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(71) Applicant: **Mitsubishi Electric Corporation**
Chiyoda-ku
Tokyo 100-8310 (JP)

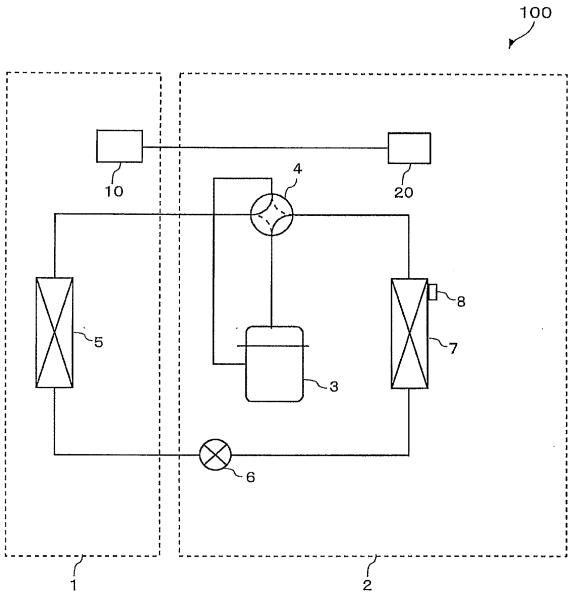
(72) Inventors:
- **KIBATA, Shinnosuke**
  Tokyo 100-8310 (JP)
- **TOMITA, Masafumi**
  Tokyo 100-8310 (JP)
- **FUKUI, Koji**
  Tokyo 100-8310 (JP)

(74) Representative: **Pfenning, Meinig & Partner mbB**
Patent- und Rechtsanwälte
Joachimsthaler Straße 10-12
10719 Berlin (DE)

(54) **AIR CONDITIONING DEVICE**

(57) An air-conditioning apparatus includes: an outdoor unit including a compressor and an outdoor air temperature detector detecting an outdoor air temperature; an outdoor controller performing rotation-locked energization in accordance with the outdoor air temperature; and an indoor controller transmitting a power feeding ON signal to the outdoor controller, wherein, under operation stop of the compressor, the outdoor controller includes a storage unit storing the outdoor air temperature detected by the outdoor air temperature detector every certain period of time, turns on, upon receiving the power feeding ON signal from the indoor controller, power feeding to the outdoor unit, and performs heating necessity determination to determine whether or not heating of the compressor is necessary in accordance with a current outdoor air temperature and an outdoor air temperature stored in the storage unit, and when it is determined that heating of the compressor is necessary, performs the rotation-locked energization, and, when it is determined that heating of the compressor is unnecessary, stops power feeding to the outdoor unit.

FIG. 1



EP 3 321 603 A1

Description

Technical Field

[0001] The present invention relates to an air-conditioning apparatus capable of reducing power consumption when an operation of a compressor is stopped.

Background Art

[0002] Conventionally, a compressor provided to an outdoor unit of an air-conditioning apparatus, in low temperature, such as when the outdoor air temperature is below zero, has a problem that refrigerant accumulating inside the compressor is condensed and liquefied to cause so-called refrigerant liquefaction in which a large amount of liquefied refrigerant dissolves into lubricating oil of the compressor.

[0003] Moreover, when heating operation is started in an air-conditioning apparatus, a compressor is immediately activated and starts compression of refrigerant; however, at the time of activation, since the temperature of the compressor is close to outdoor air temperature, the temperature of refrigerant discharged from the compressor is not raised until the temperature of the compressor is raised sufficiently. If it takes time to raise the temperature of refrigerant, it takes time, also, to raise temperature of an indoor heat exchanger; accordingly, there is a problem that it takes time to raise the indoor temperature to a predetermined temperature and rapid heating cannot be performed.

[0004] As a method to overcome the above problem, that is, as a method to achieve the rapid heating and to suppress refrigerant liquefaction inside a compressor in low outdoor temperature, it can be considered that a heater is provided to the compressor and the heater is always energized, when operation of the compressor is stopped, to thereby heat the compressor. However, like the method, if the compressor is heated by energizing the heater all the time during suspension of operation of the compressor, there is a problem that power consumption in the heater is increased, and power consumption during suspension of operation of the compressor, namely, so called standby power is increased.

[0005] Therefore, air-conditioning apparatus capable of, while preventing refrigerant liquefaction inside a compressor, reducing standby power by reducing power consumption in a controller is suggested (see, for example, Patent Literature 1).

[0006] In Patent Literature 1, in a detection mode, the temperature of the compressor is measured to calculate a change rate of temperature of the compressor being stopped, by use of the measured temperature of the compressor, and a period of operation in a sleep mode, which consumes less power than the detection mode, is varied in accordance with the calculation result. Then, a heating unit is energized in accordance with the temperature of the compressor taken in the detection mode. Consequently, by appropriately heating the compressor by the heating unit, it is possible to reduce power consumption in the controller while suppressing refrigerant liquefaction inside the compressor.

Citation List

Patent Literature

[0007] Patent Literature 1: Japanese Unexamined Patent Application Publication No. 2013-204979

Summary of Invention

Technical Problem

[0008] In Patent Literature 1, in accordance with the change rate of temperature of the compressor being stopped, the time period of the sleep mode, which consumes less power than the detection mode, is extended to reduce power consumption. However, even in the sleep mode, power feeding to the outdoor unit is performed, and therefore, there was a problem that the power was consumed by that amount.

[0009] The present invention has been made to overcome the above problem, and has an object to provide an air-conditioning apparatus with improved energy saving performance.

Solution to Problem

[0010] An air-conditioning apparatus related to an embodiment of the present invention includes: an outdoor unit including a compressor and an outdoor air temperature detector detecting an outdoor air temperature; an outdoor controller performing rotation-locked energization in accordance with the outdoor air temperature; and an indoor controller transmitting a power feeding ON signal to the outdoor controller, wherein, under operation stop of the compressor, the outdoor controller includes a storage unit storing the outdoor air temperature detected by the outdoor air temperature detector every certain period of time, turns on, upon receiving the power feeding ON signal from the indoor controller, power feeding to the outdoor unit, and performs heating necessity determination to determine whether or not heating of the compressor is necessary in accordance with a current outdoor air temperature and an outdoor air temperature stored in the storage unit, and when it is determined that heating of the compressor is necessary, performs the rotation-locked energization, and, when it is determined that heating of the compressor is unnecessary, stops power feeding to the outdoor unit.

