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

(72) Inventors:
- **INAGAKI, Tomoki**
  Tokyo 102-0073 (JP)
- **OKANO, Hiroyuki**
  Tokyo 100-8310 (JP)
- **MORIMOTO, Osamu**
  Tokyo 100-8310 (JP)
- **OKA, Shinji**
  Tokyo 102-0073 (JP)

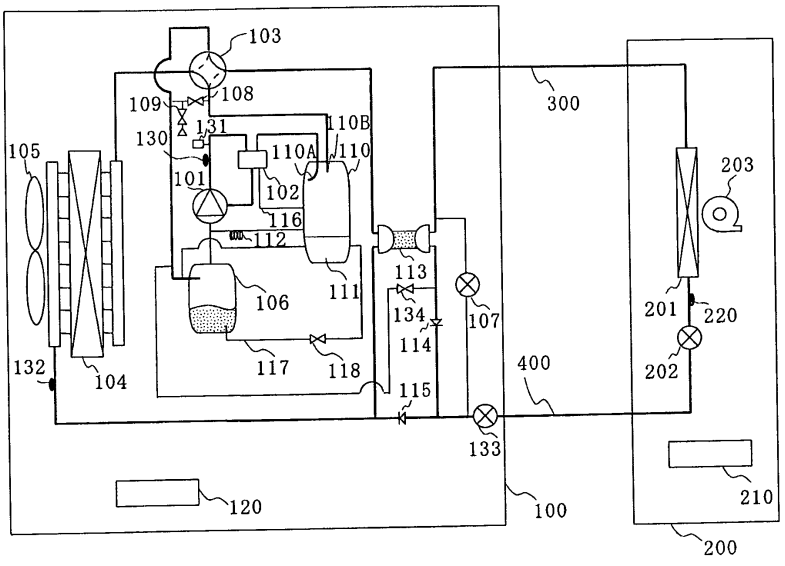
(74) Representative: **Pfenning, Meinig & Partner GbR**
Theresienhöhe 13
80339 München (DE)

(54) HEAT-SOURCE-SIDE UNIT AND REFRIGERATION AIR CONDITIONER

(57) A heat source side unit and a refrigeration air-conditioning apparatus capable of effective use of a tank or the like and efficient recovery or the like are provided.

In a heat source side unit 100 which has a compressor 101 and a heat source side heat exchanger 104 and forms a refrigerant cycle by connecting a load side expansion device 202 and a load side heat exchanger 201 by a pipeline, an oil tank 110 which feeds refrigerator oil whose amount has become insufficient by washing of the refrigerant cycle to the compressor 101 for replenishment is further provided in the refrigerant cycle.

F I G. 1



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Description

Technical Field

[0001] The present invention relates to a heat source side unit and a refrigeration air-conditioning apparatus. Particularly, the present invention relates to an apparatus which can wash an existing refrigerant pipeline and recover foreign substances and the like when the air-conditioning apparatus is installed.

Background Art

[0002] Hitherto, when a refrigeration air-conditioning apparatus, which is a so-called split refrigeration cycle apparatus, is installed in a building or the like, the installation might be accomplished by using an existing refrigerant pipeline (hereinafter referred to as an existing pipeline). For example, a heat source side unit and a load side unit to be removed are replaced by a new heat source side unit (outdoor unit) and load side unit (indoor unit) and they are connected to the existing pipeline to perform the installation. In such installation, since it is not necessary to replace the refrigerant pipeline with a new one, labor, cost and time required for the replacement work of the refrigerant pipeline can be reduced. Also, since it is only necessary to replace the heat source side unit and the load side unit, large-scale construction work in the building or the like in which the refrigeration air-conditioning apparatus is installed is not required, and reliability of the refrigeration air-conditioning apparatus is improved.

[0003] When the existing pipeline is used as described above, in the refrigeration air-conditioning apparatus, usually after the heat source side unit and the load side unit are replaced, old refrigerator oil (mineral oil) remaining in the existing pipeline and other foreign substances such as depleted substances (hereinafter referred to as foreign substances and the like) are recovered (See Patent Literature 1, for example).

Citation List

Patent Literature

[0004] Patent Literature 1: Japanese Unexamined Patent Application Publication No. 2004-333121 (Fig. 2)

Summary of Invention

Technical Problem

[0005] In the refrigeration air-conditioning apparatus as above, a new refrigerant is made to circulate through a refrigerant cycle through which a refrigerant is circulated, for example, so that the foreign substances and the like remaining in the existing pipeline are washed out by the refrigerant and recovered (hereinafter the operation for washing and recovering the foreign substances and the like is referred to as a recovery operation). Thus, a recovery unit (recovery tank) which catches and recovers the washed-out foreign substances and the like by a filter, gravity separation or the like becomes necessary. Also, an oil tank is also needed to replenish new refrigerator oil (hereinafter referred to as refrigerator oil) whose amount becomes insufficient during the recovery operation.

[0006] The recovery unit or oil tank as above is means which occupies a large capacity in the heat source side unit and is left in the heat source side unit even after the recovery operation, for example, until it is replaced by the subsequent heat source side unit. Here, the oil tank is disposed independently of the refrigerant cycle and has pipeline connection or the like to replenish the refrigerator oil in a compressor separately from an oil separator mounted in the refrigerant cycle.

[0007] Also, the recovery unit is disposed on a pipeline of another system connected in parallel with the refrigerant cycle. Here, when an outside air temperature is low, for example, the refrigerant stagnation occurs in the recovery unit and the refrigerant can collect in the recovery unit more than necessary. If it is judged that the refrigerant is not sufficient in the refrigerant cycle, and the refrigerant is replenished in this state, a charged amount of the refrigerant might be inadvertently large. As a result, excess charging of the refrigerant increases a cost or an excess refrigerant overflows from an accumulator, which might make liquid return into the compressor excessive and break the compressor or the like.

[0008] The present invention was made to solve the above problems and an object thereof is to provide a heat source side unit and a refrigeration air-conditioning apparatus in which a tank can be effectively used or the like, efficient recovery can be made, and a refrigerant amount can be made appropriate.

Solution to Problem

[0009] A heat source side unit according to the present invention is a heat source side unit, which has a compressor and a heat source side heat exchanger and forms a refrigerant cycle by connecting an expansion device and a load side heat exchanger by a pipeline, including an oil tank to feed and supply refrigerator oil to the compressor due to a lack of refrigeration oil caused by washing the refrigerant cycle. The oil tank is disposed in the refrigerant cycle. Also, the oil tank and a recovery unit are integrally formed having a partition with pressure resistance between them. Advantageous Effects of Invention

[0010] According to the present invention, since the oil tank is disposed in the refrigerant cycle so that the refrigerant can pass therethrough, the refrigerant cycle can be simplified, workability is improved, and a manufacturing cost can be reduced. Also, pulsation of the refrigerant discharged from the compressor can be reduced or the

like in the oil tank. Moreover, by integrally forming the oil tank and the recovery unit, temperature drop of the recovery unit is prevented, and stagnation of the refrigerant in the recovery unit can be prevented. Thus, a refrigerant amount which has been decreased by the recovery operation can be judged with accuracy, and an appropriate amount of the refrigerant can be replenished. Therefore, a risk of liquid return of the excess refrigerant to the compressor is reduced, and a system with high reliability can be realized.

