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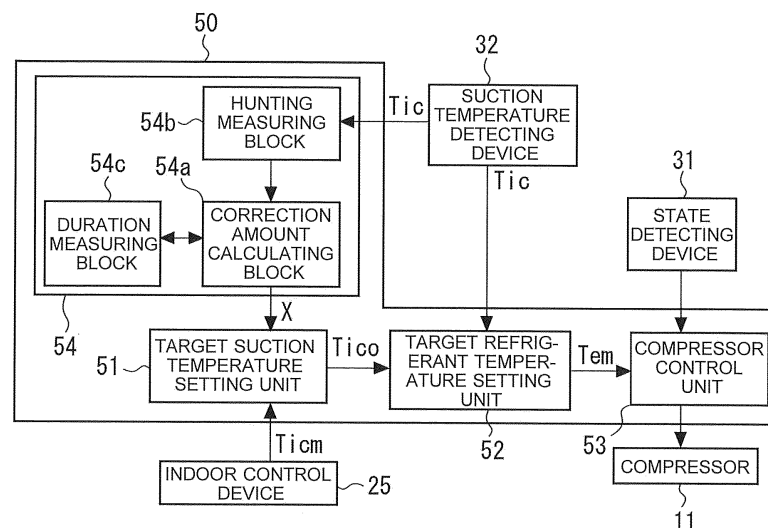
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(54) **REFRIGERATING AND AIR-CONDITIONING APPARATUS**

(57) An operation control device in a refrigerating and air-conditioning apparatus includes a correction amount setting unit configured to reduce, by a predetermined change amount at each setting, a temperature correction amount for such a correction that a necessary air-conditioning capability is lower than an air-conditioning capability corresponding to a set temperature, a target suction temperature setting unit configured to set a target suction temperature based on the temperature correction

amount set by the correction amount setting unit and the set temperature, a target refrigerant temperature setting unit configured to set a target refrigerant temperature of refrigerant flowing into a use side heat exchanger so that a suction temperature is equal to the target suction temperature, and a compressor control unit configured to control a capacity of a compressor so that the refrigerant flowing into the use side heat exchanger has the target refrigerant temperature.

FIG. 2



Description

Technical Field

[0001] The present invention relates to a refrigerating and air-conditioning apparatus controlled based on a set temperature.

Background Art

[0002] In the conventionally known refrigerating and air-conditioning apparatus, one outdoor unit is connected with a plurality of indoor units. To perform the operation control of this refrigerating and air-conditioning apparatus, a differential temperature control is performed that the capacity of a compressor is controlled in accordance with an indoor air conditioning load (for example, refer to Patent Literature 1). In Patent Literature 1, in the differential temperature control during a cooling operation, a target evaporating temperature in accordance with an air conditioning load is calculated based on a difference between the set temperature of a use side unit and the suction temperature of the use side unit, and the operation of the compressor is controlled so that the target evaporating temperature is achieved. Specifically, a control to reduce the target evaporating temperature is performed when the suction temperature becomes higher than the set temperature, and a control to increase the target evaporating temperature is performed when the suction temperature becomes lower than the set temperature.

[0003] When the suction temperature is deviated from the set temperature by, for example, 0.5 degrees C during the cooling operation, it is determined that the air-conditioning apparatus is excessively operating, and air at room temperature is blown indoors without cooling of a use side heat exchanger (thermo OFF). In this case, no heat exchange is need with indoor air at the use side heat exchanger, and thus the capacity of the compressor is controlled to decrease to achieve appropriate electric power consumption. In this manner, the capacity of the compressor is controlled depending on a change in the air conditioning load to perform the energy saving operation of the refrigerating and air-conditioning apparatus.

Citation List

Patent Literature

[0004] Patent Literature 1: Japanese Patent Laid-open No. 2003-247742

Summary of Invention

Technical Problem

[0005] In Patent Literature 1, the capacity of the compressor is controlled after the detection that the suction

temperature is deviated from the set temperature. Accordingly, air-conditioning of indoor air is performed after the change of the capacity of the compressor, and thus there exists a time lag until the air-conditioning is reflected on the suction temperature, leading to undershoot of the suction temperature. In the differential temperature control, the set temperature is a control target of the suction temperature, and thus, the undershoot of the suction temperature is likely to cause hunting of the suction temperature and the thermo OFF of the use side unit. The thermo OFF of the use side unit leads to degradation of the capacity of the air-conditioning apparatus, so that the suction temperature is likely to change significantly, resulting in degradation of the stability of the suction temperature. In this manner, when the suction temperature is unstable, the compressor is repeatedly turned on and off, and thus it takes time to control the suction temperature to be equal to the set temperature in some cases.

[0006] The present invention is intended to solve the above problem, and it is an object of the present invention to provide a refrigerating and air-conditioning apparatus capable of controlling the suction temperature to be the set temperature in a short time.

Solution to Problem

[0007] A refrigerating and air-conditioning apparatus according to an embodiment of the present invention is provided with a refrigeration cycle in which a compressor, a heat source side heat exchanger, an expansion device, and a use side heat exchanger are connected with each other through a refrigerant pipe. The refrigerating and air-conditioning apparatus includes a suction temperature detecting device configured to detect, as a suction temperature, a temperature of air sucked into the use side heat exchanger from a space to be air-conditioned, a state detecting device configured to detect a state of refrigerant flowing inside the use side heat exchanger, and an operation control device configured to control an operation of the compressor based on a set temperature as a target temperature of the space to be air-conditioned, the suction temperature detected by the suction temperature detecting device, and the state of the refrigerant detected by the state detecting device. The operation control device (50) includes a correction amount setting unit configured to reduce, by a predetermined change amount at each setting, a temperature correction amount for such a correction that a necessary air-conditioning capability is lower than an air-conditioning capability corresponding to the set temperature, a target suction temperature setting unit configured to set a target suction temperature based on the temperature correction amount set by the correction amount setting unit and the set temperature, a target refrigerant temperature setting unit configured to set a target refrigerant temperature of refrigerant flowing into the use side heat exchanger so that the suction temperature is equal to the target suction temperature, and a compressor control unit configured

to control a capacity of the compressor so that the refrigerant flowing into the use side heat exchanger is equal to the target refrigerant temperature.

