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(54) **CASCADE REFRIGERATING SYSTEM**

KASKADENKÜHLANLAGE

SYSTÈME DE RÉFRIGÉRATION EN CASCADE

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WO-A1-2008/150289 **JP-A- 2004 190 917**
US-A- 5 170 639

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Description

Technical Field

[0001] The present invention relates to a cascade refrigerating system having a low temperature side refrigerating cycle and a high temperature side refrigerating cycle and a control method for such refrigerating cycle.

Background

[0002] Patent Literature 1 discloses a known cascade refrigerating system. More specifically, Patent Literature 1 discloses a starter device for a cascade refrigerating system provided with a low temperature side refrigerant line provided with low temperature side refrigerant piping having a low temperature side compressor, a cascade condenser, a low temperature side expansion valve and a low temperature side heat exchanger intervening thereon, and a high temperature side refrigerant line provided with high temperature side refrigerant piping having a high temperature side compressor, a condenser, a high temperature side expansion valve and a low temperature side heat exchanger, which exchanges heat with the cascade condenser, intervening thereon, wherein a controller which is equipped with a thermostat for detecting the temperature of the refrigerant flowing in a low pressure part of the high temperature side refrigerant piping, starts the high temperature side compressor at the time of starting operation, starts the low temperature side compressor when the detected temperature of the thermostat falls to or below a set temperature and, when the refrigerant temperature in the low pressure part does not fall to or below the set temperature when a certain length of time has passed since the high temperature side compressor was started, stops the high temperature side compressor.

[0003] Thus, regarding the startup of the cascade refrigerating system intended for refrigeration according to Patent Literature 1, the high temperature side refrigerating cycle is started at the time of starting operation, and the low temperature side refrigerating cycle is started after confirming from the refrigerant temperature a pressure fall due to a fall of the low pressure of the high temperature side refrigerating cycle.

[0004] Patent Literature 1: Japanese Unexamined Patent Application Publication No. Hei2(1990)-143056

[0005] In US 5 170 639 A, a cascade vapor compression refrigeration system having a high stage and a low stage is shown. Each stage has a compressor, evaporator, condenser and expansion device. The high-stage evaporator is in heat transfer relationship with the low-stage condenser. Control means are provided which are responsive to some characteristic related to outdoor temperature whereby high-stage compressor operation is permitted when the outdoor ambient is below a preset temperature and high-stage compressor operation is prevented when the outdoor ambient is above a preset temperature. In JP 2004 190 917 A, a refrigeration device is constituted by heat-exchangeably connecting a vaporizer of a primary side refrigerant circuit and a condenser cascade of the secondary side refrigerant circuit, and uses carbon dioxide as the refrigerant in the secondary side refrigerant circuit. It is an object to enable lowering of design pressure in a refrigeration device using carbon dioxide as a refrigerant in a secondary side refrigerant circuit.

Summary

[0006] In the case of the cascade refrigerating system disclosed in cited Literature 1, the low pressure in the high temperature side refrigerating cycle may fall too low and, depending on the load level, the refrigerating cycle may prove poor in the rate of rise or inefficient.

[0007] The present invention is intended to restrain a fall in space heating capacity due to a deterioration in the rate of rise by suppressing losses at the time of rise of the refrigerating cycle in a cascade refrigerating system. A cascade refrigerating system according to the invention has the features of claim 1.

[0008] A control method for use in a cascade refrigerating system according to claim 1, has the features of claim 3.

[0009] In a cascade refrigerating system according to the invention, a low temperature side refrigerating cycle in which a low temperature side compressor, a cascade heat exchanger, a low temperature side expansion valve and a low temperature side heat exchanger (an evaporator) are connected by low temperature side refrigerant piping and a high temperature side refrigerating cycle in which a high temperature side compressor, a condenser for exchanging heat between high temperature side refrigerant and refrigerated medium, a high temperature side expansion valve and the cascade heat exchanger are connected by high temperature side refrigerant piping are thermally connected via the cascade heat exchanger, and/or the low temperature side compressor is started when the cascade refrigerating system is to be started, and subsequently the high temperature side compressor is started.

[0010] According to the invention, it is possible to restrain a fall in space heating capacity due to a deterioration in the rate of rise by suppressing losses at the time of rise of the refrigerating cycle in the cascade refrigerating system.

Brief Description of the Drawings

[0011]

Fig. 1 shows the configuration of a refrigerating cycle when a cascade refrigerating system is in cascade heating operation.
Fig. 2 is control flow chart 1.
Fig. 3 is control flow chart 2.