Advantageous Effects of Invention

[0011] According to an embodiment of the present invention, when a power feeding ON signal is received from

an indoor controller during a power feeding OFF time of an outdoor unit, an outdoor controller turns on power feeding to the outdoor unit and determines heating necessity of a compressor, and then turns off the power feeding to the outdoor unit when it is determined that heating of the compressor is unnecessary. Therefore, it is possible to turn OFF the power feeding to the outdoor unit until the power feeding ON signal is received from the indoor controller, to thereby improve the energy saving performance.

Brief Description of Drawings

[0012]

[Fig. 1] Fig. 1 is a refrigerant circuit diagram of an air-conditioning apparatus related to an embodiment of the present invention.

[Fig. 2] Fig. 2 is a functional block diagram of the air-conditioning apparatus related to the embodiment according to the present invention.

[Fig. 3] Fig. 3 is a first diagram showing timing of rotation-locked energization and power feeding to an outdoor unit under operation stop of a compressor in the air-conditioning apparatus related to the present invention.

[Fig. 4] Fig. 4 is a second diagram showing timing of rotation-locked energization and power feeding to the outdoor unit under operation stop of the compressor in the air-conditioning apparatus related to the present invention.

[Fig. 5] Fig. 5 is a flowchart showing a process flow of heating control of the compressor on an outdoor controller side under operation stop of the compressor in the air-conditioning apparatus related to the embodiment of the present invention.

[Fig. 6] Fig. 6 is a flowchart showing a process flow of heating control of the compressor on an indoor controller side under operation stop of the compressor in the air-conditioning apparatus related to the embodiment of the present invention.

Description of Embodiments

[0013] Hereinafter, an embodiment according to the present invention will be described based on drawings. Note that the embodiment to be described below does not limit the present invention. Moreover, in the following figures, relations between sizes of respective components in the following figures may be different from those in actual ones.

Embodiment

[0014] Fig. 1 is a refrigerant circuit diagram of an air-conditioning apparatus 100 related to an embodiment of the present invention.

[0015] As shown in Fig. 1, the air-conditioning apparatus 100 includes an indoor unit 1 and an outdoor unit 2.

[0016] The indoor unit 1 includes an indoor heat exchanger 5, and has a function of cooling or heating an air-conditioning target space, such as indoors, by heating energy or cooling energy supplied from the outdoor unit 2.

[0017] The indoor heat exchanger 5 functions as an evaporator in cooling operation and as a condenser or a radiator in heating operation, to exchange heat between refrigerant and air.

[0018] The outdoor unit 2 includes a compressor 3, a flow path switching valve 4, an expansion device 6, an outdoor heat exchanger 7 and an outdoor air temperature detector 8, and has a function of supplying heating energy or cooling energy to the indoor unit 1.

[0019] The compressor 3 compresses sucked refrigerant to bring it into a state of high temperature and high pressure. The flow path switching valve 4 switches a flow of refrigerant between the cooling operation and the heating operation. Note that the flow path switching valve 4 is exemplified as a four-way valve; however, the flow path switching valve 4 may be composed by combining a two-way valve, a three-way valve or other valves.

[0020] The expansion device 6 functions as a pressure-reducing valve or an expansion valve to reduce pressure of refrigerant and expands thereof. The outdoor heat exchanger 7 functions as a condenser or a radiator in cooling operation and as an evaporator in heating operation, to exchange heat between refrigerant and air supplied from a fan (not shown). The outdoor air temperature detector 8 is, for example, a thermistor, an infrared temperature sensor or others, to detect an outdoor air temperature.

[0021] Moreover, the air-conditioning apparatus 100 related to the embodiment includes a refrigerant circuit in which the compressor 3, the flow path switching valve 4, the indoor heat exchanger 5, the expansion device 6 and the outdoor heat exchanger are sequentially connected via pipes to allow refrigerant to circulate. The air-conditioning apparatus 100 is configured to perform cooling operation or heating operation by circulating refrigerant in the refrigerant circuit.

[0022] Moreover, the indoor unit 1 includes the indoor controller 10 and the outdoor unit 2 includes the outdoor controller 20.

[0023] The indoor controller 10 and the outdoor controller 20 are composed of, for example, dedicated hardware or a CPU (also referred to as a Central Processing Unit, a processing device, a computer, a microprocessor, a microcomputer or a processor) executing programs loaded in a memory.

[0024] Fig. 2 is a functional block diagram of the air-conditioning apparatus 100 related to the embodiment according to the present invention.

[0025] As shown in Fig. 2, the indoor controller 10 includes an indoor communication unit 11 configured to communicate with the outdoor controller 20 and an indoor measurement unit 12 for measuring time.

[0026] The outdoor controller 20 includes an outdoor

communication unit 21 communicating with the indoor controller 10, a power supply management unit 22 for turning ON or OFF the power feeding to the outdoor unit 2 and a measurement unit 23 for obtaining a signal of the outdoor air temperature detected by the outdoor air temperature detector 8. Moreover, the outdoor controller 20 includes a storage unit 24 for storing the outdoor air temperature obtained by the measurement unit 23 and a computation unit 25 for computing, from the current outdoor air temperature obtained by the measurement unit 23 and the past outdoor air temperature stored in the storage unit 24, a predicted outdoor air temperature after an elapse of a certain period of time (hereinafter, referred to as a predicted outdoor air temperature). Further, a determination unit 26 for determining whether or not the predicted outdoor air temperature computed by the computation unit 25 is higher than the current outdoor air temperature obtained by the measurement unit 23, a drive unit 27 for performing rotation-locked energization when the determination unit 26 determines that the predicted outdoor air temperature is higher than the current outdoor air temperature, and an outdoor measurement unit 28 for measuring time are included. Note that the rotation-locked energization is to energize the compressor 3 to electrically heat the compressor 3.

[0027] The outdoor controller 20 has a power supply system different from other components of the outdoor unit 2; therefore, the outdoor controller 20 can communicate with the indoor controller 10 even though power feeding to the outdoor unit 2 is turned off.

[0028] Note that, in the embodiment, the outdoor unit 2 is provided with the outdoor controller 20; however, the present invention is not limited thereto, and the outdoor controller 20 may be provided separately from the outdoor unit 2.

[0029] Next, operations of the air-conditioning apparatus 100 related to the embodiment will be described by use of Fig. 1.

[0030] In the cooling operation, the flow path switching valve 4 is switched to the cooling operation side, in other words, as indicated by the solid line in Fig. 1, switched so that the discharge side of the compressor 3 and the outdoor heat exchanger 7 are connected.

