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(71) Applicant: **Daikin Industries, Ltd.**
Osaka-shi, Osaka 530-8323 (JP)

(72) Inventor: **SAKAMOTO, Shinichi**
Kusatsu-shi, Shiga; 525-8526 (JP)

(74) Representative: **HOFFMANN EITLE**
Patent- und Rechtsanwälte
Arabellastrasse 4
81925 München (DE)

(54) **HEAT PUMP HOT WATER SUPPLIER**

(57) It is an object of the present invention to prevent a shortage of suction gas in a compressor by ensuring that surplus refrigerant does not occur in a refrigerant circuit and to suppress the occurrence of noise in the vicinity of a rotary type compressor. A refrigerating apparatus (1) is disposed with a compressor (21), a first heat exchanger (22), an expansion mechanism (23), a second heat exchanger (24) and a muffler (26). The compressor is a rotary type compressor that compresses a refrigerant. The first heat exchanger causes the refrigerant of a high temperature and a high pressure that has been compressed by the compressor to exchange heat with a first fluid. The expansion mechanism reduces the pressure of the refrigerant that has been condensed inside the first heat exchanger. The second heat exchanger causes the refrigerant whose pressure has been reduced by the expansion mechanism to exchange heat with a second fluid. The muffler is disposed between the second heat exchanger and the compressor and reduces the pulsation of the flow of the refrigerant.

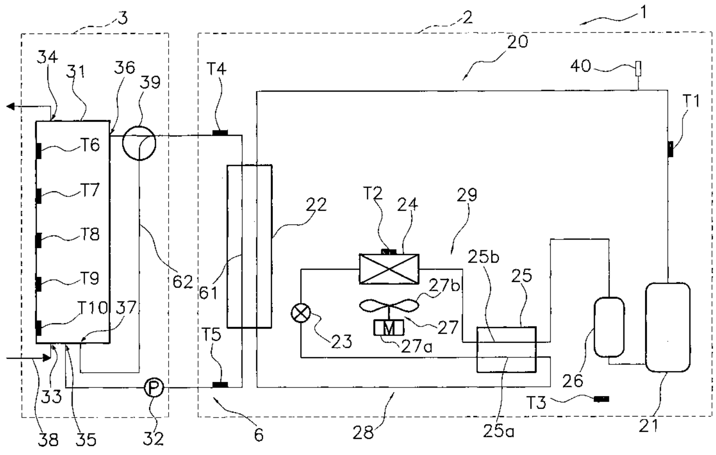

FIG. 1

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Description

TECHNICAL FIELD

[0001] The present invention relates to a refrigerating apparatus that is disposed with a rotary type compressor (including a swing type).

BACKGROUND ART

[0002] Conventionally, in technology such as in Patent Document 1, a refrigerating apparatus where a rotary type compressor, a condenser, a pressure reducing mechanism and an evaporator are sequentially interconnected is given a configuration where an accumulator is installed between the evaporator and a suction side of the compressor.
Patent Document 1
JP-A No. 2003-247490

DISCLOSURE OF THE INVENTION

PROBLEM THAT THE INVENTION IS TO SOLVE

[0003] However, when a liquid accumulating mechanism such as an accumulator is disposed as in Patent Document 1, the compressor becomes short of suction gas and the refrigerant becomes uselessly necessary.
[0004] It is an object of the present invention to prevent a shortage of suction gas in a compressor and to suppress the occurrence of noise in the vicinity of a rotary type compressor by ensuring that surplus refrigerant does not occur in a refrigerant circuit.