Detailed Description

[0012] By using the high temperature side refrigerating cycle of a cascade refrigerating system as the utility side, warm water of high temperature can be generated. However, in a cascade refrigerating system in which a low temperature side refrigerating cycle and a high temperature side refrigerating cycle are thermally connected via a cascade heat exchanger, starting from a state in which the temperature of the cascade heat exchanger is low, the cycles will not be stabilized, with losses arising at the time of rise of the refrigerating cycles and deterioration in the rate of rise, and the space heating capacity will decline.

[0013] In view of this problem, in a cascade refrigerating system of this embodiment of the invention, a low temperature side refrigerating cycle in which a low temperature side compressor, a cascade heat exchanger, a low temperature side expansion valve and a low temperature side heat exchanger (an evaporator) are connected by low temperature side refrigerant piping and a high temperature side refrigerating cycle in which a high temperature side compressor, a condenser for exchanging heat between high temperature side refrigerant and refrigerated medium, a high temperature side expansion valve and the cascade heat exchanger are connected by high temperature side refrigerant piping are thermally connected via the cascade heat exchanger, the low temperature side compressor is started when the cascade refrigerating system is to be started, and subsequently the high temperature side compressor is started. In this embodiment, which is a cascade refrigerating system in which the low temperature side refrigerating cycle and the high temperature side refrigerating cycle are thermally connected via the cascade heat exchanger, when this cascade refrigerating system is to be started, the high temperature side compressor is started after the low temperature side compressor is started and the temperature of the cascade heat exchanger is raised, with the result that the cascade cycle can be started in a state in which the temperature of the cascade heat exchanger is high, so that a stable cascade cyclic operation is possible without inviting a fall in the low pressure of the high temperature side refrigerating cycle, and accordingly it is possible to restrain a fall in space heating capacity due to a deterioration in the rate of rise of the cascade refrigerating system.

[0014] The cascade refrigerating system of this embodiment will be described below with reference to drawings. Fig. 1 is a conf igurational diagram of the refrigerating cycle when the cascade refrigerating system of this embodiment is in cascade heating operation. The cascade refrigerating system is provided with a low temperature side refrigerating cycle 1 and a high temperature side refrigerating cycle 10. The low temperature side refrigerating cycle 1 is configured by connecting a low temperature side compressor 2, an expansion valve 3, a low temperature side heat exchanger 4, a heat exchanger (a condenser) 20 and a cascade heat exchanger 21 by low temperature side refrigerating piping. The high temperature side refrigerating cycle 10 is configured by connecting a high temperature side compressor 11, the heat exchanger 20, a high temperature side expansion valve 12 and the cascade heat exchanger 21 by high temperature side refrigerating piping. Refrigerated medium is caused to flow into the heat exchanger 20 by being circulated by a pump, and is heated by its heat exchange with refrigerant in the heat exchanger 20, and warm water thereby generated is supplied to where it is needed.

[0015] Fig. 2 is a control flow chart of the cascade refrigerating system of this embodiment. With reference to Fig. 2, a control flow to start a cascade cycle from a state in which the cascade cycle of the cascade refrigerating system is at halt in cascade heating operation to supply high temperature water will be described below.

[0016] In the low temperature side refrigerating cycle 1, the refrigerant compressed by the low temperature side compressor 2 turns into high pressure gas and flows into the cascade heat exchanger 21, in which the high pressure gas refrigerant is condensed by exchanging heat with low pressure gas-liquid refrigerant of the high temperature side refrigerating cycle 10. After that, the condensed refrigerant is evaporated in the low temperature side heat exchanger 4 by exchanging heat with air taken in by a fan to become gasified. This gas refrigerant is reduced in pressure by the expansion valve 3 to turn into gas-liquid flow refrigerant, sucked into the compressor 2 to be compressed into high pressure gas again. In the low temperature side refrigerating cycle 1, this cyclic process is repeated.

[0017] In the high temperature side refrigerating cycle 10, the refrigerant compressed in the high temperature side compressor 11 turns into high pressure gas, which flows into the heat exchanger 20 and exchanges heat with the refrigerated medium 30 to become liquefied. The liquid refrigerant is expanded by the expansion valve 12 under reduced pressure to turn into gas-liquid flow refrigerant and flows into the cascade heat exchanger 21, where it exchanges heat with gas refrigerant of the low temperature side refrigerating cycle 1 to become gasified. This gas refrigerant is sucked into the compressor 11 to be compressed into high pressure gas again. In the high temperature side refrigerating cycle 10, this cyclic process is repeated.