Brief Description of Drawings

[0011]

[Fig. 1] Fig. 1 is a diagram illustrating a configuration of a refrigeration air-conditioning apparatus according to Embodiment 1.
[Fig. 2] Fig. 2 is a diagram illustrating a procedure related to replacement including a recovery operation.
[Fig. 3] Fig. 3 is a flowchart illustrating processing related to charging of a refrigerant into a refrigerant cycle during the recovery operation. Description of Embodiments

Embodiment 1.

[0012] Fig. 1 is a configuration diagram of a refrigeration air-conditioning apparatus according to Embodiment 1 of the present invention. In this embodiment, a refrigeration air-conditioning apparatus, which is a refrigeration cycle (heat-pump cycle) apparatus, will be described. The refrigeration air-conditioning apparatus in Fig. 1 is provided with a heat source side unit (outdoor unit) 100 and a load side unit (indoor unit) 200, and these units are connected by refrigerant pipelines so as to form a refrigerant cycle (hereinafter referred to as a refrigerant cycle) through which a refrigerant is circulated. Among the refrigerant pipelines, a pipeline through which a gas refrigerant flows is referred to as a gas pipeline 300, and a pipeline through which a liquid refrigerant (liquid refrigerant, or a gas-liquid two-phase refrigerant in case) flows is referred to as a liquid pipeline 400. In this embodiment, the heat source side unit (outdoor unit) 100 and the load side unit (indoor unit) 200 are assumed to be new units after the replacement. Also, the gas pipeline 300 and the liquid pipeline 400 are assumed to be existing pipelines. Here, the magnitude of the pressure is not determined by a relationship with a pressure that serves as a reference (numerical value). The magnitude of the pressure is assumed to be expressed on the basis of a relative level in the refrigerant cycle as the result of control of pressurization of a compressor 101, an open/closed state (opening degree) of each expansion device (flow control device) and the like. The same also applies to temperature.

[0013] With regard to the refrigerant to be circulated through the refrigerant cycle, a non-azeotropic refrigerant mixture (R407C or the like), a near-azeotropic refrigerant mixture (R410A, R404A or the like), a single refrigerant (R22, R134a or the like), a natural refrigerant (carbon dioxide, propane or the like) can be used. Here, the type of refrigerant used before and after the replacement may be the same or may be different.

[0014] The heat source side unit 100 of this embodiment has the compressor 101, an oil separator 102, a four-way valve 103, a heat source side heat exchanger 104, a heat source side fan 105, an accumulator 106, a heat source side expansion device (expansion valve) 107, a second heat source side expansion device (expansion valve) 133, an on-off valve 134, a refrigerant supply on-off valve 108, a refrigerant charging port on-off valve 109, an oil tank 110, an inter-refrigerant heat exchanger 113, and check valves 114 and 115 in the refrigerant cycle. Also, in a system different from the refrigerant cycle, a recovery unit 111 and a capillary tube 112 are connected. A heat source side control device 120 is provided in order to control each device (means) in the refrigerant cycle. The oil tank 110 and the recovery unit 111 are integrally formed and have a mirror plate made of copper or the like therebetween.

[0015] The compressor 101 is formed of an inverter circuit, a compressor motor and the like. A rotation speed (operation frequency of the compressor 101) of the compressor motor is controlled by the inverter circuit, and the refrigerant used in the refrigeration cycle is compressed and circulated through the refrigerant pipeline. Also, the oil separator 102 separates, from the refrigerant, the refrigerator oil which is mixed with the refrigerant, discharged from the compressor 101 and becomes lubricant oil. Then, the separated refrigerator oil is made to flow into the oil tank 110 through an oil pipeline 116 and to return to the compressor 101 through the oil tank 110 so as to unify a path of return oil.

[0016] The four-way valve 103 switches the flow of the refrigerant according to a cooling operation and a heating operation on the basis of an instruction from the heat source side control device 120. Also, the heat source side heat exchanger 104 exchanges heat between the refrigerant and the air (outside air). For example, the heat exchanger functions as an evaporator during the heating operation and exchanges heat between a low-pressure refrigerant and the air so as to evaporate and gasify the refrigerant. Also, the heat exchanger functions as a condenser during cooling operation and exchanges heat between the refrigerant having been compressed in the compressor 101 and flowed in from the four-way valve 103 and the air so as to condense and liquefy the refrigerant. In the heat source side heat exchanger 104, the heat source side fan 105 is disposed so as to exchange heat between the refrigerant and the air efficiently. The heat source side fan 105 may also have an inverter circuit so that the operation frequency of the fan motor is arbitrarily changed so as to finely change the rotation speed of the fan.

[0017] The accumulator 106 is means which collects an excess liquid refrigerant, for example. In this embodiment, the accumulator also plays the role of separating foreign substances and the like. The heat source side expansion device 107 adjusts the flow rate and pressure of the refrigerant flowing from a pipeline through which mainly a liquid refrigerant flows to a pipeline through which mainly a gas refrigerant flows, for example. Moreover, the second heat source side expansion device 133 mainly adjusts the pressure by a using saturation value on the basis of detection performed by a downstream-side pressure sensor (not shown) in accordance with a withstanding pressure of the liquid pipeline 400 during the cooling operation. Also, the expansion device adjusts a liquid back amount flowing back to the accumulator 106 by using a discharge superheat degree of the compressor 101 during the heating operation.

[0018] The oil tank 110 is filled with the refrigerator oil, and when the refrigerator oil mixed into the refrigerant and discharged from the compressor 101 during a recovery operation, for example, collects in the recovery unit 111 and does not return and the amount thereof becomes insufficient, the refrigerator oil in the compressor 101 is replenished. Here, in this embodiment, the oil tank has a refrigerant inflow pipe port 110A and a refrigerant outflow pipe port 110B, and the oil tank 110 is disposed (connected by pipeline in series) in the refrigerant cycle particularly between the oil separator 102 (compressor 101) and the four-way valve 103 (when the four-way valve 103 is not provided, the heat source side heat exchanger 104). Also, in this embodiment, one housing is partitioned by a mirror plate or the like so as to form two spaces, one of which is used as the oil tank 110 and the other as the recovery unit 111. Though not particularly illustrated, an on-off valve is provided so that the refrigerator oil does not leak from the oil tank 110 at shipment. The details of the oil tank 110 and the like will be described later.