Advantageous Effects of Invention

[0008] According to the present invention, during the differential temperature control operation, the differential temperature control is performed based on a target suction temperature obtained by applying a temperature correction amount to a set temperature, and the temperature correction amount is reduced in steps by a change amount, so that thermo OFF is reduced even when hunting of a suction temperature is generated, and thus the suction temperature can be controlled to the set temperature in a short time.

Brief Description of Drawings

[0009]

[Fig. 1] Fig. 1 is a refrigerant circuit diagram illustrating an exemplary refrigerating and air-conditioning apparatus according to an embodiment of the present invention.

[Fig. 2] Fig. 2 is a block diagram of an exemplary control unit in the refrigerating and air-conditioning apparatus in Fig. 1.

[Fig. 3] Fig. 3 is a flowchart of an exemplary process of a cooling operation of the refrigerating and air-conditioning apparatus in Fig. 1.

[Fig. 4] Fig. 4 is a flowchart of an exemplary method of setting a target suction temperature in Fig. 3.

[Fig. 5] Fig. 5 is a graph illustrating exemplary transition of a suction temperature during the cooling operation of the refrigerating and air-conditioning apparatus in Fig. 1.

[Fig. 6] Fig. 6 is a graph illustrating transition of the suction temperature during the conventional cooling operation.

[Fig. 7] Fig. 7 is a graph illustrating the transition of the suction temperature during a heating operation of the refrigerating and air-conditioning apparatus according to the embodiment of the present invention.

Description of Embodiments

[0010] An embodiment of a refrigerating and air-conditioning apparatus according to the present invention will be described below in detail with reference to the accompanying drawings. Fig. 1 is a refrigerant circuit diagram illustrating an exemplary refrigerating and air-conditioning apparatus according to the embodiment of the present invention. As illustrated in Fig. 1, this refrigerating and air-conditioning apparatus 1 includes a heat source unit 10 and two use side units 20A and 20B. The heat source unit 10 and the use side units 20A and 20B are

connected with each other through a liquid pipe 2 and a gas pipe 3. Although Fig. 1 illustrates the example in which the heat source unit 10 is connected with the two use side units 20A and 20B in the refrigerating and air-conditioning apparatus 1, the heat source unit 10 may be connected with only one use side unit or a plurality of use side units.

[0011] The heat source unit 10 houses a compressor 11, a flow path switching device 12, a heat source side heat exchanger 13, and an accumulator 14, and the use side units 20A and 20B each house an expansion device 21 and a use side heat exchanger 22. The compressor 11, the flow path switching device 12, the heat source side heat exchanger 13, the expansion device 21, and the use side heat exchanger 22 are connected with each other through the liquid pipe 2 and the gas pipe 3, forming a refrigerant circuit. The compressor 11 is configured to compress and discharge sucked refrigerant, and is, for example, a scroll compressor or a vane compressor. For example, the compressor 11 is under inverter control such that its capacity is controlled by controlling its rotation speed.

[0012] The flow path switching device 12 is configured to perform switching between a heating flow path and a cooling flow path in response to switching of an operation mode between a cooling operation and a heating operation, and is, for example, a four-way valve. During the cooling operation, the flow path switching device 12 connects an outlet of the compressor 11 and the heat source side heat exchanger 13 and connects the use side heat exchanger 22 and the accumulator 14. During the heating operation, the flow path switching device 12 connects the outlet of the compressor 11 and the use side heat exchanger 22 and connects the heat source side heat exchanger 13 and the accumulator 14. The heat source side heat exchanger 13 serves as a condenser (radiator) during the cooling operation, and serves as an evaporator (heat absorber) during the heating operation. The flow path switching device 12 does not necessarily need to be provided but may be omitted as long as the refrigerating and air-conditioning apparatus 1 can perform the cooling operation or the heating operation.

[0013] The heat source side heat exchanger 13 is, for example, a finned-tube heat exchanger configured to condense and liquefy refrigerant compressed by the compressor 11, by performing heat exchange of the refrigerant with, for example, outdoor air (external air). A heat source side fan (not illustrated) configured to feed external air into the heat source side heat exchanger 13 may be installed. The accumulator 14 is provided on an inlet side of the compressor 11, and has a function of accumulating excess refrigerant and a function of separating liquid refrigerant and gas refrigerant. The compressor 11 is configured to suck and compress gas refrigerant in refrigerant accumulated in the accumulator 14.

[0014] The expansion device 21 is, for example, an electric expansion valve configured to change its opening degree to adjust a flow rate or the like of refrigerant pass-

ing therethrough and adjust pressure of the refrigerant, and then discharge the refrigerant to the use side heat exchanger 22. The use side heat exchanger 22 is, for example, a finned-tube heat exchanger configured to perform heat exchange between refrigerant controlled to be a low-pressure state by the expansion device 21 and air. The use side heat exchanger 22 includes a use side fan (not illustrated) configured to blow in a space to be air-conditioned (indoor space).

[0015] The described above operation of the refrigerating and air-conditioning apparatus 1 is controlled by an outdoor control device 15 and an indoor control device 25. Specifically, the heat source unit 10 is provided with the outdoor control device

[0016] 15 configured to control an operation of each component in the heat source unit 10, and the use side units 20A and 20B are each provided with the indoor control device 25 configured to control an operation of each component in the use side units 20A and 20B. The outdoor control device 15 and the indoor control device 25 are connected with each other in such a manner that information can be communicated therebetween, and are configured to cooperatively perform the operation control of the entire refrigerating and air-conditioning apparatus 1.

