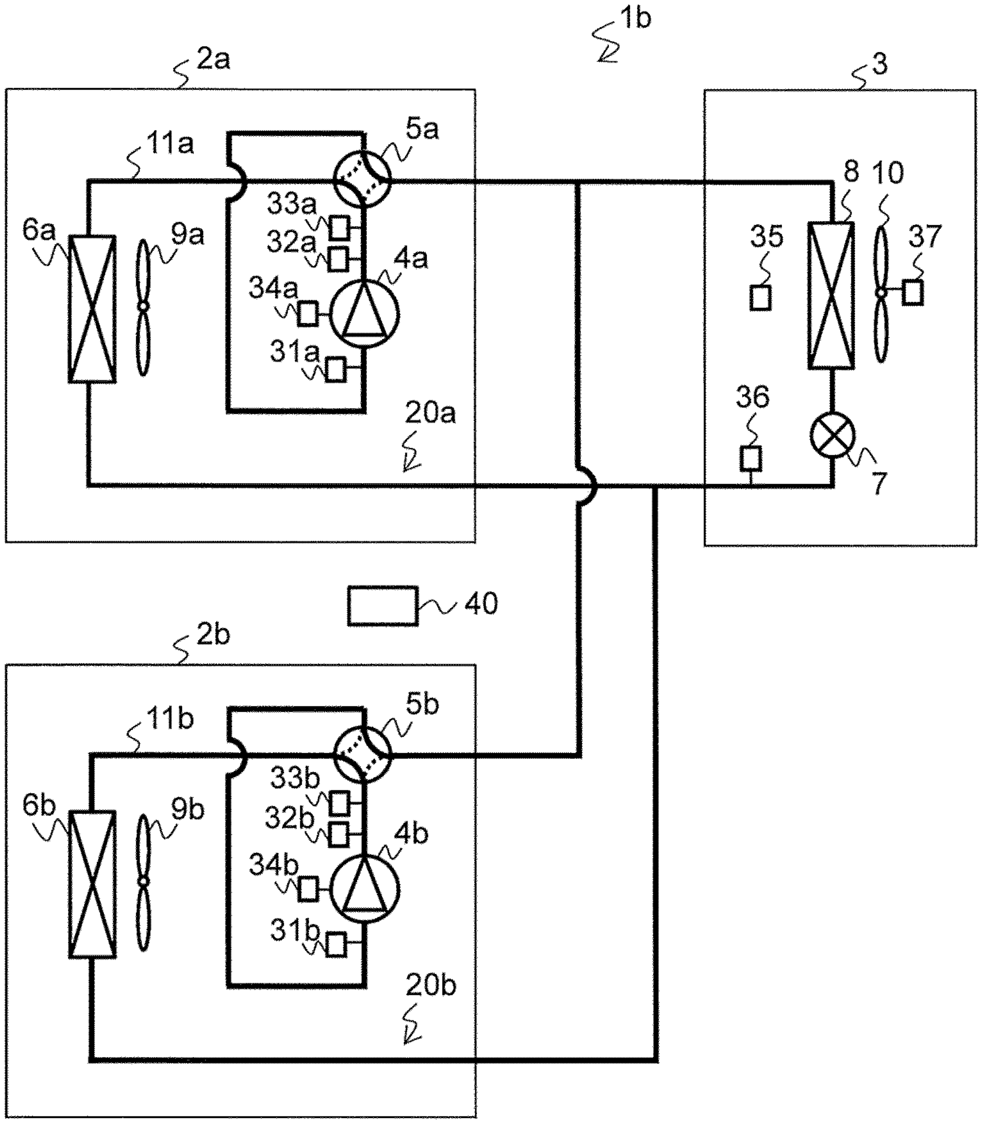

1b
2a
3
11a
5a
8
10
33a
6a
9a
35
37
32a
4a
34a
31a
36
20a
7
40
2b
11b
5b
33b
6b
9b
32b
4b
34b
31b
20b