MEANS FOR SOLVING THE PROBLEM

[0005] A refrigerating apparatus according to a first aspect of the present invention comprises a compressor, a first heat exchanger, an expansion mechanism, a second heat exchanger and a muffler. The compressor is a rotary type compressor that compresses a refrigerant. The first heat exchanger causes the refrigerant of a high temperature and a high pressure that has been compressed by the compressor to exchange heat with a first fluid. The expansion mechanism reduces the pressure of the refrigerant that has been condensed inside the first heat exchanger. The second heat exchanger causes the refrigerant whose pressure has been reduced by the expansion mechanism to exchange heat with a second fluid. The muffler is disposed between the second heat exchanger and the compressor and reduces the pulsation of the flow of the refrigerant.
[0006] Conventionally, in a refrigerating apparatus such as a natural refrigerant heat pump type electric hot water supplier, an accumulator is disposed on a suction side of a rotary type (including a swing type) compressor. However, when a liquid accumulating mechanism such as an accumulator is disposed, the compressor becomes short of suction gas and the refrigerant becomes uselessly necessary.
[0007] Thus, in the present invention, a muffler that does not include a refrigerant liquid accumulating function is installed instead of an accumulator, whereby it can be ensured that surplus refrigerant does not occur in the refrigerant circuit, and a shortage of suction gas in the compressor can be prevented. Further, the occurrence of noise in the vicinity of the rotary type compressor can be suppressed.
[0008] A refrigerating apparatus according to a second aspect of the present invention is the refrigerating apparatus according to the first aspect of the present invention, wherein the muffler is disposed on a side of the compressor and is fixed to, so as to become integrated with, a side wall portion of the compressor.
[0009] In this refrigerating apparatus, the muffler and the compressor are fixed so as to become integrated, whereby the vibration of the compressor can be suppressed. For this reason, the occurrence of noise in the compressor can be suppressed.
[0010] A refrigerating apparatus according to a third aspect of the present invention is the refrigerating apparatus according to the first or the second aspect of the present invention, wherein the muffler includes a muffler body component and a filter component. The muffler body component is a cylindrical component that has a flow path cross-sectional area that is larger than a flow path cross-sectional area of a gas refrigerant pipe that interconnects the second heat exchanger and the compressor. The filter component is supported inside the muffler body component and traps foreign particles in the refrigerant that flows from the second heat exchanger toward the compressor.
[0011] In this refrigerating apparatus, foreign particles in the refrigerant that flows from the second heat exchanger toward the compressor are trapped by the filter component that is disposed inside the muffler body component. Further, the muffler body component in which the filter component is disposed has a flow path cross-sectional area that is larger than the flow path cross-sectional area of the gas refrigerant pipe, so the flow path cross-sectional area of the filter component can be enlarged.
[0012] For this reason, foreign particles in the refrigerant can be prevented from circulating inside the refrigerant circuit, and damage to the devices or a drop in the capability of the devices can be prevented from being triggered by foreign particles. Further, an increase in pressure loss in the filter component can be suppressed.
[0013] A refrigerating apparatus according to a fourth aspect of the present invention is the refrigerating apparatus according to any of the first to the third aspect of the present invention, wherein the muffler takes in, from a top portion of the muffler, the low pressure gas refrigerant that has flowed out from the second heat exchanger and causes the low pressure gas refrigerant to flow out from a bottom portion of the muffler to the compressor.

[0014] In this refrigerating apparatus, the muffler is disposed vertically such that the muffler takes in the low pressure gas refrigerant from its top portion and causes the low pressure gas refrigerant to flow out from its bottom portion to the compressor.

[0015] Consequently, even when the liquid refrigerant is mixed in with the gas refrigerant and flows into the inside of the muffler at the time of a low outdoor air temperature or the like, the muffler has a structure where it is difficult for the liquid refrigerant to accumulate and the muffler can efficiently use the refrigerant that fills the inside of the refrigerant circuit. For this reason, a shortage of suction gas in the compressor can be suppressed, and the used refrigerant can be reduced.

[0016] A refrigerating apparatus according to a fifth aspect of the present invention is the refrigerating apparatus according to any of the first to the fourth aspect of the present invention, wherein the refrigerating apparatus further comprises a liquid-gas heat exchanger. The liquid-gas heat exchanger performs heat exchange between the liquid refrigerant that flows out from the first heat exchanger and flows into the expansion mechanism and the gas refrigerant that flows out from the second heat exchanger and flows into the compressor.