[0017] The outdoor control device 15 and the indoor control device 25 perform control of each component based on outputs from various sensors. Specifically, a state detecting device 31 configured to detect the low pressure of the refrigerant as the state of the refrigerant is provided before the accumulator 14 on an exit side of the use side heat exchanger 22. The state detecting device 31 is, for example, a pressure sensor configured to detect the pressure of the refrigerant as the state of the refrigerant. In addition, a suction temperature detecting device 32 configured to detect, as a suction temperature, the temperature of air sucked into the use side heat exchanger 22 is provided on an indoor-air inlet side of the use side units 20A and 20B. The outdoor control device 15 calculates an evaporating temperature of the use side heat exchanger 22 during the cooling operation based on the pressure of the refrigerant detected by the state detecting device 31. Although the above describes the example in which the state detecting device 31 is a pressure sensor, the present invention is not limited to the above configuration, and any device configured to detect the evaporating temperature, and hence the well-known technology, is applicable.

[0018] In the refrigerating and air-conditioning apparatus 1, for example, the outdoor control device 15 of the heat source unit 10 includes an operation control device 50 configured to perform operation control through the differential temperature control. Although Fig. 1 illustrates the example in which the operation control device 50 is provided to the heat source unit 10, the operation control device 50 may be provided to the use side units 20A and 20B or a central control unit (not illustrated) configured to collectively manage the heat source unit 10

and the use side units 20A and 20B. The indoor control device 25 stores therein a set temperature of the space to be air-conditioned, and the operation control device 50 controls the operation of each component so that the temperature (suction temperature) of the space to be air-conditioned is equal to the set temperature.

[0019] Specifically, the operation control device 50 performs the differential temperature control of controlling the capacity of the compressor 11 so that the suction temperature of air sucked into the use side heat exchanger 22 is equal to the set temperature. When the suction temperature is lower than the set temperature, the operation control device 50 determines that the air-conditioning capability is excessive and controls to reduce the capacity of the compressor 11. When the suction temperature is lower than the set temperature by a predetermined temperature (for example, 0.5 degrees C), the operation control device 50 performs control so that the state of thermo OFF is achieved. In the refrigerating and air-conditioning apparatus 1, hunting of the suction temperature occurs and the thermo OFF due to the hunting is repeated in some cases. Thus, the operation of the refrigerating and air-conditioning apparatus 1 is controlled to reduce generation of the thermo OFF due to the hunting of the suction temperature.

[0020] Fig. 2 is a block diagram of an exemplary operation control device (50) in the refrigerating and air-conditioning apparatus in Fig. 1. The operation control device 50 in Fig. 2 is configured to control the operation of the refrigerating and air-conditioning apparatus 1 by the differential temperature control, and includes a target suction temperature setting unit 51, a target refrigerant temperature setting unit 52, a compressor control unit 53, and a correction amount setting unit 54. The target suction temperature setting unit 51 is configured to set a target suction temperature Tico based on a set temperature Ticm of the space to be air-conditioned. The target refrigerant temperature setting unit 52 is configured to set a target refrigerant temperature Tem of the refrigerant flowing into the use side heat exchanger 22 so that the suction temperature Tic is equal to the target suction temperature Tico. During the cooling operation, the target refrigerant temperature Tem is equivalent to a target evaporating temperature. The compressor control unit 53 is configured to control the capacity of the compressor 11 so that a refrigerant temperature Te is equal to the target refrigerant temperature Tem.

[0021] Specifically, the target suction temperature setting unit 51 does not set the set temperature Ticm per se to be the target suction temperature Tico, but sets the target suction temperature Tico to become closer to the set temperature Ticm gradually in time. Specifically, the correction amount setting unit 54 included in the operation control device 50 is configured to set a temperature correction amount X that decreases in steps of a predetermined change amount α . The target suction temperature setting unit 51 sets the target suction temperature Tico obtained by applying the temperature correction

amount X to the set temperature T_{icm}.

[0022] The correction amount setting unit 54 includes a correction amount calculating block 54a, a hunting measuring block 54b, and a duration measuring block 54c. The correction amount calculating block 54a is configured to calculate the temperature correction amount X, which is a parameter that changes in the range of, for example, $0.2 \leq X \leq 1$ where an initial value when the compressor 11 is started is set to be 1 and the change amount α is set to 0.2. Thus, the temperature correction amount X is set to five values of 0.2 to 1.0 in steps of the change amount α (0.2). The method of setting the temperature correction amount X is not limited to the method using numerical values described above, but the initial value and the change amount α are set as appropriate. In other words, although the above describes the example in which the temperature correction amount X gradually decreases in the five steps, the temperature correction amount X only needs to decrease at least in two steps. Although the above describes the example in which the steps have equal intervals, but the steps may have unequal intervals.

[0023] Accordingly, the target suction temperature setting unit 51 calculates the target suction temperature T_{ico} by correcting the set temperature T_{icm} using the temperature correction amount X set by the correction amount setting unit 54. The target suction temperature setting unit 51 calculates the target suction temperature

[0024] T_{ico} during the cooling operation by using Expression (1) below.

$$T_{ico} = T_{icm} + X \dots (1)$$

[0025] For example, when the set temperature T_{icm} is 27 degrees C, the target suction temperature T_{ico} at start of the compressor 11 is calculated to be 28 degrees C by Expression (1). In this manner, the target suction temperature T_{ico} is set so that necessary air-conditioning capability is lower than the air-conditioning capability corresponding to the set temperature T_{icm}.

[0026] The hunting measuring block 54b is configured to count the number of times of hunting when the suction temperature T_{ic} becomes lower than or higher than the target suction temperature T_{ico}. When the number of times of hunting counted by the hunting measuring block 54b becomes equal to a set number of times, the correction amount calculating block 54a reduces the temperature correction amount X by the predetermined change amount α . The set number of times is set to, for example, three, and the correction amount calculating block 54a reduces the temperature correction amount X by the change amount α when the number of times of hunting measured by the hunting measuring block 54b becomes equal to three ($X = X - \alpha$). Accordingly, the target suction temperature T_{ico} calculated by Expression (1) becomes closer to the set temperature T_{icm} by the change amount

α .