[0031] The gas refrigerant of high temperature and pressure discharged from the compressor 3 passes through the flow path switching valve 4 and is subjected to heat exchange with outdoor air blown by a fan (not shown) in the outdoor heat exchanger 7 to be condensed and liquefied. The refrigerant condensed and liquefied is subjected to pressure reduction to low pressure by the expansion device 6, and thereafter, subjected to heat exchange with indoor air in the indoor heat exchanger 5 to be evaporated and gasified. Then, the refrigerant brought into a gas state passes through the flow path switching valve 4 and is sucked into the compressor 3.

[0032] In the heating operation, the flow path switching valve 4 is switched to the heating operation side, in other words, as indicated by the broken line in Fig. 1, switched so that the suction side of the compressor 3 and the outdoor heat exchanger 7 are connected.

[0033] The gas refrigerant of high temperature and high pressure discharged from the compressor 3 passes through the flow path switching valve 4 and is subjected to heat exchange with indoor air in the indoor heat exchanger 5 to be condensed and liquefied. The refrigerant condensed and liquefied is subjected to pressure reduction to low pressure by the expansion device 6. The pressure-reduced refrigerant is subjected to heat exchange with outdoor air blown by a fan (not shown) in the outdoor heat exchanger 7 to be evaporated and gasified. Then, the refrigerant brought into a gas state passes through the flow path switching valve 4 and is sucked into the compressor 3.

[0034] Fig. 3 is a first diagram showing timing of rotation-locked energization and power feeding to the outdoor unit under operation stop of the compressor 3 in the air-conditioning apparatus 100 according to an embodiment of the present invention, and Fig. 4 is a second diagram showing timing of rotation-locked energization and power feeding to the outdoor unit under operation stop of the compressor 3 in the air-conditioning apparatus 100 according to an embodiment of the present invention.

[0035] The air-conditioning apparatus 100 related to the embodiment performs rotation-locked energization in response to the outdoor air temperature to suppress refrigerant liquefaction inside the compressor 3 under operation stop of the compressor 3. Specifically, when the outdoor air temperature tends rise, and thereby rise in the outdoor air temperature is predicted, rotation-locked energization is performed, and in other cases rotation-locked energization is not performed.

[0036] The air-conditioning apparatus 100 related to the embodiment determines whether or not the rotation-locked energization is to be performed based on heating necessity determination described as follows.

[0037] As shown in Fig. 3, the air-conditioning apparatus 100 obtains the outdoor air temperature every certain period of time (in the embodiment, assumed to be N minutes), and stores the obtained outdoor air temperature in the storage unit 24 each time. Then, from the current outdoor air temperature and the past outdoor air temperature, for example, the outdoor air temperatures N minutes before and 2N minutes before, the outdoor air temperature after N minutes is calculated as a predicted outdoor air temperature by an approximate expression. When the calculated predicted outdoor air temperature is higher than the current outdoor air temperature, it is predicted that the outdoor air temperature tends to be raised, and the rotation-locked energization is turned on. On the other hand, when the calculated predicted outdoor air temperature is not higher than the current outdoor air temperature, it is predicted that the outdoor air temperature does not tend to be raised, and the rotation-locked energization is not performed.

[0038] Moreover, as shown in Fig. 4, when it is determined that the rotation-locked energization is not per-

formed, the air-conditioning apparatus 100 turns off the power feeding to the outdoor unit 2. Thereafter, the indoor unit 1 measures the time from turning off the power feeding to the outdoor unit 2, and transmits a power feeding ON signal to the outdoor unit 2 at every timing of performing the heating necessity determination, namely, every N minutes, to turn on the power feeding to the outdoor unit 2. Then, every time the power feeding to the outdoor unit 2 is turned on, the outdoor unit 2 performs heating necessity determination. In other words, the outdoor unit 2 repeatedly performs the heating necessity determination at every N minutes.

[0039] As described above, since power feeding to the outdoor unit 2 can be turned off during the period of not performing the rotation-locked energization, the air-conditioning apparatus 100 according to the embodiment can improve the energy saving performance.

[0040] Fig. 5 is a flowchart showing a process flow of heating control of the compressor on the outdoor controller 20 side under operation stop of the compressor 3 in the air-conditioning apparatus 100 related to the embodiment of the present invention, and Fig. 6 is a flowchart showing a process flow of heating control of the compressor on the indoor controller 10 side under operation stop of the compressor 3 in the air-conditioning apparatus 100 related to the embodiment of the present invention.

[0041] Next, description will be given of the process of heating control of the compressor under operation stop of the compressor 3 in the air-conditioning apparatus 100 related to the embodiment by use of Figs. 5 and 6.

[0042] As shown in Fig. 5, the measurement unit 23 of the outdoor controller 20 obtains a signal of outdoor air temperature detected by the outdoor air temperature detector 8 (step S101). Note that the outdoor air temperature obtained by the measurement unit 23 is stored in the storage unit 24. Moreover, the process of obtaining a signal of outdoor air temperature by the measurement unit 23 is performed every certain period of time, and the obtained outdoor air temperature is stored in the storage unit 24 each time.

[0043] After step S101, from the current outdoor air temperature obtained by the measurement unit 23 and the past outdoor air temperature stored in the storage unit 24, the computation unit 25 calculates the outdoor air temperature after a certain period of time as the predicted outdoor air temperature by an approximate expression (step S102).

[0044] After step S102, the determination unit 26 performs heating necessity determination to determine whether or not the predicted outdoor air temperature calculated by the computation unit 25 is higher than the current outdoor air temperature (step S103).

[0045] When the determination unit 26 determines that the predicted outdoor air temperature is higher than the current outdoor air temperature, in other words, it is predicted that the outdoor air temperature tends to rise (Yes in step S103), the outdoor measurement unit 28 starts time measurement (step S108), and the drive unit 27 turns on the rotation-locked energization (step S109).

[0046] After step S109, when a certain period of time measured by the outdoor measurement unit 28 has passed, in other words, a certain period of time in which the rotation-locked energization is ON has passed (Yes in step S110), the process returns to step S101 and the measurement unit 23 obtains a signal of outdoor air temperature detected by the outdoor air temperature detector 8 again (step S101).

[0047] On the other hand, when the determination unit 26 determines that the predicted outdoor air temperature is not higher than the current outdoor air temperature, in other words, when the determination unit 26 predicts that the outdoor air temperature does not tend to rise (No in step S103), the outdoor communication unit 21 transmits a power feeding OFF signal to the indoor communication unit 11 of the indoor controller 10 (step S104), and the power supply management unit 22 turns off the power feeding to the outdoor unit 2 (step S105). At this time, when the rotation-locked energization is on, the drive unit 27 turns off the rotation-locked energization.