[0017] In this refrigerating apparatus, the refrigerating apparatus is disposed with the liquid-gas heat exchanger, whereby the refrigerant gas that is to be sent to the compressor is placed in a superheated state such that wet compression and liquid compression can be prevented. Thus, an abnormal rise in the internal pressure of the compressor can be suppressed, and damage to the compressor can be prevented. Further, the supercooling degree of the liquid refrigerant that is to be sent to the evaporator is increased, whereby the occurrence of flash gas in the liquid refrigerant pipe can be prevented. Thus, a drop in the capability of the expansion mechanism can be prevented.

[0018] A refrigerating apparatus according to a sixth aspect of the present invention is the refrigerating apparatus according to any of the first to the fifth aspect of the present invention, wherein the first fluid is water, and the first heat exchanger is a heat exchanger for hot water supply that heats the water by causing the refrigerant to exchange heat with the water.

[0019] In this refrigerating apparatus, the heat exchanger for hot water supply is used as the first heat exchanger and heats the water by causing the refrigerant to exchange heat with the water to obtain hot water.

[0020] Consequently, even in the case of a heat pump unit of a heat pump hot water supplier, the refrigerating apparatus can ensure that surplus refrigerant does not occur in the refrigerant circuit and a shortage of suction gas in the compressor can be prevented. Further, the occurrence of noise in the vicinity of the compressor can be suppressed.

EFFECTS OF THE INVENTION

[0021] In the refrigerating apparatus according to the first aspect of the present invention, a muffler that does not include a refrigerant liquid accumulating function is installed instead of an accumulator, whereby it can be ensured that surplus refrigerant does not occur in the refrigerant circuit and a shortage of suction gas in the compressor can be prevented. Further, the occurrence of noise in the vicinity of the rotary type compressor can be suppressed.

[0022] In the refrigerating apparatus according to the second aspect of the present invention, the muffler and the compressor are fixed so as to become integrated, whereby the vibration of the compressor can be suppressed. For this reason, the occurrence of noise in the compressor can be suppressed.

[0023] In the refrigerating apparatus according to the third aspect of the present invention, foreign particles in the refrigerant can be prevented from circulating inside the refrigerant circuit, and damage to the devices or a drop in the capability of the devices can be prevented from being triggered by foreign particles. Further, an increase in pressure loss in the filter component can be suppressed.

[0024] In the refrigerating apparatus according to the fourth aspect of the present invention, even when the liquid refrigerant is mixed in with the gas refrigerant and flows into the inside of the muffler at the time of a low outdoor air temperature or the like, the muffler has a structure where it is difficult for the liquid refrigerant to accumulate and the muffler can efficiently use the refrigerant that fills the inside of the refrigerant circuit. For this reason, a shortage of suction gas in the compressor can be suppressed, and the used refrigerant can be reduced.

[0025] In the refrigerating apparatus according to the fifth aspect of the present invention, the refrigerating apparatus is disposed with the liquid-gas heat exchanger, whereby the refrigerant gas that is to be sent to the compressor is placed in a superheated state such that wet compression and liquid compression can be prevented. Thus, an abnormal rise in the internal pressure of the compressor can be suppressed, and damage to the compressor can be prevented. Further, the supercooling degree of the liquid refrigerant that is to be sent to the evaporator is increased, whereby the occurrence of flash gas in the liquid refrigerant pipe can be prevented. Thus, a drop in the capability of the expansion mechanism can be prevented.

[0026] In the refrigerating apparatus according to the sixth aspect of the present invention, even in the case of a heat pump unit of a heat pump hot water supplier, the refrigerating apparatus can ensure that surplus refrigerant does not occur in the refrigerant circuit and a shortage of suction gas in the compressor can be prevented. Further, the occurrence of noise in the vicinity of the compressor can be suppressed.

BRIEF DESCRIPTION OF THE DRAWINGS

[0027]

FIG. 1 is a general configural diagram of a circuit of a heat pump hot water supplier pertaining to an embodiment of the present invention.
FIG. 2 is a control block diagram of the heat pump hot water supplier.
FIG. 3 is a plan general diagram showing an operating state of a swing type compressor.
FIG. 4(a) is a front diagram showing a state where a compressor and muffler are fixed.
FIG. 4(b) is a plan diagram of FIG. 4(a).
FIG. 5 is a plan general diagram of a rotary type compressor pertaining to a modification (2).