[0027] In this manner, whether to reduce the temperature correction amount X is determined based on the number of times of hunting of the suction temperature T_{ic}, so that change of the target suction temperature T_{ico} based on the temperature correction amount X is performed after the suction temperature T_{ic} sufficiently becomes stable at a temperature close to the target suction temperature T_{ico} and the suction temperature T_{ic}. This can reliably prevent generation of the thermo OFF due to the hunting of the suction temperature T_{ic} due to hasty change of the target suction temperature T_{ico}.

[0028] The duration measuring block 54c is configured to measure an elapsed time since the correction amount calculating block 54a has changed the temperature correction amount X by the change amount α . The correction amount calculating block 54a is configured to reduce the temperature correction amount X by the change amount α when the elapsed time thus measured becomes equal to or longer than a defined duration Pref. The defined duration Pref is set based on, for example, a target time until the suction temperature T_{ic} becomes equal to the set temperature T_{icm}. Specifically, the defined duration Pref is set to 120 minutes/5 = 24 minutes when the temperature correction amount X changes in five steps as described above and the target time is two hours. The defined duration Pref is set to 24 minutes in the above example, but is not limited thereto and changeable as appropriate.

[0029] In this manner, the temperature correction amount X decreases after the defined duration Pref has elapsed, so that the differential temperature control is performed by using the target suction temperature T_{ico} until the suction temperature T_{ic} reaches a range in which the suction temperature T_{ic} is allowed to be set to the set temperature T_{icm}, which is highly effective in preventing the thermo OFF due to hunting. As a result, actuation of the thermo OFF can be further prevented to set the suction temperature T_{ic} to the set temperature T_{icm} in a short time.

[0030] Fig. 3 is a flowchart of an exemplary process of the cooling operation of the refrigerating and air-conditioning apparatus 1 in Fig. 1. The following describes control of an operation capacity in the refrigerating and air-conditioning apparatus 1 with reference to Figs. 1 to Fig. 3. When the compressor is started, the target suction temperature setting unit 51 sets the target suction temperature T_{ico} by using Expression (1) based on the set temperature T_{icm} and the initial value of the temperature correction amount X (step ST1). Thereafter, the target refrigerant temperature setting unit 52 calculates a difference between the suction temperature T_{ic} detected by the suction temperature detecting device 32 and the target suction temperature T_{ico} (step ST2), and calculates the target refrigerant temperature T_{em} based on this difference (T_{ico}-T_{ic}) (step ST3). Then, the compressor control unit 53 calculates the refrigerant temperature T_e (evaporating temperature) based on the pressure of

the refrigerant detected by the state detecting device 31, and calculates a difference ($T_m - T_e$) between the refrigerant temperature T_e and the target refrigerant temperature T_m (step ST4). Thereafter, the operation capacity of the compressor 11 is controlled based on the difference ($T_m - T_e$) between the refrigerant temperature T_e and the target refrigerant temperature T_m (step ST5).

[0031] Fig. 4 is a flowchart of an exemplary method of setting the target suction temperature in Fig. 3. The following describes the method of setting the target suction temperature T_{ico} based on the temperature correction amount X with reference to Fig. 4. When the temperature correction amount X has an initial value ($X = 1$) and the differential temperature control described above is performed, the hunting measuring block 54b counts the number of times of the hunting of the suction temperature T_{ic} , and the correction amount calculating block 54a determines whether the number of times of hunting becomes equal to the set number of times (for example, three) (steps ST11 to ST13). Specifically, when the suction temperature T_{ic} becomes lower than the target suction temperature T_{ico} (step ST11), then the suction temperature T_{ic} becomes higher than the target suction temperature T_{ico} (step ST12), and thereafter, the suction temperature T_{ic} becomes lower than the target suction temperature T_{ico} (step ST13), it is determined that the number of times of hunting reaches the set number of times.

[0032] Subsequently, after the number of times of hunting has reached the set number of times (YES in step ST13), it is determined whether the defined duration P_{ref} (for example, 24 minutes) has elapsed since the calculation (refer to step ST1) of the target suction temperature T_{ico} using Expression (1) (step ST14). Then, when the defined duration P_{ref} has elapsed since the calculation of the target suction temperature T_{ico} (YES in step ST14), the temperature correction amount X is changed by the change amount α (step ST15). Thereafter, it is determined whether the temperature correction amount X is zero (step ST16). When the temperature correction amount X is larger than zero, the target suction temperature T_{ico} is set again based on a new temperature correction amount X (refer to step ST1 in Fig. 3), and the differential temperature control is performed based on the corrected target suction temperature T_{ico} (refer to steps ST1 to ST5 in Fig. 3). When the temperature correction amount X is zero, the routine of change of the target suction temperature T_{ico} using the temperature correction amount X is ended because the set temperature T_{icm} is equal to the target suction temperature T_{ico} (step ST17 in Fig. 4), and the differential temperature control with the set temperature T_{icm} being the target suction temperature T_{ico} is performed.

[0033] In this manner, when the target suction temperature T_{ico} is set by using the set temperature T_{icm} to which the gradually decreasing temperature correction amount X is applied, the actuation of the thermo OFF can be reduced as compared to the differential temper-

ature control based on comparison between the set temperature T_{icm} per se and the target suction temperature T_{ico} . Fig. 5 is a graph illustrating exemplary transition of the suction temperature during the cooling operation of the refrigerating and air-conditioning apparatus in Fig. 1. In Fig. 5, the horizontal axis represents time, and the vertical axis represents temperature. In Fig. 5, the target suction temperature T_{ico} is set to be higher than the set temperature T_{icm} by the temperature correction amount X , and thus is unlikely to be reduced to an actuation temperature T_{off} at which the thermo OFF occurs, even when the hunting of the suction temperature T_{ic} is generated due to start of the cooling operation. Accordingly, the compressor 11 continues its operation without being stopped by the thermo OFF.