[0019] The recovery unit 111 has a sufficient space or the like so that foreign substances precipitate (settle) by use of a filter or gravity and recovers foreign substances and the like carried with the refrigerant and having collected on the bottom part of the accumulator 106 and returns the refrigerant flowing with the foreign substances and the like to the accumulator 106 in the recovery. Thus, a circuit for recovery different from the refrigerant cycle is formed by a recovery pipeline 117 between the recovery unit and the accumulator 106. Also, a recovery on-off valve 118 is disposed in the recovery pipeline 117 and is closed except when the foreign substances and the like are recovered by the recovery unit 111, for example, so that the foreign substances and the like do not leak out.

[0020] In the oil pipeline 116 which feeds the oil to the suction side of the compressor 101 from the oil tank 110, the capillary tube 112 adjusts the amount of refrigerator oil to be fed to the compressor 101 from the oil tank 110. Here, the amount of refrigerator oil may be adjusted by using a solenoid valve, a flow control device or the like instead of the capillary tube 112. Also, by arranging the capillary tube 112 and the solenoid valve in parallel, the solenoid valve may be opened so that the refrigerator oil is supplied to the compressor 101 in a state in which the amount of refrigerator oil is not sufficient such as immediately after washing.

[0021] The inter-refrigerant heat exchanger 113 exchanges heat between the refrigerant flowing into/out of the liquid pipeline 400 and the refrigerant flowing into/out of the gas pipeline 300. Particularly in this embodiment, since the gas-liquid two-phase refrigerant has a pipeline washing effect higher than that of a gas or liquid single-phase refrigerant, the gas-liquid two-phase refrigerant is made to pass through the liquid pipeline 400 and the gas pipeline 300 by heat exchange during the recovery operation. Also, during the usual cooling operation, heat is exchanged between the liquid refrigerant to be fed out to the load side unit 200 and the refrigerant from the load side unit 200 side so as to supercool the liquid refrigerant. Then, during the usual heating operation, the check valves 114 and 115 are disposed for bypassing so that the refrigerant flowing in from the load side unit 200 does not pass through the inter-refrigerant heat exchanger 113.

[0022] Also, the refrigerant supply on-off valve 108 is a valve which forms the flow of the refrigerant from the compressor 101 discharge side to the suction side by being opened so that the refrigerant flows from a refrigerant charging port which becomes a supply port through which the refrigerant is charged from the outside (refrigerant cylinder or the like) to the compressor 101 suction side. The refrigerant charging port on-off valve 109 is a valve which supplies the refrigerant through the refrigerant charging port for refrigerant charging.

[0023] The heat source side control device 120 is formed of a microcomputer and the like, for example. The heat source side control device is capable of performing wired or wireless communication with a load side control device 204 and executes operation control of the entire refrigeration air-conditioning apparatus by controlling each means related to the refrigeration air-conditioning apparatus such as operation frequency control of the compressor 101 by inverter circuit control and the like on the basis of data related to detection performed by various detecting means (sensors) in the refrigeration air-conditioning apparatus, for example.

[0024] A discharge temperature sensor 130 and a discharge pressure sensor 131 are temperature detecting means that detect the temperature and pressure of the refrigerant discharged by the compressor 101. A heat source side heat exchange temperature sensor 132 is temperature detecting means that detects the temperature of the refrigerant related to condensation particularly when the heat source side heat exchanger 104 functions as a condenser in this embodiment.

[0025] On the other hand, the load side unit 200 is formed of a load side heat exchanger 201, a load side expansion device (expansion valve) 202, a load side fan 203, and the load side control device 204. The load side

heat exchanger 201 exchanges heat between the refrigerant and the air. For example, the load side heat exchanger functions as a condenser during the heating operation, exchanges heat between the refrigerant flowing in from the gas pipeline 300 and the air, condenses and liquefies the refrigerant (or makes it into the gas-liquid two-phase state) and allows the refrigerant to flow out to the liquid pipeline 400 side. On the other hand, during the cooling operation, the load side heat exchanger functions as an evaporator, exchanges heat between the refrigerant having been turned into a low-pressure state by the load side expansion device 202 and the air, makes the refrigerant take heat away from the air so as to evaporate and gasify the refrigerant, and allows the refrigerant to flow out to the gas pipeline 300 side. Also, in the load side unit 200, the load side fan 203 which adjusts the flow of the air used for heat exchange is disposed. The operation speed of this load side fan 203 is determined by setting performed by a user, for example. The load side expansion device 202 is disposed so as to adjust the flow rate of the refrigerant so as to adjust the pressure of the refrigerant in the load side heat exchanger 201 by changing the opening degree.

[0026] The load side control device 210 is also formed of a microcomputer and the like and is capable of performing wired or wireless communication with the heat source side control device 120, for example. The load side control device controls each device (means) of the load side unit 200 so that the inside of the room has a predetermined temperature, for example, on the basis of an instruction from the heat source side control device 120, an instruction from a resident and the like. Also, the load side control device transmits a signal containing data related to detection performed by the detecting means disposed in the load side unit 200. The load side heat exchange temperature sensor 220 is temperature detecting means that detects the temperature of the refrigerant related to condensation when the load side heat exchanger 201 functions as a condenser particularly in this embodiment.

[0027] In this embodiment, the oil tank 110 is disposed (in series) in the refrigerant cycle. Particularly, the oil tank is disposed between the compressor 101 and the four-way valve 103 so that the oil tank functions as a muffler which reduces pulsation of the refrigerant discharged from the compressor 101 or the like due to the discharge characteristics such as cyclic motion and the like caused by reciprocal motion and rotation in the compressor 101. Hitherto, the pulsation of the refrigerant has been reduced or the like by expanding a part of the refrigerant pipeline in the refrigerant cycle or by disposing a special device or the like, but in this embodiment, the oil tank 110 which has a space inside after the recovery operation is used.

[0028] Here, if the internal capacity of the oil tank 110 is too small, for example, the frequency band which can be reduced is narrowed or the like, and the oil tank can no longer function as a muffler. Thus, in this embodiment, in order to widen the frequency band that can be reduced or the like, the oil tank 110 is configured so as to have an internal capacity of 2 liters or more.

[0029] Also, in the oil tank 110, the refrigerator oil has been already sealed before the recovery operation is started, that is, before shipment, for example. In this embodiment, since the gas refrigerant passes through the oil tank 110, if the distance between the refrigerant outlet and the oil level is close to each other, for example, the oil level becomes wavy due to the flow of the inflow refrigerant or the like, and the refrigerator oil can flow out in a large amount with the refrigerant through the refrigerant outlet. Also, with regard to the refrigerant inlet, if the distance from the oil level of the refrigerator oil is small, the gas refrigerant can make the oil level wavy, for example.