[0018] Starting of cascade heating operation will now be described. First, the cascade refrigerating system is started (S1). If the temperature of the cascade heat exchanger 21 is low even though the low temperature side refrigerating cycle 1 is started, the pressure in the low temperature side refrigerating cycle 1 will fall. If the high temperature side refrigerating cycle 10 is started in a fallen state of the capacity of the low temperature side refrigerating cycle 1, the pressure in the low temperature side refrigerating cycle 1 will further fall, and the low pressure in the high temperature side refrigerating cycle 10 will also fall. This would mean a loss in calorific value at

the time of rise, resulting in a cycle poor in the rate of rise. If the high temperature side refrigerating cycle 10 is started in a state in which the low temperature side refrigerating cycle 1 is already started and the temperature of the cascade heat exchanger 21 is raised, a stable refrigerating cycle will be achieved without allowing the pressure in the high temperature side refrigerating cycle 10 to fall. Therefore, in order to start the low temperature side refrigerating cycle 1 to accomplish operation to raise the temperature of the cascade heat exchanger 21, first the low temperature side compressor 2 is started (S2). And when the temperature of the cascade heat exchanger 21 rises to a prescribed level (C°C) (S3), the high temperature side compressor 11 is started (S4). After that, usual cascade heating operation is performed (S5). By the cycle starting so far described, stable cycling operation is made possible at an improved rate of rise in cascade heating operation.

[0019] Fig. 3 is another control flow chart of the cascade refrigerating system of this embodiment. For starting of the cascade heating operation, the control charted in Fig. 2 can be replaced by that charted in Fig. 3. More specifically, first the cascade refrigerating system is started (S1). Next, as in the case of Fig. 2, the low temperature side compressor 2 is started (S2). And when the temperature of the cascade heat exchanger 21 has risen to the prescribed level (C°C) (S3-1), the high temperature side compressor 11 is started (S4). On the other hand, even if a state in which the temperature of the cascade heat exchanger does not rise to the prescribed level (C°C) continues, as the cascade heat exchanger 21 is already warmed, if a prescribed length of time (D seconds) has passed since the start of the low temperature side compressor 2 to prevent the low temperature side refrigerating cycle 1 from failing to achieve condensation and the temperature of the cascade heat exchanger 21 from failing to rise (S3-2), the high temperature side compressor 11 is started (S4). Control in this way enables the rate of rise at the time of cascade heating operation to be improved to make possible stable cyclic operation. After that, usual cascade heating operation is performed (S5).

[0020] In addition, if any abnormality is detected in the low temperature side refrigerating cycle 1 or in the high temperature side refrigerating cycle 10 during cascade heating operation and the low temperature side compressor 2 or the high temperature side compressor 11 is stopped, the low temperature side compressor 2 and the high temperature side compressor 11 is stopped, followed by retrial of starting. This retried starting can also be cascade heating operation similar to what was described with respect to the embodiment.

Claims

1. A cascade refrigerating system comprising:

a low temperature side refrigerating cycle (1) in which a low temperature side compressor (2), a cascade heat exchanger (21), a low temperature side expansion valve (3) and a low temperature side heat exchanger (4) are connected by low temperature side refrigerant piping;
a high temperature side refrigerating cycle (10) in which a high temperature side compressor (11), a heat exchanger (20) for exchanging heat between high temperature side refrigerant and refrigerated medium (30), a high temperature side expansion valve (12) and the cascade heat exchanger (21) are connected by high temperature side refrigerant piping wherein the high temperature side refrigerating cycle (10) is thermally connected with the low temperature side refrigerating cycle (1) via the cascade heat exchanger (21); and a control system (40);
characterized in that
the control system (40) is configured to start the low temperature side compressor (2) when the cascade refrigerating system is started, and

- to subsequently start the high temperature side compressor (11), on the condition that the temperature of the cascade heat exchanger (21) has reached a prescribed temperature; or
- to start the high temperature side compressor (11) on the condition that a prescribed length of time has passed since the start of the low temperature side compressor (2), even if the temperature of the cascade heat exchanger (21) has not reached the prescribed temperature.

2. The cascade refrigerating system of claim 1, wherein the control system (40) is configured to stop the low temperature side compressor (2) and the high temperature side compressor (11), followed by retrial of starting, on the condition that an abnormality is detected during operation in the low temperature side refrigerating cycle (1) or the high temperature side refrigerating cycle (10) and the low temperature side compressor (2) or the high temperature side compressor (11) is stopped.