[0048] As shown in Fig. 6, when the indoor communication unit 11 receives the power feeding OFF signal from the outdoor communication unit 21 (Yes in step S201), the indoor measurement unit 12 starts measurement of time (step S202).

[0049] After step S202, when a certain period of time measured by the indoor measurement unit 12 has passed, in other words, when a certain period of time has passed since turning off the power feeding to the outdoor unit 2 (Yes in step S203), the indoor communication unit 11 transmits the power feeding ON signal to the outdoor communication unit 21 of the outdoor controller 20 (step S204), and the process returns to step S201.

[0050] As shown in Fig. 5, after step S105, when the outdoor communication unit 21 receives the power feeding ON signal from the indoor communication unit 11 (Yes in step S106), the power supply management unit 22 turns on the power feeding to the outdoor unit 2 (step S107), the process returns to step S101, and the measurement unit 23 obtains a signal of outdoor air temperature detected by the outdoor air temperature detector 8 again (step S101).

[0051] As described above, according to the air-conditioning apparatus 100 of the embodiment, under operation stop of the compressor 3, the outdoor controller 20 obtains the current outdoor air temperature and calculates, from the current outdoor air temperature and the past outdoor air temperature stored in the storage unit 24, a predicted outdoor air temperature, which is an outdoor air temperature in future. Then, when it is determined that the predicted outdoor air temperature is higher than the current outdoor air temperature, in other words, when it is predicted that the outdoor air temperature tends to rise, the outdoor controller 20 starts measurement of time and turns on the rotation-locked energization. On the other hand, when it is determined that the predicted

outdoor air temperature is not higher than the current outdoor air temperature, in other words, when it is predicted that the outdoor air temperature does not tend to rise, the outdoor controller 20 transmits the power feeding OFF signal to the indoor controller 10 to turn off the power feeding to the outdoor unit 2. When the power feeding OFF signal is received from the outdoor controller 20, the indoor controller 10 starts measurement of time, and when a certain period of measured time has passed, transmits the power feeding ON signal to the outdoor controller 20. When the power feeding ON signal is received from the outdoor controller 20, the outdoor controller 20 turns on the power feeding to the outdoor unit 2, and obtains the current outdoor air temperature again.

[0052] As described above, the outdoor controller 20 turns off power feeding to the outdoor unit 2 during a period in which the compressor 3 is not heated, turns on the power feeding to the outdoor unit 2 when the power feeding ON signal is received from the indoor controller 10 during the time when the power feeding to the outdoor unit 2 is off, and determines heating necessity of the compressor 3 and then turns off the power feeding to the outdoor unit 2 when it is determined that heating of the compressor 3 is unnecessary. Therefore, it is possible to turn off the power feeding to the outdoor unit until the power feeding ON signal is received from the indoor controller 10, and to improve the energy saving performance.

Reference Signs List

[0053] 1 indoor unit 2 outdoor unit 3 compressor 4 flow path switching valve 5 indoor heat exchanger 6 expansion device 7 outdoor heat exchanger 8 outdoor air temperature detector 10 indoor controller 11 indoor communication unit 12 indoor measurement unit 20 outdoor controller 21 outdoor communication unit 22 power supply management unit 23 measurement unit 24 storage unit 25 computation unit 26 determination unit 27 drive unit 28 outdoor measurement unit 100 air-conditioning apparatus

Claims

1. An air-conditioning apparatus comprising:

an outdoor unit including a compressor and an outdoor air temperature detector configured to detect an outdoor air temperature;
an outdoor controller configured to perform rotation-locked energization in accordance with the outdoor air temperature; and
an indoor controller configured to transmit a power feeding ON signal to the outdoor controller,
the outdoor controller including a storage unit storing the outdoor air temperature detected by the outdoor air temperature detector every certain period of time,
the outdoor controller being configured to,

under operation stop of the compressor and upon receiving the power feeding ON signal from the indoor controller, turn on power feeding to the outdoor unit, and perform heating necessity determination to determine whether or not heating of the compressor is necessary in accordance with a current outdoor air temperature and an outdoor air temperature stored in the storage unit, and
when determining that heating of the compressor is necessary, perform the rotation-locked energization, and, when determining that heating of the compressor is unnecessary, stop power feeding to the outdoor unit.

2. The air-conditioning apparatus of claim 1, wherein, the indoor controller is configured to start measurement of time upon receiving a power feeding OFF signal transmitted by the outdoor controller when the outdoor controller turns off power feeding to the outdoor unit, and transmit the power feeding ON signal to the outdoor controller after an elapse of a certain period of measured time.

3. The air-conditioning apparatus of claim 1 or 2, wherein
the outdoor controller includes:

a communication unit configured to receive the power feeding ON signal from the indoor controller;
a power supply management unit configured to turn on power feeding to the outdoor unit when the communication unit receives the power feeding ON signal;
a measurement unit configured to obtain a signal of the outdoor air temperature detected by the outdoor air temperature detector;
the storage unit storing the outdoor air temperature obtained by the measurement unit;
a computation unit configured to compute, from the outdoor air temperature obtained by the measurement unit and a past temperature stored in the storage unit, a predicted outdoor air temperature after an elapse of a certain period of time;
a determination unit configured to perform the heating necessity determination to determine whether or not the predicted outdoor air temperature is higher than the outdoor air temperature obtained by the measurement unit; and
a drive unit configured to turn on the rotation-locked energization when the determination unit determines that the predicted outdoor air tem-

perature is higher than the outdoor air temperature obtained by the measurement unit, wherein

the power supply management unit is configured to turn off power feeding to the outdoor unit when the determination unit determines that the predicted outdoor air temperature is not higher than the outdoor air temperature obtained by the measurement unit.

4. The air-conditioning apparatus of any one of claims 1 to 3, wherein the outdoor controller is configured to start measurement of time when the rotation-locked energization is turned on and perform the heating necessity determination after an elapse of a certain period of measured time.