FIG. 8

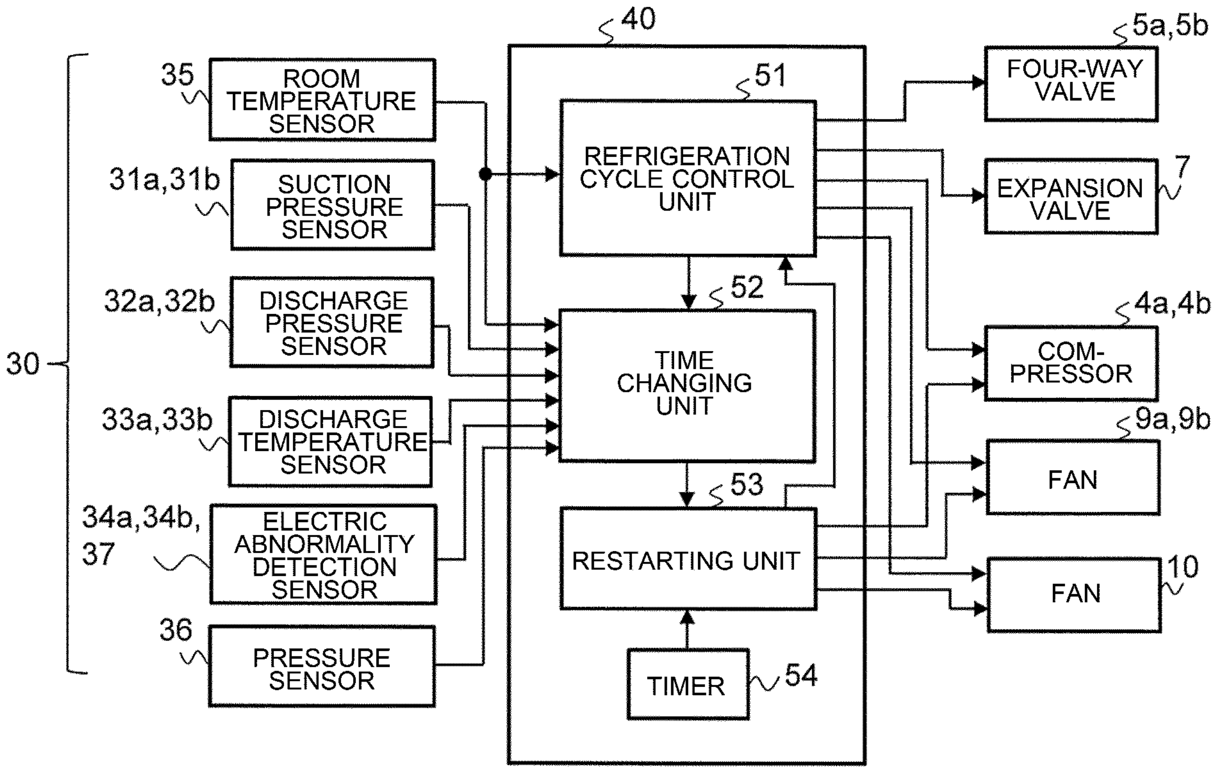
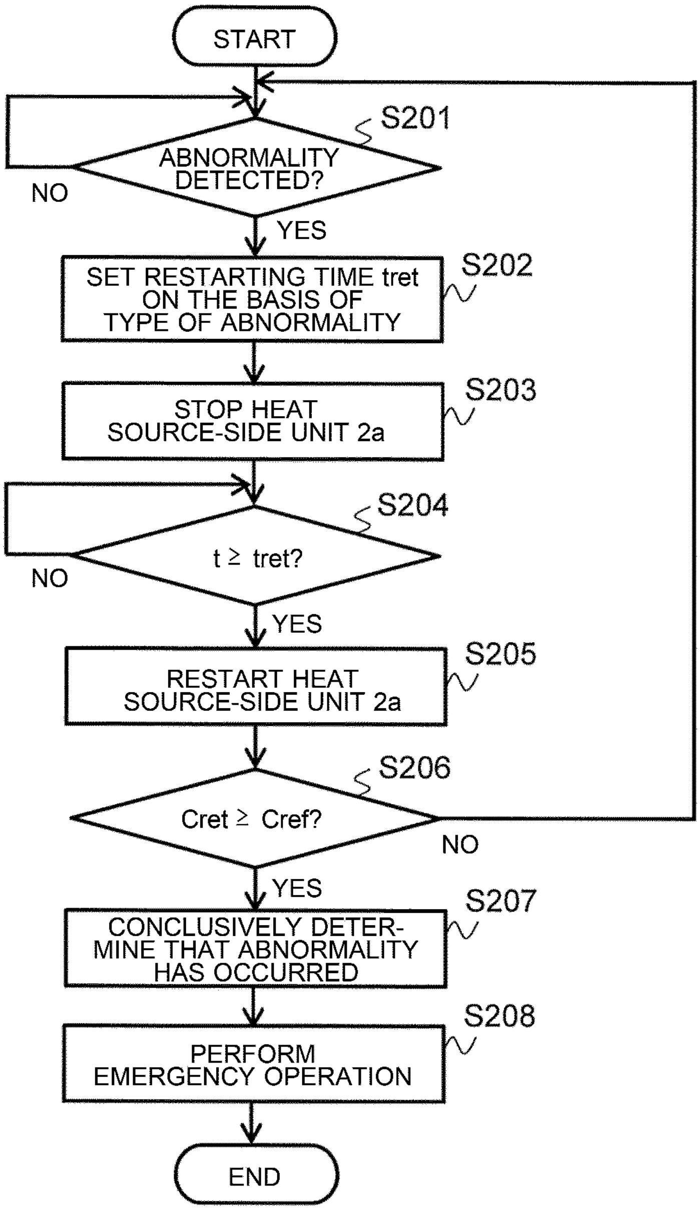