DESCRIPTION OF THE REFERENCE SYMBOLS

[0028]

1	Heat Pump Hot Water Supplier (Refrigerating Apparatus)
21	Compressor
22	Water Heat Exchanger (First Heat Exchanger, Heat Exchanger for Hot Water Supply)
23	Electrically Powered Expansion Valve (Expansion Mechanism)
24	Evaporator (Second Heat Exchanger)
25	Liquid-Gas Heat Exchanger
26	Muffler
26a	Muffler Body (Muffler Body Component)
26b	Filter (Filter Component)
29	Gas Refrigerant Pipe

BEST MODE FOR CARRYING OUT THE INVENTION

[0029] Below, an embodiment of a heat pump hot water supplier 1 pertaining to the present invention will be described on the basis of the drawings.

<Configuration of Heat Pump Hot Water Supplier>

[0030] FIG. 1 is a general configural diagram of the heat pump hot water supplier 1 pertaining to the embodiment of the present invention. The heat pump hot water supplier 1 is an apparatus that heats tap water and supplies hot water to household bathtubs and the like by performing a vapor compression type refrigeration cycle operation using a CO2 refrigerant. The heat pump hot water supplier 1 is mainly disposed with a hot water storage unit 3, which includes a hot water storage tank 31 that stores hot water, and a heat pump unit 2, which includes a refrigerant circuit 20.

(1) Hot Water Storage Unit

[0031] The hot water storage unit 3 is mainly configured by the hot water storage tank 31, a circulation pump 32 and a three-way valve 39.

[0032] A water supply opening 33 is disposed in a bottom wall of the hot water storage tank 31, and a hot water exit opening 34 is disposed in a top wall of the hot water storage tank 31. Tap water is supplied from the water supply opening 33 to the hot water storage tank 31, and high temperature hot water that has been stored in the hot water storage tank 31 exits from the hot water exit opening 34 such that the hot water storage tank 31 is capable of supplying the hot water to bathtubs and the like. A flow path 38 for water supply that supplies the tap water is connected to the water supply opening 33. Further, a water intake opening 35 is disposed in the bottom wall of the hot water storage tank 31, and a hot water supply opening 36 is disposed in an upper portion of a side wall (peripheral wall) of the hot water storage tank 31. The water intake opening 35 and the hot water supply opening 36 are connected to a circulation path 6, and the circulation pump 32 and a water heat exchanger 22 of the later-described heat pump unit 2 are connected to the circulation path 6.

[0033] The circulation pump 32 is connected in the vicinity of the water intake opening 35 in the hot water storage tank 31. Further, the water heat exchanger 22 is connected to a discharge side of the circulation pump 32. The circulation pump 32 causes unheated water inside the hot water storage tank 31 to flow out from the water intake opening 35 to the circulation path 6 and causes the unheated water to flow into a heat exchange path 61 inside the water heat exchanger 22. The unheated water that has flowed into the water heat exchanger 22 is heated in the heat exchange path 61 inside the water heat exchanger 22 and reversely flows back inside the hot water storage tank 31 from the hot water supply opening 36.

[0034] The three-way valve 39 is disposed on the hot water supply opening 36 side of the inside of the circulation path 6 and is connected to a bypass-use flow path 62 that is connected to a water return opening 37 that is disposed in the bottom wall of the hot water storage tank 31. For this reason, in the present embodiment, the three-way valve 39 can perform normal operation, where the hot water does not flow through the bypass-use flow path 62 but rather the water (warm water) that has entered the circulation path 6 from the water intake opening 35 flows through the circulation path 6 and returns to the hot water storage tank 31 from the hot water supply opening 36, and bypass operation, where the water (warm water) that has entered the circulation path 6 from the water intake opening 35 flows through the circulation path 6, passes through the bypass-use flow path 62 via the three-way valve 39, and returns to the hot water storage tank 31 from the water return opening 37.