FIG. 1

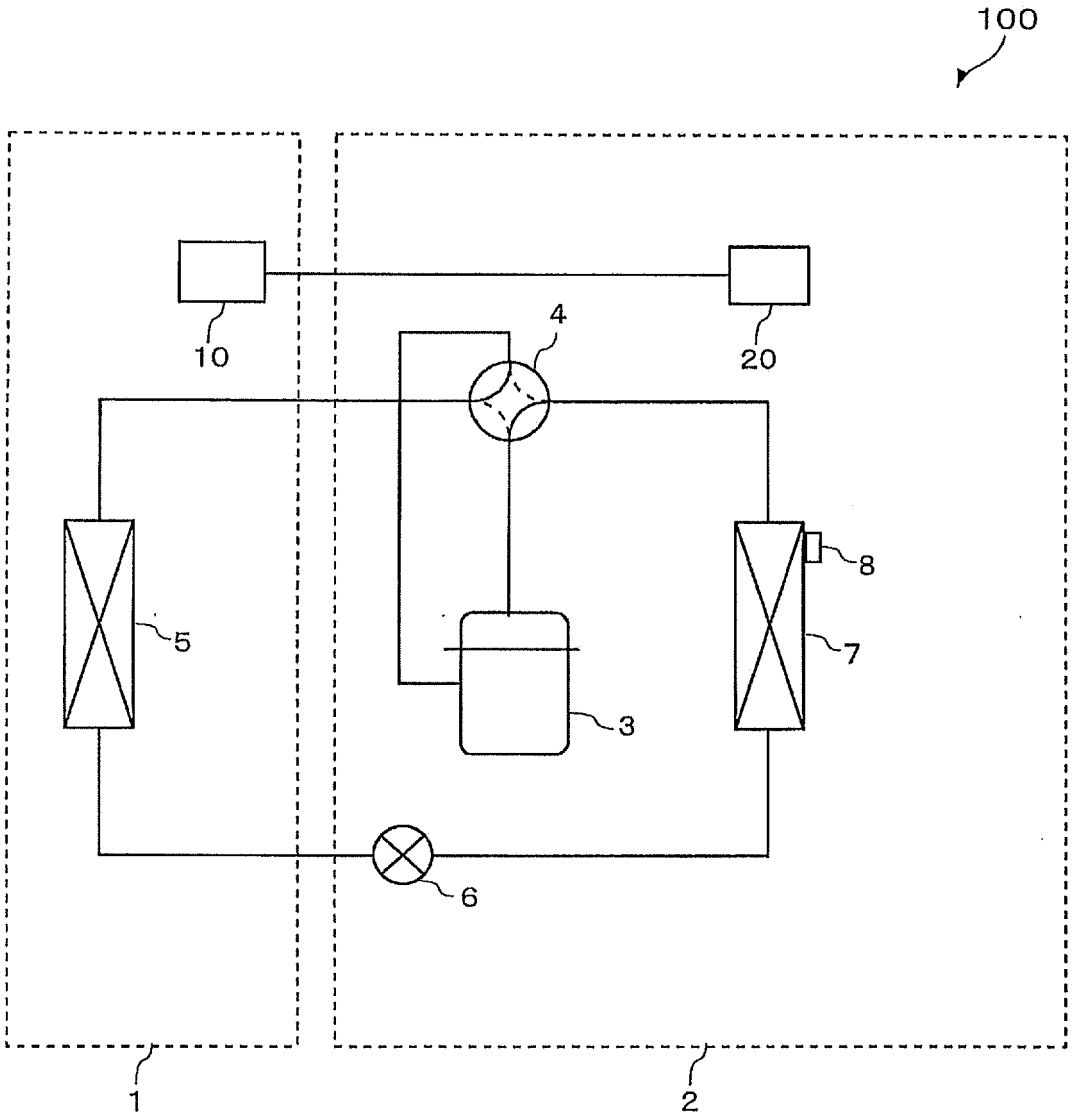


FIG. 2

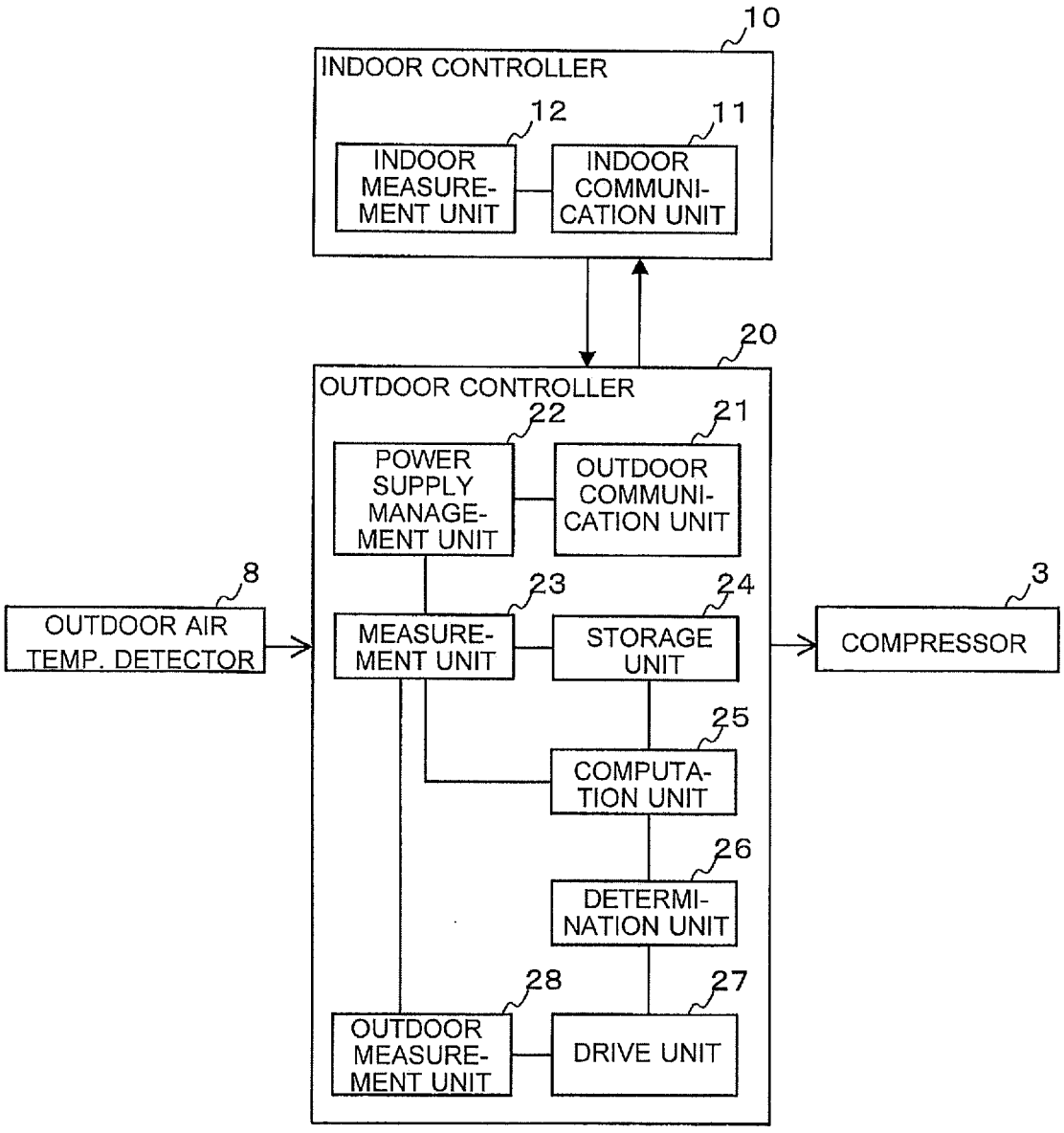

10
INDOOR CONTROLLER
12
11
INDOOR MEASURE-MENT UNIT
INDOOR COMMUNI-CATION UNIT
20
OUTDOOR CONTROLLER
22
21
POWER SUPPLY MANAGE-MENT UNIT
OUTDOOR COMMUNI-CATION UNIT
8
OUTDOOR AIR TEMP. DETECTOR
23
24
3
MEASURE-MENT UNIT
STORAGE UNIT
COMPRESSOR
25
COMPUTA-TION UNIT
26
DETERMI-NATION UNIT
28
27
OUTDOOR MEASURE-MENT UNIT
DRIVE UNIT

FIG. 3

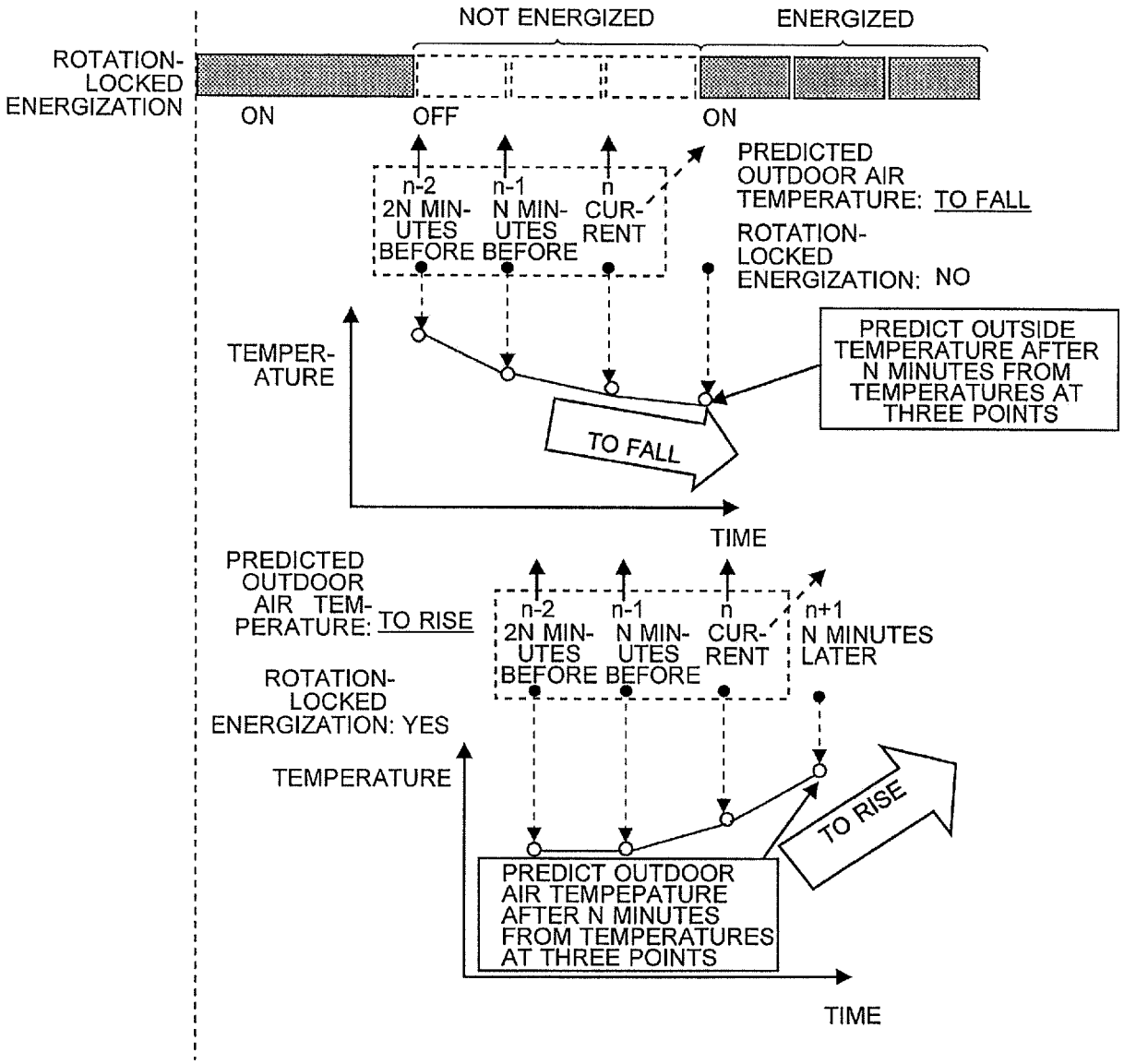

NOT ENERGIZED
ENERGIZED
ROTATION-LOCKED ENERGIZATION
ON
OFF
ON
n-2
2N MIN-UTES BEFORE
n-1
N MIN-UTES BEFORE
n
CUR-RENT
PREDICTED OUTDOOR AIR TEMPERATURE: TO FALL
ROTATION-LOCKED ENERGIZATION: NO
TEMPER-ATURE
PREDICT OUTSIDE TEMPERATURE AFTER N MINUTES FROM TEMPERATURES AT THREE POINTS
TO FALL
TIME
PREDICTED OUTDOOR AIR TEM-PERATURE: TO RISE
n-2
2N MIN-UTES BEFORE
n-1
N MIN-UTES BEFORE
n
CUR-RENT
n+1
N MINUTES LATER
ROTATION-LOCKED ENERGIZATION: YES
TEMPERATURE
TO RISE
PREDICT OUTDOOR AIR TEMPEPATURE AFTER N MINUTES FROM TEMPERATURES AT THREE POINTS
TIME