3. A control method for use in a cascade refrigerating system that includes:

a low temperature side refrigerating cycle (1) in which a low temperature side compressor (2), a cascade heat exchanger (21), a low temperature side expansion valve (3) and a low temperature side heat exchanger (4) are connected by low temperature side refrigerant piping; and
a high temperature side refrigerating cycle (10) in which a high temperature side compressor (11), a heat exchanger (20) for exchanging heat

between high temperature side refrigerant and refrigerated medium (30), a high temperature side expansion valve (12) and the cascade heat exchanger (21) are connected by high temperature side refrigerant piping, wherein the high temperature side refrigerating cycle (10) is thermally connected with the low temperature side refrigerating cycle (1) via the cascade heat exchanger (21),
characterized in that the method comprises:
starting the low temperature side compressor (2) when the cascade refrigerating system is started; and

- determining if the temperature of the cascade heat exchanger (21) is higher than a prescribed temperature; and starting the high temperature side compressor (11) if the temperature of the cascade heat exchanger (21) is higher than the prescribed temperature; or
- determining if a prescribed length of time has passed since the start of the low temperature side compressor (2); and starting the high temperature side compressor (11) if the prescribed length of time has passed since the start of the low temperature side compressor (2), even if the temperature of the cascade heat exchanger (21) has not reached the prescribed temperature.

4. The control method according to claim 3, further comprising:
stopping the low temperature side compressor (2) and the high temperature side compressor (11), followed by retrial of starting, if an abnormality is detected during operation in the low temperature side refrigerating cycle (1) or the high temperature side refrigerating cycle (10) and the low temperature side compressor (2) or the high temperature side compressor (11) is stopped.

Patentansprüche

1. Kaskadenkühlsystem, umfassend:

- einen niedertemperaturseitigen Kühlkreislauf (1), in dem ein niedertemperaturseitiger Kompressor (2), ein Kaskadenwärmetauscher (21), ein niedertemperaturseitiges Expansionsventil (3) und ein niedertemperaturseitiger Wärmetauscher (4) mit niedertemperaturseitigen Kühlmittelleitungen verbunden sind;
- einen hochtemperaturseitigen Kühlkreislauf (10), in dem ein hochtemperaturseitiger Kompressor (11), ein Wärmetauscher (20) zum Austausch von Wärme zwischen hochtemperaturseitigem Kühlmittel und Kühlmittel (30), ein hochtemperaturseitiges Expansionsventil (12) und der Kaskadenwärmetauscher (21) mit hochtemperaturseitigen Kühlmittelleitungen verbunden sind, wobei der hochtemperaturseitige Kühlkreislauf (10) thermisch mit dem niedertemperaturseitigen Kühlkreislauf (1) über den Kaskadenwärmetauscher (21) verbunden ist; und
- ein Steuerungssystem (40); **dadurch gekennzeichnet, dass**

das Steuerungssystem (40) dazu eingerichtet ist, den niedertemperaturseitigen Kompressor (2) zu starten, wenn das Kaskadenkühlsystem gestartet wird, und
den hochtemperaturseitigen Kompressor (11) unter der Bedingung, dass die Temperatur des Kaskadenwärmetauschers (21) eine vorgeschriebene Temperatur erreicht hat unmittelbar zu starten, oder
den hochtemperaturseitigen Kompressor (11) unter der Bedingung, dass seit dem Start des niedertemperaturseitigen Kompressors (2) eine vorgeschriebene Zeit verstrichen ist auch dann zu starten, wenn die Temperatur des Kaskadenwärmetauschers (21) nicht die vorgeschriebene Temperatur erreicht hat.

2. Kaskadenkühlsystem nach Anspruch 1, wobei
das Steuerungssystem (40) dazu eingerichtet ist, den niedertemperaturseitigen Kompressor (2) und den hochtemperaturseitigen Kompressor (11) zu stoppen, gefolgt von einem erneuten Startversuch, unter der Bedingung, dass eine Unregelmäßigkeit während des Betriebs im niedertemperaturseitigen Kühlkreislauf (1) oder im hochtemperaturseitigen Kühlkreislauf (10) festgestellt wird, und der niedertemperaturseitige Kompressor (2) oder der hochtemperaturseitige Kompressor (11) gestoppt wird.