[0030] Thus, in this embodiment, the internal capacity of the oil tank 110 is made sufficiently larger than the required charged amount of the refrigerator oil. Also, the oil tank 110 is formed so as to have a cylindrical shape, and the refrigerant is made to flow in so as to follow the tangental direction of the cylindrical shape. As a result, an advantage of preventing the liquid level from becoming wavy, which is caused by the inflow of the refrigerant, can be obtained. Then, in the initial state (when the recovery operation is started), too, in order to ensure that there is sufficient distance (space) between the oil level of the refrigerator oil and the refrigerant inflow pipe port 110A as well as the refrigerant outflow pipe port 110B in the oil tank 110, the refrigerant inflow pipe and the refrigerant outflow pipe are disposed at positions on the upper face of the oil tank 110. Here, the distance is preferably three times or more as large as the diameters of the refrigerant inflow pipe port 110A and the refrigerant outflow pipe port 110B, respectively, for example. Moreover, the diameter of the oil tank 110 having a cylindrical shape is preferably eight times or more as large as the diameters of the refrigerant inflow pipe port 110A and the refrigerant outflow pipe port 110B. As a result, even if the oil level is somewhat made wavy and an oil droplets are generated, they precipitate under the gravity (its own weight), and outflow of the refrigerator oil can be prevented.

[0031] Then, in the refrigeration air-conditioning apparatus of this embodiment, by disposing the oil tank 110 between the compressor 101 and the four-way valve 103, heating and cooling can both be performed in the load side unit 200 even during the recovery operation.

[0032] Also, in this embodiment, two spaces are formed in one housing, and one of them is used as the oil tank 110, and the other as the recovery unit 111 so that heat in the oil tank 110 is transmitted to the recovery unit 111. The recovery unit 111 is basically disposed in parallel with a refrigerant pipeline through which the refrigerant having passed through the gas pipeline 300 and the liquid pipeline 400 passes. Thus, if the temperature of the refrigerant is low and the outside air temperature is also low, stagnation of the refrigerant might occur. Thus, as described above, a configuration is adopted

such that the high-temperature refrigerant from the compressor 101 passes through the oil tank 110 and the heat is transmitted to the recovery unit 111 in the same housing so as to warm the recovery unit 111, and the stagnation of the refrigerant can be prevented. As a result, the operation can be performed with the refrigerant in an appropriate state all the time. Also, by judging the refrigerant amount with accuracy, excess supply of the refrigerant is avoided, and thus, excess refrigerant which collects in the accumulator 106, for example, is reduced, the risk of liquid returning to the compressor 101 is lowered, and a system with high reliability can be obtained.

[0033] Here, the relationship between the oil separator 102 and the oil tank 110 will be described. The oil separator 102 and the oil tank 110 both feed the refrigerator oil into the compressor 101. Since the oil tank 110 is used for the recovery operation, the oil separator and the oil tank are configured to feed the refrigerator oil into the compressor 101 by pipelines that are independent of each other.

[0034] In this embodiment, the oil pipeline 116 is connected between the oil separator 102 and the oil tank 110 so that the refrigerator oil separated by the separator 102 from the refrigerant is fed to the oil tank 110. Thus, not only during the recovery operation but also during the usual operation, the refrigerator oil is supplied to the compressor 101 from the oil tank 110 through the capillary tube 112. Thus, the quantity of pipelines can be reduced and the pipelines can be simplified. Also, the refrigerator oil can be temporarily stored in the oil tank 110. The oil separator 102 may be omitted, and the refrigerator oil may be separated and stored only in the oil tank 110. In this case, drop of the separation efficiency of the refrigerator oil is a concern, but by measuring the amount of the refrigerator oil which would worsen the separation efficiency and be circulated (taken out) through the refrigerant cycle and by charging a large amount of the refrigerator oil in advance, reliability can be ensured.

[0035] FIG. 2 is a diagram illustrating a procedure related to the replacement including the recovery operation. First, updating of the refrigeration air-conditioning apparatus is started (STEP 1). The existing heat source side unit 100 and the like are removed (STEP 2). A new unit is installed (STEP 3). The gas pipeline 300 and the liquid pipeline 400 are connected to the new unit (STEP 4). After the liquid pipeline 400, the gas pipeline 300, and the load side unit 200 are vacuumed, the refrigerant for the load side unit 200 is charged (STEP 5). Then, the on-off valve (not shown) located between the heat source side unit 100 and the liquid pipeline 400 as well as the gas pipeline 300 are opened, and the recovery operation is performed (STEP 6). The recovery on-off valve 118 is closed and a trial operation of the cooling/heating operation is performed (STEP 7) and then, the updating is completed (STEP 8).

[0036] Subsequently, the recovery operation performed at STEP 6 will be described. First, operation control when the recovery operation is performed while cooling operation is performed in the load side unit 200 will be described on the basis of the flow of the refrigerant. The operation control related to the recovery operation is assumed to be executed by the heat source side control device 120.

[0037] A high-temperature and high-pressure gas refrigerant discharged from the compressor 101 reaches the heat source side heat exchanger 104 through the oil separator 102, the oil tank 110, and the four-way valve 103 and is condensed and liquefied therein. The condensed and liquefied liquid refrigerant is cooled by the inter-refrigerant heat exchanger 113 and flows into the liquid pipeline 400 through the check valve 114 as a supercooled refrigerant.

[0038] The gas-liquid two-phase refrigerant having flowed into the liquid pipeline 400 flows into the load side unit 200 while taking away the foreign substances and the like in the liquid pipeline 400 through the flow of the refrigerant. The refrigerant containing the foreign substances and the like having flowed into the load side unit 200 is expanded by the load side expansion device 202 to a low pressure, takes heat away from the periphery in the load side heat exchanger 201, a part of the liquid refrigerant is evaporated so as to cool an air-conditioning space, and becomes the gas-liquid two-phase refrigerant and flows out of the load side unit 200 and flows into the gas pipeline 300.

[0039] The gas-liquid two-phase refrigerant having flowed into the gas pipeline 300 flows into the heat source side unit 100 while taking away foreign substances and the like in the gas pipeline 300. The gas-liquid two-phase refrigerant containing the foreign substances and the like having returned to the heat source side unit 100 is, as described above, fully gasified through heat exchange with the condensed and liquefied liquid refrigerant. Then, the refrigerant is sucked into the compressor 101 through the four-way valve 103 and the accumulator 106 and, as described above, compressed and discharged so as to be circulated.

[0040] Here, the foreign substances and the like are separated from the refrigerant by gravity or the like in the accumulator 106 and precipitate on the bottom part of the accumulator 106. If the recovery on-off valve 118 is opened, while a part of a dynamic pressure in the refrigerant changes to a static pressure inside the accumulator 106, the pressure in the recovery unit 111 becomes lower than the pressure of the accumulator 106, and thus, the flow of the foreign substances and the like from the accumulator 106 to the recovery unit 111 is generated in accordance with the differential pressure. As a result, the foreign substances and the like separated in the accumulator 106 pass through the recovery pipeline 117 through the recovery on-off valve 118 and flow into the recovery unit 111 so as to be recovered.