FIG. 4

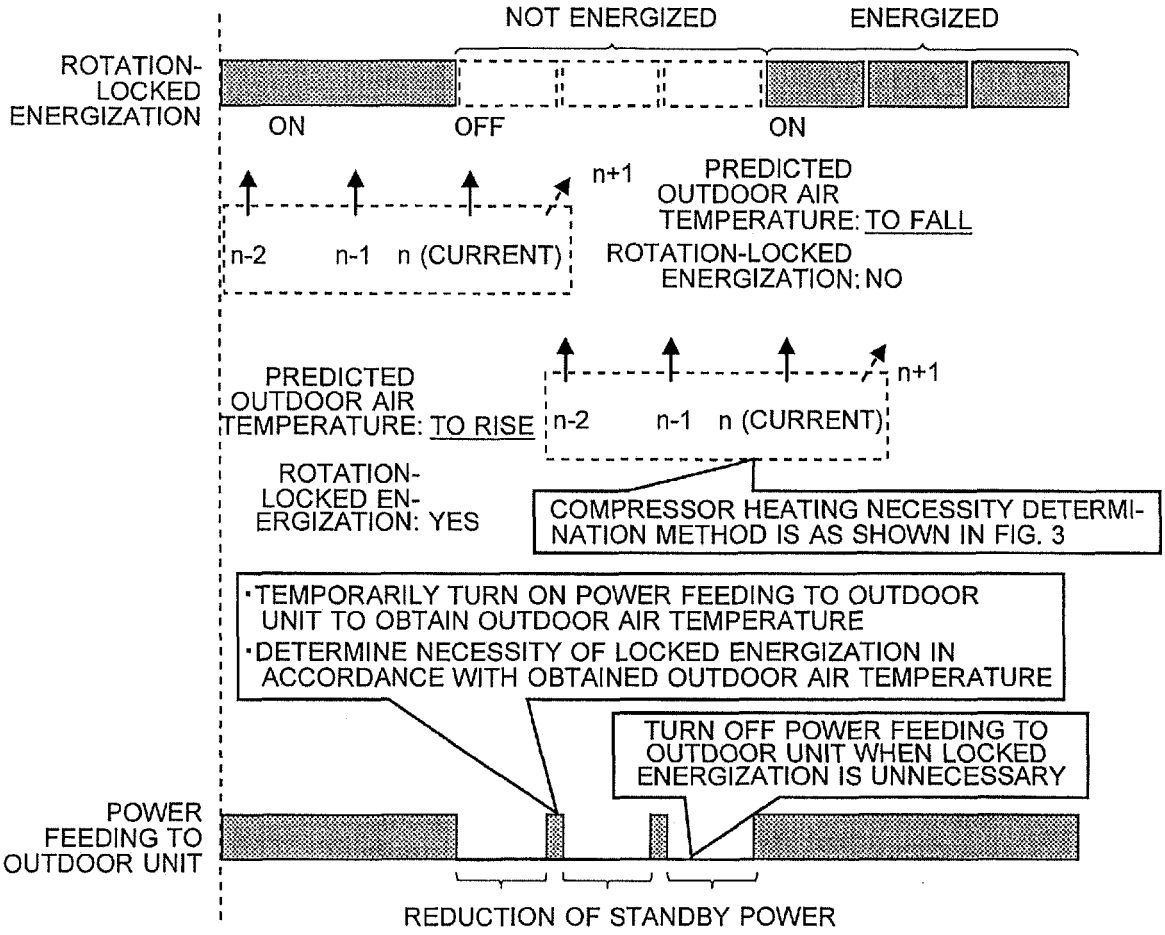

NOT ENERGIZED
ENERGIZED
ROTATION-LOCKED ENERGIZATION
ON
OFF
ON
n+1
PREDICTED OUTDOOR AIR TEMPERATURE: TO FALL
n-2
n-1
n (CURRENT)
ROTATION-LOCKED ENERGIZATION: NO
PREDICTED OUTDOOR AIR TEMPERATURE: TO RISE
n+1
n-2
n-1
n (CURRENT)
ROTATION-LOCKED EN-ERGIZATION: YES
COMPRESSOR HEATING NECESSITY DETERMI-NATION METHOD IS AS SHOWN IN FIG. 3
·TEMPORARILY TURN ON POWER FEEDING TO OUTDOOR UNIT TO OBTAIN OUTDOOR AIR TEMPERATURE
·DETERMINE NECESSITY OF LOCKED ENERGIZATION IN ACCORDANCE WITH OBTAINED OUTDOOR AIR TEMPERATURE
TURN OFF POWER FEEDING TO OUTDOOR UNIT WHEN LOCKED ENERGIZATION IS UNNECESSARY
POWER FEEDING TO OUTDOOR UNIT
REDUCTION OF STANDBY POWER