3. Steuerverfahren zur Verwendung in einem Kaskadenkühlsystem, umfassend:

- einen niedertemperaturseitigen Kühlkreislauf (1), in dem ein niedertemperaturseitiger Kompressor (2), ein Kaskadenwärmetauscher (21), ein niedertemperaturseitiges Expansionsventil (3) und ein niedertemperaturseitiger Wärmetauscher (4) mit niedertemperaturseitigen Kühlmittelleitungen verbunden sind; und
- einen hochtemperaturseitigen Kühlkreislauf (10), in dem ein hochtemperaturseitiger Kompressor (11), ein Wärmetauscher (20) zum Austausch von Wärme zwischen hochtemperaturseitigem Kühlmittel und Kühlmittel, ein hochtemperaturseitiges Expansionsventil (12) und der Kaskadenwärmetauscher (21) mit hochtemperaturseitigen Kühlmittelleitungen verbunden sind, wobei der hochtemperaturseitige Kühl-

kreislauf (10) über den Kaskadenwärmetauscher (21) thermisch mit dem niedertemperaturseitigen Kühlkreislauf (1) verbunden ist,

dadurch gekennzeichnet, dass das Verfahren umfasst:

- Starten des niedertemperaturseitigen Kompressors (2), wenn das' Kaskadenkühlsystem gestartet wird; und
- Bestimmen, ob die Temperatur des Kaskadenwärmetauschers (21) höher als eine vorgeschriebene Temperatur ist; und Starten des hochtemperaturseitigen Kompressors (11), wenn die Temperatur des Kaskadenwärmetauschers (21) höher als die vorgeschriebene Temperatur ist; oder
- Bestimmen, ob eine vorgeschriebene Zeitdauer seit dem Start des niedertemperaturseitigen Kompressors (2) verstrichen ist; und Starten des hochtemperaturseitigen Kompressors (11), wenn die vorgeschriebene Zeitdauer seit dem Start des niedertemperaturseitigen Kompressors (2) verstrichen ist, auch dann, wenn die Temperatur des Kaskadenwärmetauschers (21) die vorgeschriebene Temperatur nicht erreicht hat.

4. Steuerverfahren nach Anspruch 3, ferner umfassend:
Stoppen des niedertemperaturseitigen Kompressors (2) und des hochtemperaturseitigen Kompressors (11), gefolgt von einem erneuten Startversuch, wenn während des Betriebs im niedertemperaturseitigen Kühlkreislauf (1) oder im hochtemperaturseitigen Kühlkreislauf (10) eine Unregelmäßigkeit festgestellt wird und der niedertemperaturseitige Kompressor (2) oder der hochtemperaturseitige Kompressor (11) gestoppt wird.

Revendications

1. Système de réfrigération en cascade comprenant :

un cycle de réfrigération côté basse température (1) dans lequel un compresseur côté basse température (2), un échangeur de chaleur en cascade (21), une vanne d'expansion côté basse température (3) et un échangeur de chaleur côté basse température (4) sont connectés par une tuyauterie pour réfrigérant côté basse température ;
un cycle de réfrigération côté haute température (10) dans lequel un compresseur côté haute température (11), un échangeur de chaleur (20) pour échanger de la chaleur entre un réfrigérant côté haute température et un fluide réfrigéré (30), une vanne d'expansion côté haute température (12) et l'échangeur de chaleur en cascade (21) sont connectés par une tuyauterie pour réfrigérant côté haute température, dans lequel le cycle de réfrigération côté haute température (10) est connecté thermiquement au cycle de réfrigération côté basse température (1) via l'échangeur de chaleur en cascade (21) ; et
un système de commande (40) ;
caractérisé en ce que
le système de commande (40) est configuré pour démarrer le compresseur côté basse température (2) quand le système de réfrigération en cascade est démarré, et

- pour démarrer ensuite le compresseur côté haute température (11), à la condition que la température de l'échangeur de chaleur en cascade (21) ait atteint une température prescrite ; ou
- pour démarrer le compresseur côté haute température (11) à la condition qu'une période temporelle prescrite se soit écoulée depuis le démarrage du compresseur côté basse température (2), même si la température de l'échangeur de chaleur en cascade (21) n'a pas atteint la température prescrite.

2. Système de réfrigération en cascade selon la revendication 1, dans lequel le système de commande (40) est configuré pour arrêter le compresseur côté basse température (2) et le compresseur côté haute température (11) suivi d'un nouvel essai de démarrage, à la condition qu'une anomalie soit détectée pendant le fonctionnement dans le cycle de réfrigération côté basse température (1) ou dans le cycle de réfrigération côté haute température (10), et que le compresseur côté basse température (2) ou le compresseur côté haute température (11) soit arrêté.