[0041] At this time, with regard to the refrigerator oil, the oil separator 102 makes the separated refrigerator oil pass through the oil pipeline 116 and feeds it to the oil tank 110. Also, from the oil tank 110, the refrigerator

oil for replenishment is fed to the compressor 101 through the capillary tube 112.

[0042] After the operation described above has been allowed to continue for a predetermined time, the heat source side control device 120 controls each device so that the refrigerant flowing through the liquid pipeline 400 becomes a liquid refrigerant. Also, the heat source side control device executes control so that the refrigerant flowing through the gas pipeline 300 becomes a gas refrigerant. As described above, refrigerant-amount adjustment control is executed such that the refrigerant distribution state becomes the same as that in the usual operation related to cooling.

[0043] Fig. 3 is a flowchart illustrating processing related to charging of the refrigerant into the refrigerant cycle during the recovery operation. The control related to this processing is assumed to be also executed by the heat source side control device 120. The recovery operation corresponding to the above-described STEP 6 is started (STEP 11). Particularly in the initial state of the recovery operation, only the refrigerant having been charged into the heat source side unit 100 in advance and the refrigerant for the load side unit 200 charged after the vacuuming are charged in the refrigerant cycle, and the amount of refrigerant is not sufficient. Thus, it is judged whether a value Td of the temperature of the refrigerant discharged by the compressor 101 detected by the discharge temperature sensor 130 is larger than an upper limit value Tdmax of the discharge temperature set in advance (Td > Tdmax) or not (STEP 12).

[0044] If it is judged to be Td > Tdmax, the refrigerant supply on-off valve 108 and the refrigerant charging port on-off valve 109 are opened, and the refrigerant is charged (STEP 14). On the other hand, if it is judged not to be Td > Tdmax, the refrigerant supply on-off valve 108 and the refrigerant charging port on-off valve 109 are closed (STEP 13). Then, the above processing (STEP 15) is performed until a predetermined time related to the recovery of the foreign substances and the like has elapsed. Here, with regard to the judgment at STEP 12, since the refrigerant stagnation does not occur in the recovery unit 111 in this embodiment, decrease of the refrigerant amount circulating through the refrigerant cycle can be prevented, and wasteful refrigerant charging can be prevented.

[0045] If the predetermined time has elapsed, the heat source side control device 120 starts the above-described refrigerant-amount adjustment control (STEP 16). The heat source side control device 120 waits for the processing until it is judged that the determined time has elapsed again (STEP 17).

[0046] Then, a saturated temperature Tsat (Pd) is calculated on the basis of the discharge pressure Pd of the refrigerant detected by the discharge pressure sensor 131 (STEP 18). Then, a difference SC from the temperature Tcout of the refrigerant flowing out of the heat source side heat exchanger 104 detected by the heat source side heat exchange temperature sensor 132 is calculated (STEP 19). Moreover, the difference SC and a target value SCm are compared and if it is judged to be SC≥ SCm (STEP 20), the refrigerant supply on-off valve 108 and the refrigerant charging port on-off valve 109 are closed (STEP 21), and the recovery operation is finished (STEP 23). When it is judged not to be SC ≥ SCm (SC < SCm), the refrigerant supply on-off valve 108 and the refrigerant charging port on-off valve 109 are opened (STEP 22), the refrigerant is charged for a determined time (STEP 16), and the processing at STEP 17 and after is performed again. If the condition of the refrigerant charging completion is not satisfied for a predetermined time or more, the fact may be displayed on display means (not shown) provided in the heat source side unit 100, a remote controller (not shown) or the like. Also, completion of the refrigerant charging may also be informed from the heat source side unit 100, a remote controller (not shown) or the like. Moreover, the fact of the completion of the refrigerant charging may be stored in storage means (not shown) of the heat source side control device 120 so that it can be checked later. At this time, it may be stored with the operation state.

[0047] Subsequently, the operation control when the recovery operation is performed while heating is performed in the load side unit 200 will be described on the basis of the flow of the refrigerant. The high-temperature and high-pressure gas refrigerant discharged from the compressor 101 becomes a gas-liquid two-phase refrigerant through the oil separator 102, the oil tank 110, the four-way valve 103, and the inter-refrigerant heat exchanger 113, while the refrigerant having flowed into the gas pipeline 300 flows into the load side unit 200 while taking away foreign substances in the gas pipeline 300 by the flow of the refrigerant.

[0048] The refrigerant containing the foreign substances having flowed into the load side unit 200 transfers heat to the periphery in the load side heat exchanger 201, condenses and heats the air-conditioning space and is expanded to an intermediate pressure in the load side expansion device 202, becomes the gas-liquid two-phase refrigerant containing the foreign substances and the like, flows out of the load side unit 200 and flows through the liquid pipeline 400. The gas-liquid two-phase refrigerant having flowed into the liquid pipeline 400 flows into the heat source side unit 100 while taking away also the foreign substances and the like in the liquid pipeline 400.

[0049] The gas-liquid two-phase refrigerant containing the foreign substances and the like having returned to the heat source side unit 100 partially flows into the heat source side heat exchanger 104 through the check valve 115, while the remaining part flows through the inter-refrigerant heat exchanger 113 and the on-off valve 134 and flows to the refrigerant inflow side (upstream side) of the accumulator 106. The refrigerant having been evaporated and gasified in the heat source side heat exchanger 104 is sucked into the compressor 101 through the four-way valve 103 and the accumulator 106 and is

compressed and discharged as described above and is circulated. The gas-liquid two-phase refrigerant having flowed into the inter-refrigerant heat exchanger 113 exchanges heat with the high-temperature and high-pressure gas refrigerant discharged by the compressor 101 and is evaporated, and flows to the refrigerant inflow side of the accumulator 106 through the on-off valve 134. After the above operation is performed for a predetermined time, the refrigerant-amount adjustment control is executed so that the refrigerant distribution state becomes the same as that in the usual operation related to heating.

[0050] At this time, as described above, the foreign substances and the like separated in the accumulator 106 pass through the recovery pipeline 117 via the recovery on-off valve 118 and flow to the recovery unit 111 and are recovered therein. Also, the refrigerator oil to compensate for the shortage is also fed from the oil tank 110 to the compressor 101.

[0051] Also, the processing related to charging of the refrigerant while heating is performed in the load side unit 200 is basically the same as the processing described on the basis of Fig. 3. However, with regard to the temperature Tcout, the temperature of the refrigerant flowing out of the load side heat exchanger 201 detected by the load side heat exchange temperature sensor 220 is assumed to be the temperature Tcout. When a plurality of the load side units 200 are installed, an average value of the temperatures detected by the load side heat exchange temperature sensor 220 is the temperature Tcout.