[0034] Fig. 6 is a graph illustrating the transition of the suction temperature during the conventional cooling operation. In Fig. 6, the target suction temperature T_{ico} is set to the set temperature T_{icm} , and the differential temperature control is performed so that the suction temperature T_{ic} becomes equal to the target suction temperature T_{ico} . In some cases, due to the hunting of the suction temperature T_{ic} , the suction temperature T_{ic} becomes equal to or lower than the set temperature T_{icm} and then equal to or lower than the actuation temperature T_{off} for the thermo OFF. As a result, a long time is needed and electrical power is wasted before the space to be air-conditioned reaches at the set temperature T_{icm} because no air-conditioning is performed during the thermo OFF. In Fig. 6, however, the target suction temperature T_{ico} is set to become closer to the set temperature T_{icm} in steps, and thus the actuation of the thermo OFF can be reduced, and the space to be air-conditioned can be controlled to the set temperature T_{icm} in a short time, thereby achieving energy saving.

[0035] In the case in which the temperature correction amount X is changed depending on the number of times of the hunting of the suction temperature T_{ic} , the target suction temperature T_{ico} is changed when the suction temperature T_{ic} sufficiently becomes close to the target suction temperature T_{ico} , which allows stable transition with reduced hunting of the suction temperature T_{ic} . Accordingly, the space to be air-conditioned can be controlled to the set temperature T_{icm} reliably in a short time, thereby achieving energy saving. Moreover, the next temperature correction amount X is changed after the defined duration P_{ref} has elapsed since the previous change of the temperature correction amount X , which allows stable transition with reduced hunting of the suction temperature T_{ic} . Thus, the space to be air-conditioned can be controlled to the set temperature T_{icm} reliably in a short time, thereby achieving energy saving.

[0036] Embodiments of the present invention are not limited to the above-described embodiment. For example, the above-described embodiment describes the setting of the target suction temperature T_{ico} during the cooling operation, but the target suction temperature T_{ico} may be set by the same method also during the heating

operation. Fig. 7 is a graph illustrating the transition of the suction temperature during the heating operation of the refrigerating and air-conditioning apparatus according to the embodiment of the present invention. As illustrated in Fig. 7, during the heating operation, the temperature correction amount X is a parameter for such a correction that the necessary air-conditioning capability becomes lower than the air-conditioning capability corresponding to the set temperature T_{icm} . Specifically, during the heating operation, the target suction temperature T_{ico} is calculated by subtracting the temperature correction amount X from the set temperature T_{icm} in place of Expression (1) to perform the differential temperature control, and the temperature correction amount X changes gradually closer to the set temperature T_{icm} .

[0037] Although Fig. 4 illustrates the example in which both of the determination of the number of times of hunting and the determination of the defined duration P_{ref} are performed, the temperature correction amount X may be changed by performing the determination of the number of times of hunting without the determination of the defined duration P_{ref} , or the temperature correction amount X may be changed by performing the determination of the defined duration P_{ref} without the determination of the number of times of hunting.

Reference Signs List

[0038] 1 refrigerating and air-conditioning apparatus 2 liquid pipe 3 gas pipe 10 heat source unit 11 compressor 12 flow path switching device 13 heat source side heat exchanger 14 accumulator 15 outdoor control device 20A, 20B use side unit 21 expansion device 22 use side heat exchanger 25 indoor control device 31 state detecting device 32 suction temperature detecting device 50 operation control device 51 target suction temperature setting unit 52 target refrigerant temperature setting unit 53 compressor control unit 54 correction amount setting unit 54a correction amount calculating block 54b hunting measuring block 54c duration measuring block P_{ref} defined duration T_e refrigerant temperature T_{em} target refrigerant temperature T_{ic} suction temperature T_{icm} set temperature T_{ico} target suction temperature T_{off} actuation temperature X temperature correction amount α change amount

Claims

1. A refrigerating and air-conditioning apparatus provided with a refrigeration cycle in which a compressor, a heat source side heat exchanger, an expansion device, and a use side heat exchanger are connected through a refrigerant pipe, the refrigerating and air-conditioning apparatus comprising:

a suction temperature detecting device configured to detect, as a suction temperature, a tem-

perature of air sucked into the use side heat exchanger from a space to be air-conditioned; a state detecting device configured to detect a state of refrigerant flowing through inside the use side heat exchanger; and an operation control device configured to control an operation of the compressor based on a set temperature as a target temperature of the air-conditioned space, the suction temperature detected by the suction temperature detecting device, and the state of the refrigerant detected by the state detecting device, wherein the operation control device includes

a correction amount setting unit configured to set a temperature correction amount for such a correction that a necessary air-conditioning capability is lower than an air-conditioning capability corresponding to the set temperature, such that the temperature correction amount is to be reduced by a predetermined change amount at each setting, a target suction temperature setting unit configured to set a target suction temperature based on the temperature correction amount set by the correction amount setting unit and the set temperature, a target refrigerant temperature setting unit configured to set a target refrigerant temperature of refrigerant flowing into the use side heat exchanger such that the suction temperature is to be equal to the target suction temperature, and a compressor control unit configured to control a capacity of the compressor such that the refrigerant flowing into the use side heat exchanger is to be the target refrigerant temperature.

2. The refrigerating and air-conditioning apparatus of claim 1, wherein the correction amount setting unit includes

a hunting measuring block configured to determine whether a number of times of hunting of the suction temperature is larger than a set number of times, and a correction amount calculating block configured to reduce the temperature correction amount by the change amount when the hunting measuring block determines that the number of times of hunting is larger than the set number of times.

3. The refrigerating and air-conditioning apparatus of claim 2, wherein

the hunting measuring block is configured to measure, as the number of times of hunting, a sum of a number of times that the suction temperature becomes lower than the target suction temperature and a number of times that the suction temperature be-

comes higher than the target suction temperature,
and
the correction amount calculating block is configured
to reduce the temperature correction amount by the
change amount when the number of times of hunting 5
becomes equal to or larger than three in the hunting
measuring block.