3. Procédé de commande pour utiliser un système de réfrigération en cascade qui inclut :

un cycle de réfrigération côté basse température (1) dans lequel un compresseur côté basse température (2), un échangeur de chaleur en cascade (21), une vanne d'expansion côté basse température (3) et un échangeur de chaleur côté basse température (4) sont connectés par une tuyauterie pour réfrigérant côté basse température ; et
un cycle de réfrigération côté haute température (10) dans lequel un compresseur côté haute température (11), un échangeur de chaleur (20) pour échanger de la chaleur entre un réfrigérant côté haute température et un fluide réfrigéré

(30), une vanne d'expansion côté haute température (12) et l'échangeur de chaleur en cascade (21) sont connectés par une tuyauterie pour réfrigérant côté haute température, dans lequel le cycle de réfrigération côté haute température (10) est connecté thermiquement avec le cycle de réfrigération côté basse température (1) via l'échangeur de chaleur en cascade (21),
caractérisé en ce que le procédé comprend les étapes consistant à :
démarrer le compresseur côté basse température (2) quand le système de réfrigération en cascade est démarré ; et

- déterminer si la température de l'échangeur de chaleur en cascade (21) est plus élevée qu'une température prescrite ; et démarrer le compresseur côté haute température (11) si la température de l'échangeur de chaleur en cascade (21) est supérieure à la température prescrite ; ou
- déterminer si une période temporelle prescrite s'est écoulée depuis le démarrage du compresseur côté basse température (2) ; et démarrer le compresseur côté haute température (11) si la période temporelle prescrite s'est écoulée depuis le démarrage du compresseur côté basse température (2), même si la température de l'échangeur de chaleur en cascade (21) n'a pas atteint la température prescrite.

4. Procédé de commande selon la revendication 3, comprenant en outre les étapes consistant à :
arrêter le compresseur côté basse température (2) et le compresseur côté haute température (11), effectuer à la suite un nouvel essai de démarrage, si une anomalie est détectée pendant le fonctionnement dans le cycle de réfrigération côté basse température (1) ou dans le cycle de réfrigération côté haute température (10) et que le compresseur côté basse température (2) ou le compresseur côté haute température (11)est arrêté.