[0052] As described above, when a new unit is installed for updating by using an existing pipeline, even if the shape of the existing pipeline is embedded in the wall or ceiling, the correct refrigerant amount can be judged and the refrigerant can be charged and thus, time for construction can be reduced. Also, since the refrigerant amount can be judged whether it is cooling or heating, reliability on the refrigerant amount can be improved whether the pipeline is existing or not.

[0053] As described above, according to the refrigeration air-conditioning apparatus of Embodiment 1, during the recovery operation, the oil tank 110 that collects the refrigerator oil to be replenished into the compressor 101 is disposed in series in the refrigerant cycle and the gas refrigerant discharged by the compressor 101 is made to pass therethrough, and thus, the oil tank can be used as a muffler that stirs the refrigerant in the space inside the oil tank 110 and reduces the pulsation of the refrigerant generated by the discharge characteristics of the compressor 101. As a result, the pulsation of the refrigerant is not transmitted to the other devices in the heat source side unit 100, the load side unit 200 and the like, and thus, vibration, noise and the like generated in the apparatus (pipelines and devices) by the pulsation of the refrigerant can be reduced, and an apparatus in which breakage can be prevented and reliability is improved by prolongation of the life can be obtained. Also, by using the oil tank 110 as a muffler, the oil tank 110 having a large space can be effectively used, and by omitting the muffler, reduction of the capacity of the heat source side until 100, size reduction, cost reduction through reduction of materials can be realized. Also, since the pipelines can be simplified, productivity can be improved.

[0054] Also, since the oil tank 110 is disposed at a position where the gas refrigerant discharged by the compressor 101 passes regardless of the operation state, even if the load side unit 200 is performing cooling or heating during the recovery operation, the pulsation of the refrigerant can be reduced. Moreover, by setting the size of the oil tank at a predetermined size (2 liters, for example) or larger, the pulsation of the refrigerant can be reduced in accordance with a wide frequency range and wavelength related to the pulsation. Even if the refrigerant inflow pipe and the refrigerant outflow pipe are disposed at positions on the upper face of the oil tank 110, and the oil level of the refrigerator oil collecting in the oil tank 110 is at the highest position (usually a stage before the recovery operation is started), since the sufficient distance (space) is ensured between the refrigerant inflow pipe port 110A as well as the refrigerant outflow pipe port 110B and the oil level, excessive fluctuation of the oil level position and outflow from the refrigerant outflow pipe port 110B can be prevented. Thus, shortage of the refrigerator oil in the compressor 101 can be prevented, and a refrigeration air-conditioning apparatus with high reliability can be obtained. Also, since the capacity of the inside of the oil tank 110 is increased in order to ensure the space, the effect of reducing the refrigerant pulsation can be further improved.

[0055] Also, by transmitting the heat of the gas refrigerant passing through the oil tank 110 during the recovery operation or the usual air-conditioning operation to the recovery unit 111 and by heating the recovery unit 111, the stagnation of the refrigerant in the recovery unit 111 can be prevented. Therefore, judgment on shortage of the refrigerant amount in the refrigerant cycle can be made with high accuracy, and charging of an inadvertently large amount of refrigerant can be prevented. Thus, cost reduction and environmental preservation can be realized.

[0056] Also, since the refrigerator oil separated by the oil separator 102 is returned to the compressor 101 through the oil tank 110, the pipeline path related to oil can be unified into one system, and the pipelines can be simplified. Thus, cost reduction and productivity improvement can be realized.

Embodiment 2.

[0057] In the above-described embodiment, the two spaces obtained by partitioning the inside of one housing with a mirror plate are used as the oil tank 110 and the recovery unit 111, but this is not limiting as long as the heat of the oil tank 110 can be transmitted to the recovery unit 111. For example, the two tanks, that is, the oil tank 110 and the recovery unit 111 may be brought into con-

tact with each other and combined.

Embodiment 3.

[0058] In Embodiment 1, the refrigeration air-conditioning apparatus in which the heat source side unit 100 and the load side unit 200 are connected one each was described. The present invention is not limited by that but can be applied to a multiple refrigeration air-conditioning apparatus in which a plurality of the heat source side units 100 and the load side units 200 are connected, respectively. At this time, the number of the heat source side units 100 having a recovering function may be one or the total of the units.

[0059] Also, in the above-described embodiments, the four-way valve 103 is disposed so that the load side unit 200 can perform cooling/heating, but the configuration without the four-way valve 103 is possible. In such a case, the oil tank 110 is disposed between the oil separator 102 (compressor 101) and the heat source side heat exchanger 104.

[0060] Also, in the above-described embodiments, the description was made that the load side unit 200 is also replaced, but the present invention can be also applied to a case in which only the heat source side unit 100 is replaced by a new one.

[0061] Moreover, in the above-described embodiments, the recovery operation is performed by the refrigerant cycle in which the load side unit 200 is connected by pipeline, but it may be configured such that after the gas pipeline 300 is connected to the liquid pipeline 400 by a bypass pipeline and the recovery operation is performed, the load side unit 200 may be connected by a pipeline, for example.

Industrial Applicability

[0062] In the above-described embodiments, application to a refrigeration air-conditioning apparatus was described, but the present invention can be also applied to other refrigeration cycle apparatuses forming a refrigerant cycle such as a heat pump apparatus, a freezing apparatus, cold storage apparatus and the like. Reference Signs List

[0063] 100 heat source side unit, 101 compressor, 102 oil separator, 103 four-way valve, 104 heat source side heat exchanger, 105 heat source side fan, 106 accumulator, 107 heat source side expansion device, 108 refrigerant supply on-off valve, 109 refrigerant charging port on-off valve, 110 oil tank, 110A refrigerant inflow pipe port, 110B refrigerant outflow pipe port, 111 recovery unit, 112 capillary tube, 113 inter-refrigerant heat exchanger, 114, 115 check valve, 116 oil pipeline, 117 recovery pipeline, 118 recovery on-off valve, 120 heat source side control device, 130 discharge temperature sensor, 131 discharge pressure sensor, 132 heat source side heat exchange temperature sensor, 200 load side unit, 201 load side heat exchanger, 202 load side expansion device, 203 load side fan, 210 load side control device, 220 load side heat exchange temperature sensor, 300 gas pipeline, 400 liquid pipeline.

Claims

1. A heat source side unit having a compressor and a heat source side heat exchanger and forming a refrigerant cycle by connecting an expansion device and a load side heat exchanger by a pipeline, comprising
an oil tank to feed and supply refrigerator oil to the compressor due to a lack of refrigerator oil caused by washing the refrigerant cycle, the oil tank being disposed in the refrigerant cycle.

2. The heat source side unit of claim 1, wherein
the oil tank is disposed at a position where a gas-phase refrigerant fed out by the compressor passes in the refrigerant cycle.