4. The refrigerating and air-conditioning apparatus of
any one of claims 1 to 3, 10
wherein the correction amount setting unit includes
a duration measuring block configured to measure
an elapsed time since the temperature correction
amount is changed by the change amount, and re- 15
duces the temperature correction amount by the
change amount again when the elapsed time meas-
ured by the duration measuring block becomes equal
to or longer than a defined duration.
5. The refrigerating and air-conditioning apparatus of 20
any one of claims 1 to 4,
wherein the temperature correction amount has an
initial value of one degree C and the change amount
of 0.2 degrees C. 25
6. The refrigerating and air-conditioning apparatus of
any one of claims 1 to 5, wherein the correction
amount setting unit is configured to set the temper-
ature correction amount such that the target suction
temperature is to be higher than the set temperature 30
when the use side heat exchanger serves as an
evaporator.
7. The refrigerating and air-conditioning apparatus of
any one of claims 1 to 5, wherein the correction 35
amount setting unit is configured to set the temper-
ature correction amount such that the target suction
temperature is to be lower than the set temperature
when the use side heat exchanger serves as a con-
denser. 40

45

50

55

FIG. 1

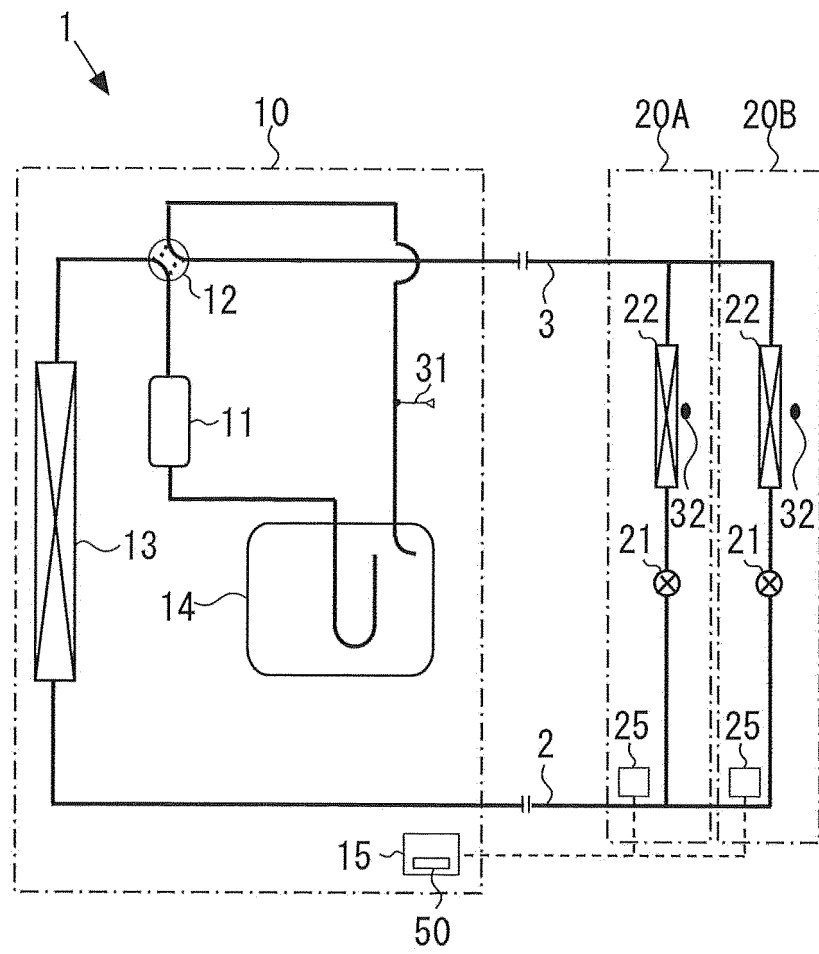


FIG. 2

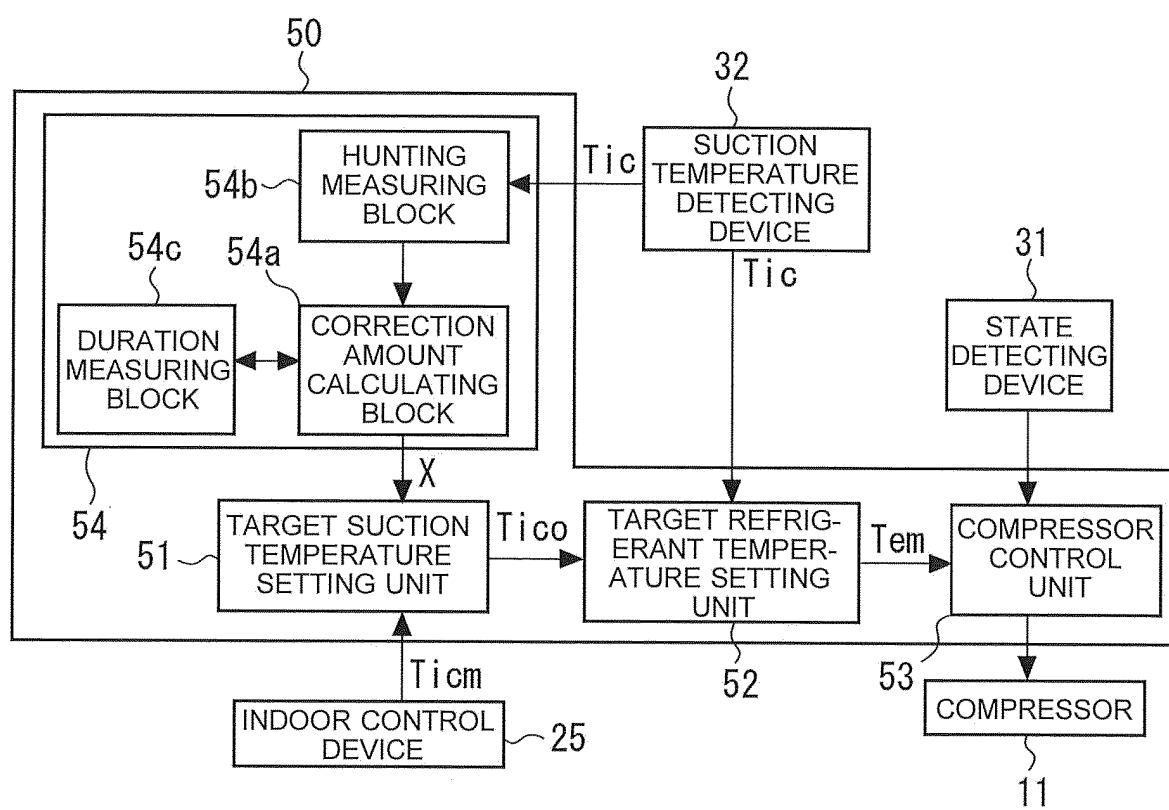


FIG. 3

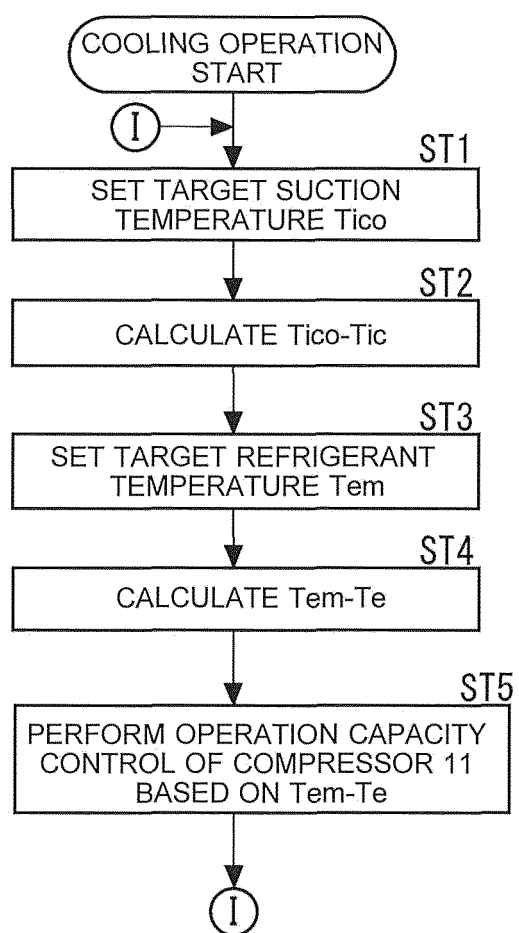


FIG. 4

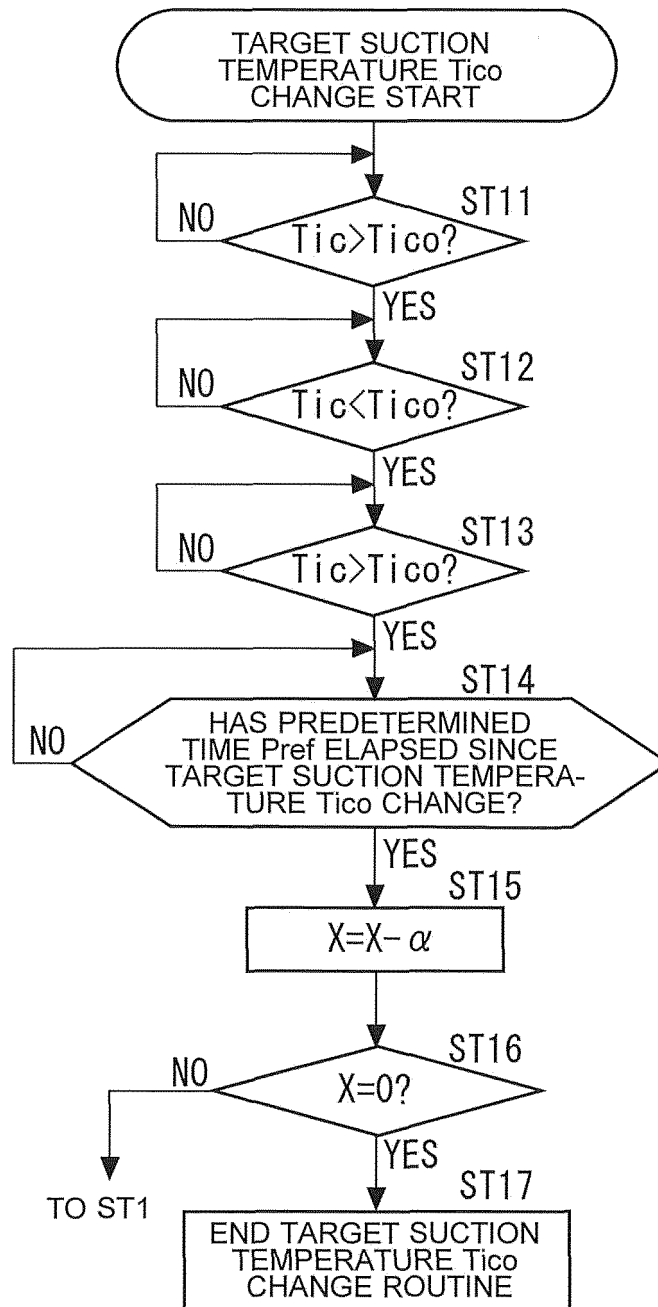


FIG. 5

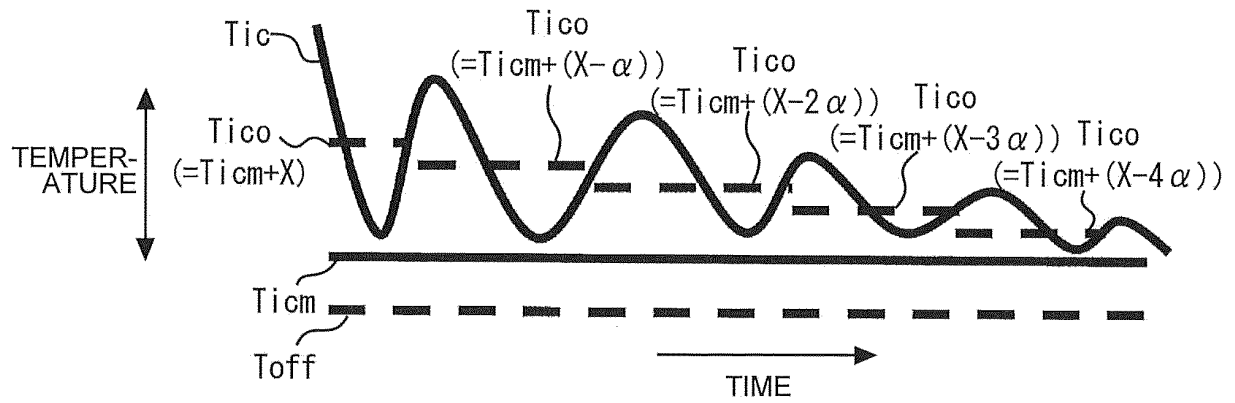


FIG. 6

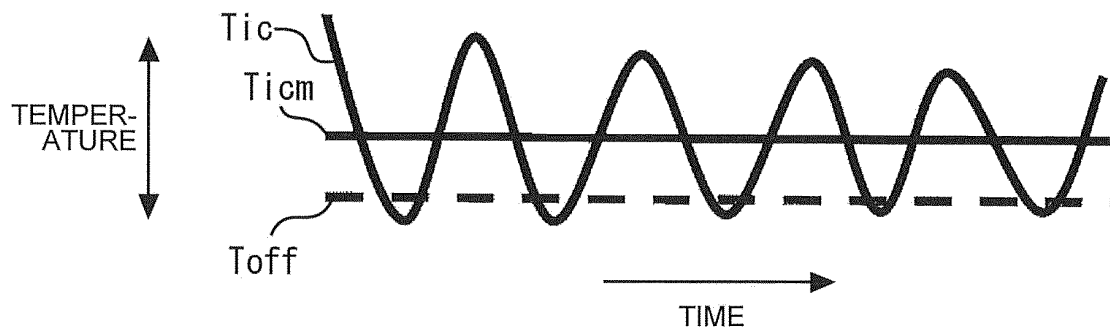
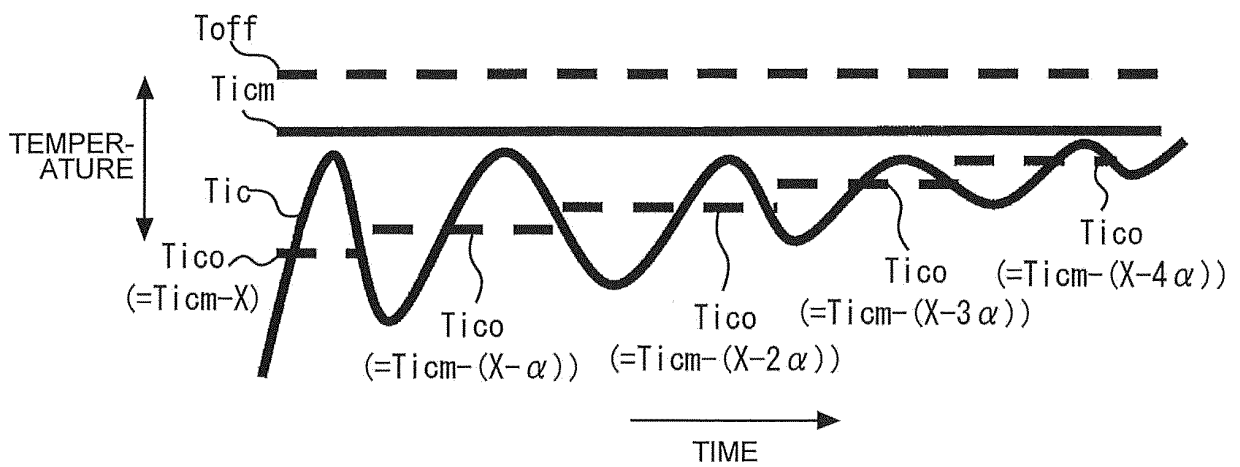


FIG. 7



INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2014/067827

A. CLASSIFICATION OF SUBJECT MATTER

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)

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 1996-2014

Kokai Jitsuyo Shinan Koho 1971-2014 Toroku Jitsuyo Shinan Koho 1994-2014

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.
Y A	JP 10-73300 A (Sanyo Electric Co., Ltd.), 17 March 1998 (17.03.1998), claims 1, 2; paragraphs [0001], [0018] to [0021], [0031], [0033], [0037] to [0039], [0046] to [0060], [0072]; fig. 1, 2, 7, 9 to 11 (Family: none)	1, 4-7 2-3
Y	WO 03/029728 A1 (Daikin Industries, Ltd.), 10 April 2003 (10.04.2003), claim 1; page 4, lines 5 to 21; page 4, line 25 to page 5, line 3; page 5, lines 8 to 13; page 8, line 16 to page 16, line 20; page 19, lines 17 to 28; fig. 1 & JP 3835453 B2 & EP 1431677 A1 & TW 571060 B & AT 514908 T & AU 2002332260 B & ES 2366535 T	1, 4-7

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

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Date of the actual completion of the international search
24 September, 2014 (24.09.14)Date of mailing of the international search report
07 October, 2014 (07.10.14)Name and mailing address of the ISA/
Japanese Patent Office

Authorized officer

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INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2014/067827

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 7-158927 A (Toshiba Corp.), 20 June 1995 (20.06.1995), claim 4; paragraphs [0001], [0010], [0016], [0033], [0038], [0049], [0069]; fig. 7 (Family: none)	4

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REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- JP 2003247742 A [0004]