FIG. 5

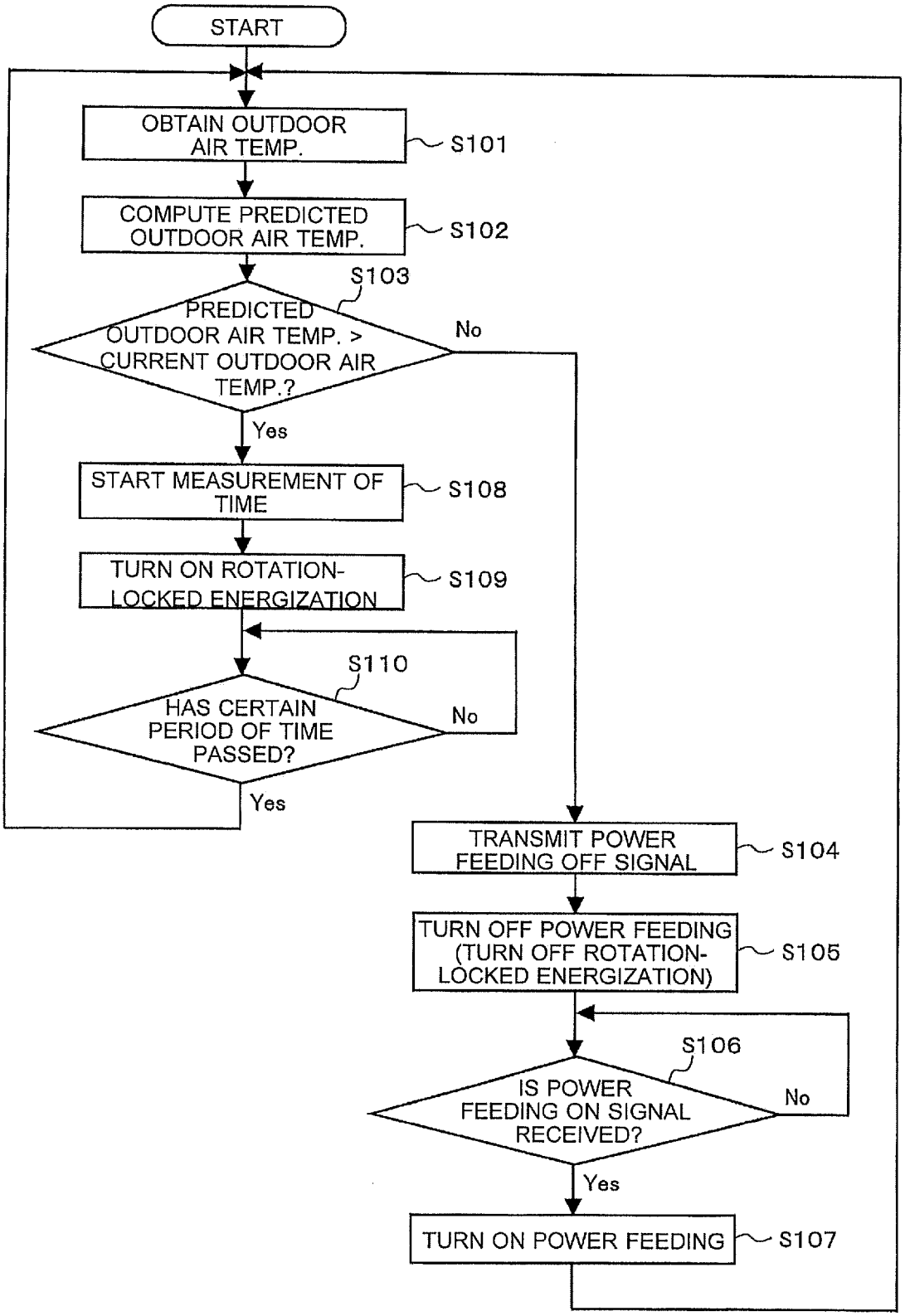
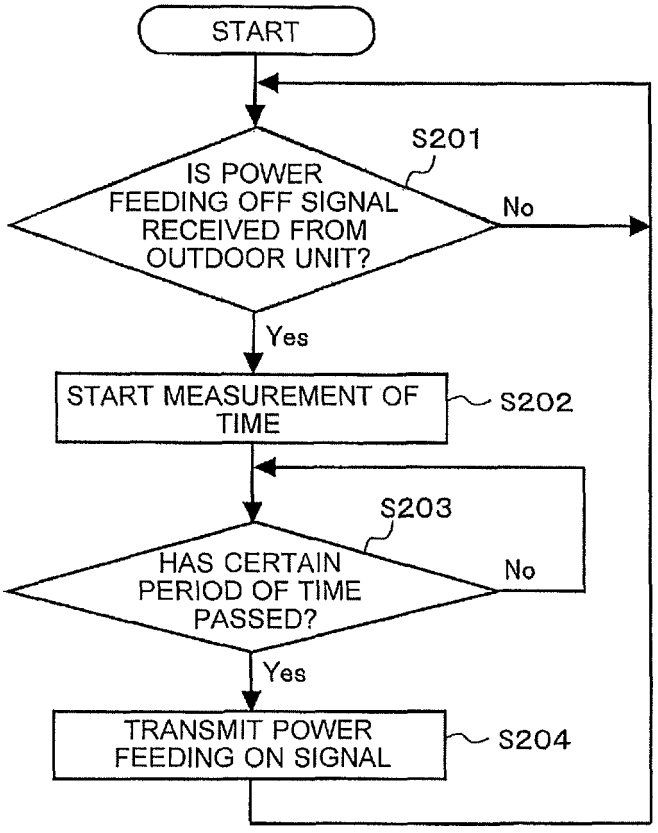

START
OBTAIN OUTDOOR AIR TEMP.
S101
COMPUTE PREDICTED OUTDOOR AIR TEMP.
S102
S103
PREDICTED OUTDOOR AIR TEMP. > CURRENT OUTDOOR AIR TEMP.?
No
Yes
START MEASUREMENT OF TIME
S108
TURN ON ROTATION-LOCKED ENERGIZATION
S109
S110
HAS CERTAIN PERIOD OF TIME PASSED?
No
Yes
TRANSMIT POWER FEEDING OFF SIGNAL
S104
TURN OFF POWER FEEDING (TURN OFF ROTATION-LOCKED ENERGIZATION)
S105
S106
IS POWER FEEDING ON SIGNAL RECEIVED?
No
Yes
TURN ON POWER FEEDING
S107

FIG. 6


START
S201
IS POWER FEEDING OFF SIGNAL RECEIVED FROM OUTDOOR UNIT?
No
Yes
START MEASUREMENT OF TIME
S202
S203
HAS CERTAIN PERIOD OF TIME PASSED?
No
Yes
TRANSMIT POWER FEEDING ON SIGNAL
S204

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2016/073870

A. CLASSIFICATION OF SUBJECT MATTER
F25B1/00(2006.01)i, *F24F11/02*(2006.01)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)
F25B1/00, F24F11/02

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
Jitsuyo Shinan Koho 1922-1996 Jitsuyo Shinan Toroku Koho 1996-2016
Kokai Jitsuyo Shinan Koho 1971-2016 Toroku Jitsuyo Shinan Koho 1994-2016

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.
A	JP 2014-145535 A (Mitsubishi Electric Corp.), 14 August 2014 (14.08.2014), paragraphs [0010] to [0064]; fig. 1 to 4 (Family: none)	1-4
A	JP 2008-286419 A (Panasonic Corp.), 27 November 2008 (27.11.2008), paragraphs [0032] to [0043]; fig. 5 to 6 (Family: none)	1-4
A	JP 2000-193325 A (Matsushita Electric Industrial Co., Ltd.), 14 July 2000 (14.07.2000), paragraphs [0018] to [0036]; fig. 1 to 7 (Family: none)	1-4

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

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
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"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
04 November 2016 (04.11.16)	15 November 2016 (15.11.16)
Name and mailing address of the ISA/ Japan Patent Office 3-4-3,Kasumigaseki,Chiyoda-ku, Tokyo 100-8915,Japan	Authorized officer Telephone No.

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

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- JP 2013204979 A **[0007]**