FIG. 1

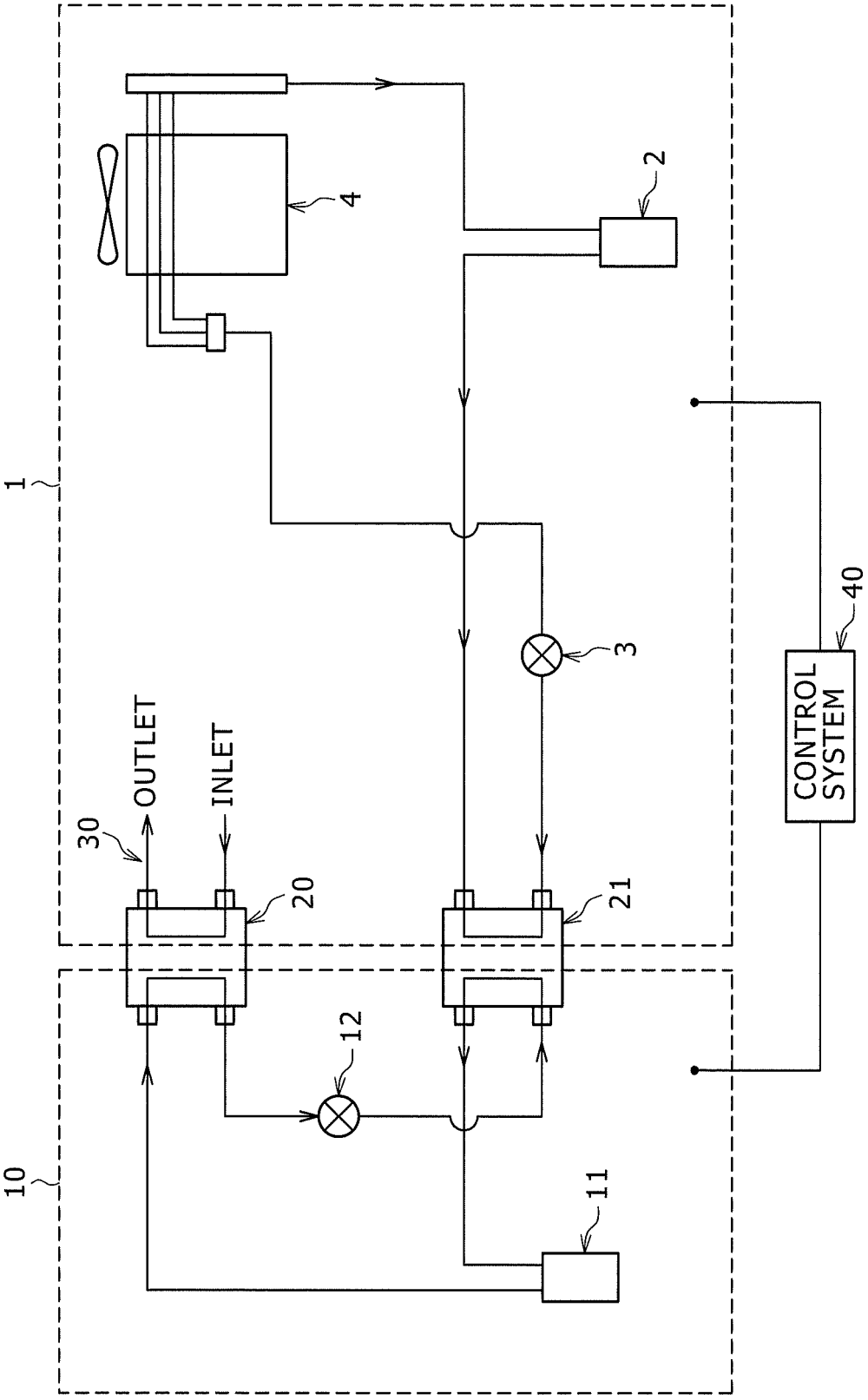


FIG. 2

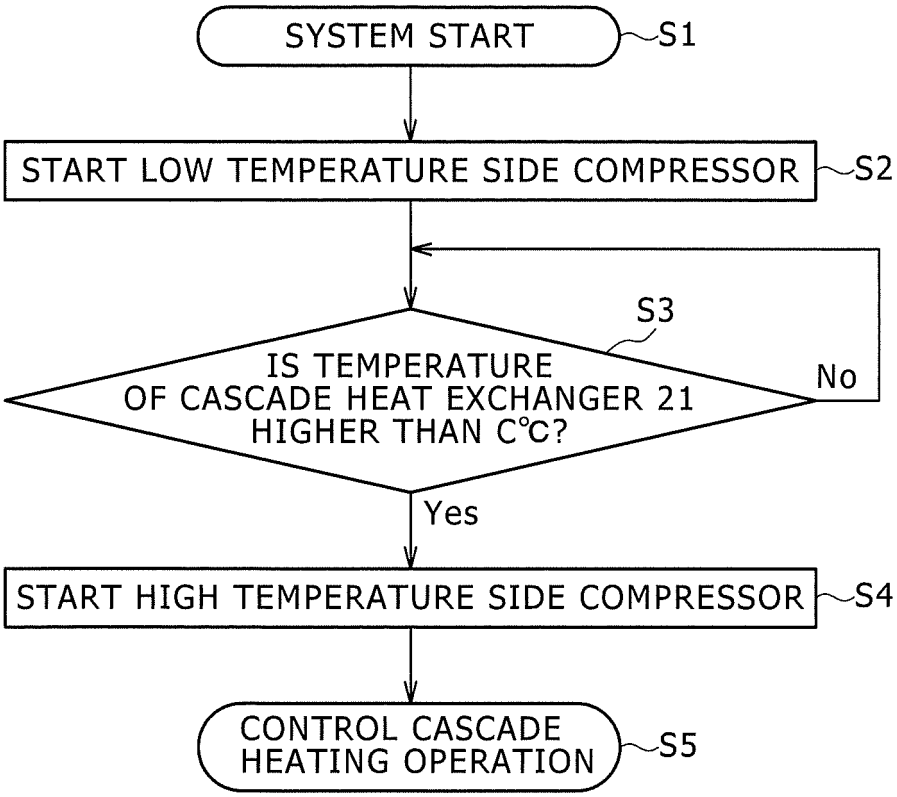
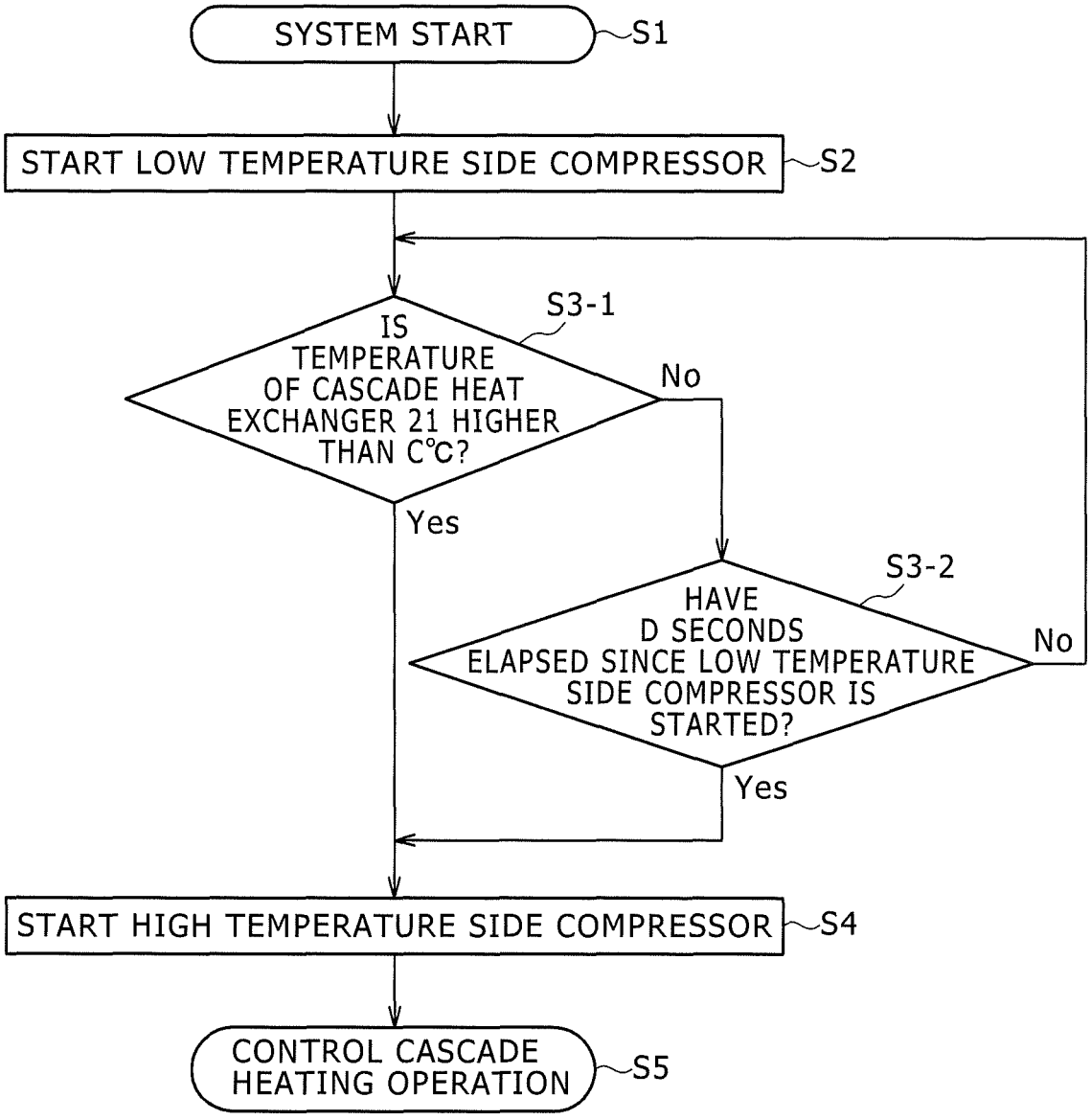

SYSTEM START
S1
START LOW TEMPERATURE SIDE COMPRESSOR
S2
S3
IS TEMPERATURE OF CASCADE HEAT EXCHANGER 21 HIGHER THAN C°C?
No
Yes
START HIGH TEMPERATURE SIDE COMPRESSOR
S4
CONTROL CASCADE HEATING OPERATION
S5

FIG. 3


SYSTEM START
S1
START LOW TEMPERATURE SIDE COMPRESSOR
S2
S3-1
IS TEMPERATURE OF CASCADE HEAT EXCHANGER 21 HIGHER THAN C℃?
No
Yes
S3-2
HAVE D SECONDS ELAPSED SINCE LOW TEMPERATURE SIDE COMPRESSOR IS STARTED?
No
Yes
START HIGH TEMPERATURE SIDE COMPRESSOR
S4
CONTROL CASCADE HEATING OPERATION
S5

REFERENCES CITED IN THE DESCRIPTION

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- JP 2004190917 A **[0005]**