3. The heat source side unit of claim 1 or 2, further comprising
an oil separator separating off the refrigerator oil contained in the refrigerant, wherein
a pipeline which feeds the refrigerator oil separated by the oil separator to the compressor through the oil tank is connected between the oil separator and the oil tank.

4. The heat source side unit of any one of claims 1 to 3, wherein
a capacity of the oil tank is 2 liters or more.

5. The heat source side unit of any one of claims 1 to 4, further comprising
a recovery unit that catches and recovers foreign substances related to washing the refrigerant cycle, wherein
the recovery unit is brought into contact with the oil tank or contained in a same housing so as to be combined with the oil tank.

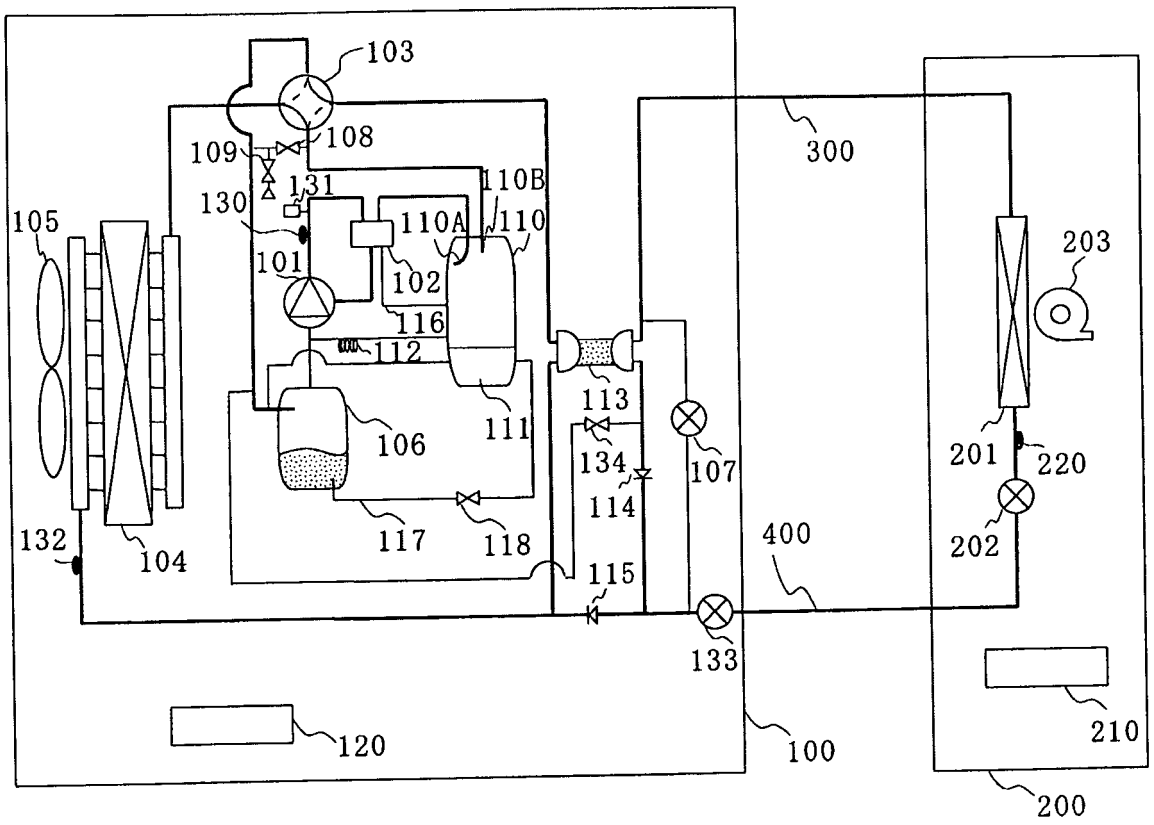
6. The heat source side unit of any one of claims 1 to 5, wherein
the oil tank has an inflow pipe and an outflow pipe for the refrigerant on an upper face of the oil tank.

7. The heat source side unit of claim 6, wherein
the distance between the inflow pipe port as well as the outflow pipe port and the oil level of the refrigerator oil in the oil tank is 3 times or more longer than a pipe diameter.

8. A refrigeration air-conditioning apparatus, comprising
one or more heat source side unit of claims 1 to 7; and

one or more load side unit having an expansion device and a load side heat exchanger, the heat source side unit and the load side unit being connected by a pipeline.

FIG. 1


103
108
109
131
130
110B
110A
110
105
101
102
116
112
113
106
111
134
107
114
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115
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133
120
100
210
200
300