40
51
REFRIGERATION CYCLE CONTROL UNIT
52
TIME CHANGING UNIT
53
RESTARTING UNIT
TIMER
54
30
35
ROOM TEMPERATURE SENSOR
31a,31b
SUCTION PRESSURE SENSOR
32a,32b
DISCHARGE PRESSURE SENSOR
33a,33b
DISCHARGE TEMPERATURE SENSOR
34a,34b, 37
ELECTRIC ABNORMALITY DETECTION SENSOR
36
PRESSURE SENSOR
5a,5b
FOUR-WAY VALVE
7
EXPANSION VALVE
4a,4b
COM-PRESSOR
9a,9b
FAN
10
FAN

FIG. 9


START
S201
ABNORMALITY DETECTED?
NO
YES
S202
SET RESTARTING TIME tret ON THE BASIS OF TYPE OF ABNORMALITY
S203
STOP HEAT SOURCE-SIDE UNIT 2a
S204
t ≥ tret?
NO
YES
S205
RESTART HEAT SOURCE-SIDE UNIT 2a
S206
Cret ≥ Cref?
NO
YES
S207
CONCLUSIVELY DETERMINE THAT ABNORMALITY HAS OCCURRED
S208
PERFORM EMERGENCY OPERATION
END

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2019/040622

A. CLASSIFICATION OF SUBJECT MATTER
Int.Cl. F24F11/32(2018.01)i

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
Int.Cl. F24F11/00-11/89, F25B1/00, F25B49/02

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Published examined utility model applications of Japan	1922-1996
Published unexamined utility model applications of Japan	1971-2019
Registered utility model specifications of Japan	1996-2019
Published registered utility model applications of Japan	1994-2019

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X A	JP 9-149547 A (MATSUSHITA ELECTRIC INDUSTRIAL CO., LTD.) 06 June 1997, paragraphs [0019]-[0023], [0028]-[0029], fig. 1-4, 7	1 2-6
X A	JP 8-254362 A (TOSHIBA CORP.) 01 October 1996, paragraph [0040]	1 2-6
X Y A	JP 7-151398 A (SHARP CORP.) 13 June 1995, paragraphs [0009]-[0018], fig. 1-2	1 2-4 5-6

☒ Further documents are listed in the continuation of Box C. ☒ See patent family annex.

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"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
25 November 2019 (25.11.2019)	03 December 2019 (03.12.2019)

Name and mailing address of the ISA/	Authorized officer
Japan Patent Office 3-4-3, Kasumigaseki, Chiyoda-ku, Tokyo 100-8915, Japan	Telephone No.

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INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2019/040622

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	JP 8-40055 A (ZEXEL CORP.) 13 February 1996, paragraphs [0001]-[0010]	2-4
A	JP 2012-67982 A (HITACHI APPLIANCES, INC.) 05 April 2012, entire text, all drawings	1-6
A	JP 7-174392 A (MATSUSHITA ELECTRIC INDUSTRIAL CO., LTD.) 14 July 1995, entire text, all drawings	1-6
A	JP 2000-28187 A (MATSUSHITA ELECTRIC INDUSTRIAL CO., LTD.) 25 January 2000, entire text, all drawings	1-6

Form PCT/ISA/210 (continuation of second sheet) (January 2015)

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/JP2019/040622

JP 9-149547 A	06 Jun. 1997	Family: none
JP 8-254362 A	01 Oct. 1996	Family: none
JP 7-151398 A	13 Jun. 1995	Family: none
JP 8-40055 A	13 Feb. 1996	Family: none
JP 2012-67982 A	05 Apr. 2012	Family: none
JP 7-174392 A	14 Jul. 1995	Family: none
JP 2000-28187 A	25 Jan. 2000	Family: none

Form PCT/ISA/210 (patent family annex) (January 2015)

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- JP 3445904 B **[0005]**