FIG. 2

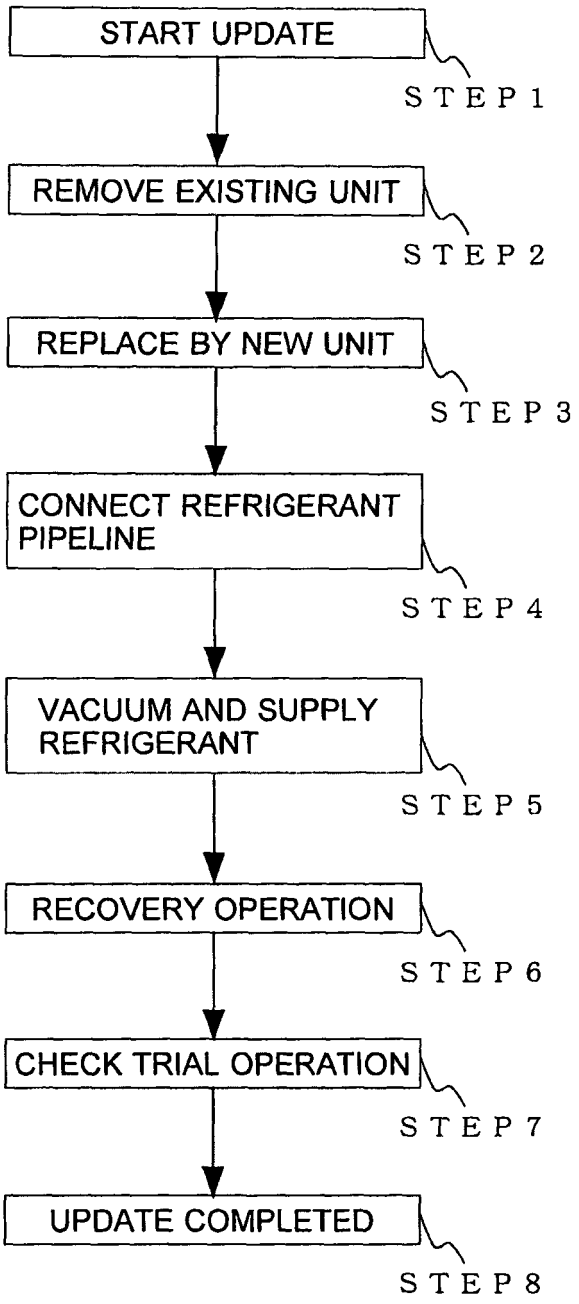
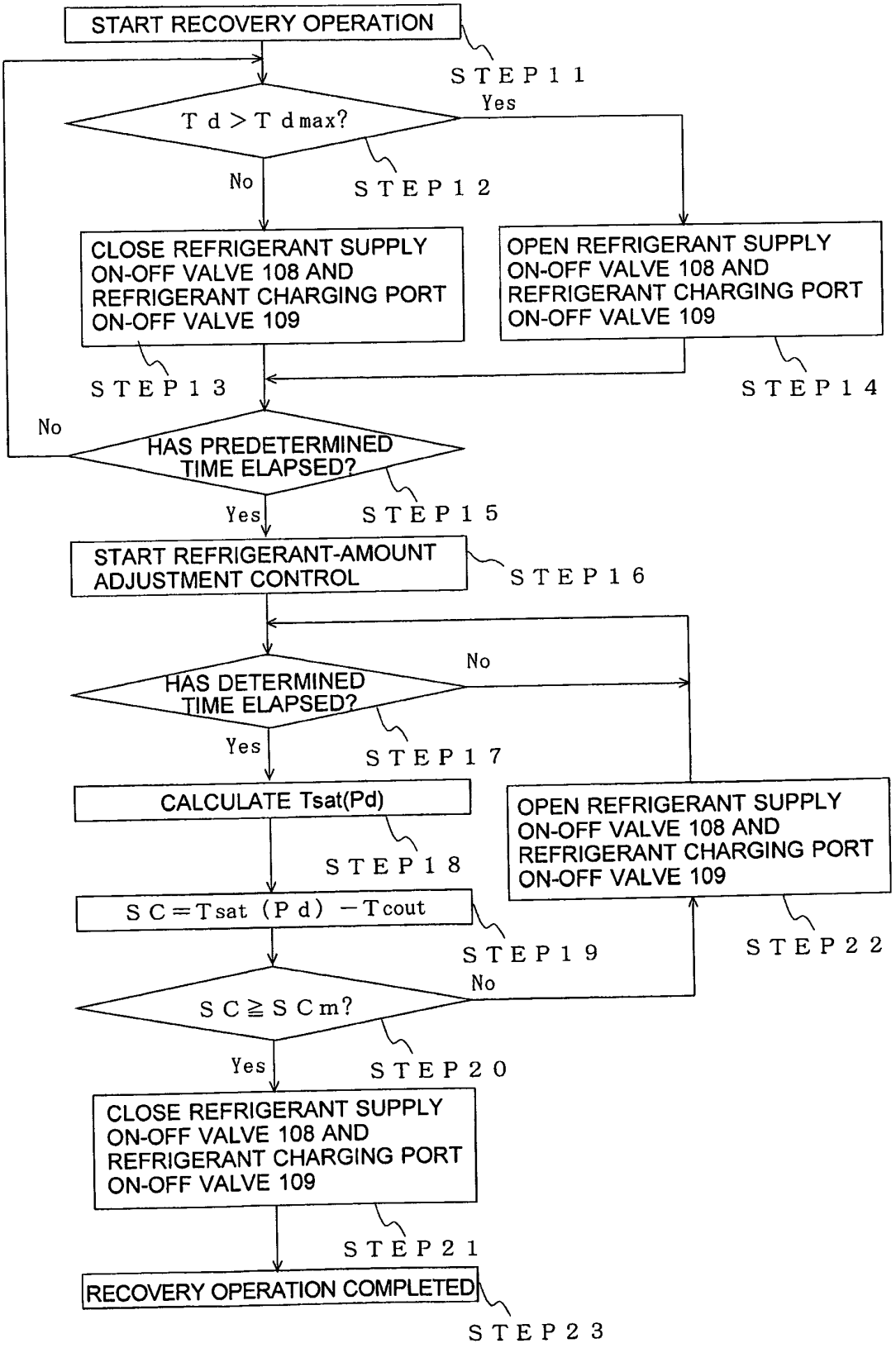

START UPDATE
STEP 1
REMOVE EXISTING UNIT
STEP 2
REPLACE BY NEW UNIT
STEP 3
CONNECT REFRIGERANT PIPELINE
STEP 4
VACUUM AND SUPPLY REFRIGERANT
STEP 5
RECOVERY OPERATION
STEP 6
CHECK TRIAL OPERATION
STEP 7
UPDATE COMPLETED
STEP 8

FIG. 3


START RECOVERY OPERATION
STEP11
Td > Td max?
Yes
No
STEP12
CLOSE REFRIGERANT SUPPLY ON-OFF VALVE 108 AND REFRIGERANT CHARGING PORT ON-OFF VALVE 109
OPEN REFRIGERANT SUPPLY ON-OFF VALVE 108 AND REFRIGERANT CHARGING PORT ON-OFF VALVE 109
STEP13
STEP14
No
HAS PREDETERMINED TIME ELAPSED?
Yes
STEP15
START REFRIGERANT-AMOUNT ADJUSTMENT CONTROL
STEP16
No
HAS DETERMINED TIME ELAPSED?
Yes
STEP17
CALCULATE Tsat(Pd)
STEP18
OPEN REFRIGERANT SUPPLY ON-OFF VALVE 108 AND REFRIGERANT CHARGING PORT ON-OFF VALVE 109
STEP22
SC=Tsat (Pd) −Tcout
STEP19
No
SC≧SCm?
Yes
STEP20
CLOSE REFRIGERANT SUPPLY ON-OFF VALVE 108 AND REFRIGERANT CHARGING PORT ON-OFF VALVE 109
STEP21
RECOVERY OPERATION COMPLETED
STEP23

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2009/067007

A. CLASSIFICATION OF SUBJECT MATTER
F25B45/00(2006.01)i, *F25B1/00*(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)
F25B45/00, F25B1/00

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 1996-2009
Kokai Jitsuyo Shinan Koho 1971-2009 Toroku Jitsuyo Shinan Koho 1994-2009

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

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X Y	JP 2003-42603 A (Mitsubishi Electric Corp.), 13 February 2003 (13.02.2003), entire text; fig. 1 to 21 (Family: none)	1,2,4-8 3
Y	JP 7-27452 A (Daikin Industries, Ltd.), 27 January 1995 (27.01.1995), paragraph [0009]; fig. 2 (Family: none)	3
A	JP 2009-74756 A (Mitsubishi Electric Corp.), 09 April 2009 (09.04.2009), entire text; fig. 1 to 11 (Family: none)	1-8

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

* Special categories of cited documents:
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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
16 December, 2009 (16.12.09)	28 December, 2009 (28.12.09)
Name and mailing address of the ISA/ Japanese Patent Office Facsimile No.	Authorized officer Telephone No.

Form PCT/ISA/210 (second sheet) (April 2007)

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- JP 2004333121 A **[0004]**