[0035] Further, disposed in the peripheral wall of the hot water storage tank 31 at a pitch of 50 L from the top in the vertical direction are a remaining hot water (50 L) temperature sensor T6, a remaining hot water (100 L) temperature sensor T7, a remaining hot water (150 L) temperature sensor T8 and a remaining hot water (200 L) temperature sensor T9, which detect the temperature of the hot water at their respective levels inside the hot water storage tank 31. Additionally, in the lowermost portion of the hot water storage tank 31, there is disposed a water supply temperature sensor T10 that detects the water supply temperature. In the present embodiment, the remaining hot water (50 L) temperature sensor T6, the remaining hot water (100 L) temperature sensor T7, the remaining hot water (150 L) temperature sensor T8, the remaining hot water (200 L) temperature sensor T9 and the water supply temperature sensor T10 comprise thermistors.

(2) Heat Pump Unit

[0036] The heat pump unit 2 is installed outdoors and includes the refrigerant circuit 20. The refrigerant circuit 20 is mainly configured as a result of a compressor 21, the water heat exchanger 22 that configures the heat exchange path 61, an electrically powered expansion valve 23 that serves as an expansion mechanism, an evaporator 24, a liquid-gas heat exchanger 25 and a muffler 26 being connected in order.

[0037] The compressor 21 is a compressor whose operating capacity is capable of being varied and, in the present embodiment, is a swing type compressor that is driven by a motor whose rotational speed is controlled by an inverter. A swing type compressor is one type of rotary type compressor. The details of this swing type compressor will be described later.

[0038] The water heat exchanger 22 is a heat exchanger that functions as a condenser of the refrigerant. The water heat exchanger 22 causes the gas refrigerant of a high temperature and a high pressure that has been compressed in the compressor 21 to exchange heat with unheated water that is delivered from the circulation pump 32 (heats the unheated water), to thereby condense the gas refrigerant. Further, a gas side of the water heat exchanger 22 is connected to a discharge side of the compressor 21, and a liquid side of the water heat exchanger 22 is connected to the electrically powered expansion valve 23.

[0039] The electrically powered expansion valve 23 is connected to a liquid side of the evaporator 24 and performs adjustment of the pressure and flow rate of the refrigerant that flows inside the evaporator 24.

[0040] The evaporator 24 is a cross-fin type fin-and-tube heat exchanger that is configured by heat transfer tubes and numerous fins, performs heat exchange with outdoor air, and causes the liquid refrigerant that flows in to evaporate.

[0041] The liquid-gas heat exchanger 25 is disposed with a liquid refrigerant passage 25a through which passes the liquid refrigerant that has flowed out from the water heat exchanger 22 and a gas refrigerant passage 25b through which passes the gas refrigerant that has flowed out from the evaporator 24, and the liquid-gas heat exchanger 25 causes heat to be exchanged between the liquid refrigerant that has flowed out from the water heat exchanger 22 and the gas refrigerant that has flowed out from the evaporator 24. That is, in the liquid-gas heat exchanger 25, the liquid refrigerant passage 25a configures part of a liquid refrigerant pipe 28 that couples together the water heat exchanger 22 and the electrically powered expansion valve 23, and the gas refrigerant passage 25b configures part of a gas refrigerant pipe 29 that couples together the evaporator 24 and the compressor 21. The liquid-gas heat exchanger 25 performs heat exchange between the high pressure refrigerant that flows out from the water heat exchanger 22 and flows into the electrically powered expansion valve 23 and the low pressure refrigerant that flows out from the evaporator 24 and flows into the compressor 21, whereby the liquid-gas heat exchanger 25 can impart supercooling to the refrigerant that has flowed out from the water exchanger 22 and can heat the refrigerant that flows into the compressor 21 to bring that refrigerant close to a superheated state. For this reason, the liquid-gas heat exchanger 25 can increase the supercooling degree of the liquid refrigerant that is to be sent to the evaporator 24 and can prevent the occurrence of flash gas in the liquid refrigerant pipe 28. Further, the liquid-gas heat exchanger 25 can prevent wet compression of the compressor 21 and enable stable operation.

[0042] Further, the heat pump unit 2 includes an outdoor fan 27 that serves as a blowing fan for sucking outdoor air into the inside of the unit and, after heat has been exchanged between the air and the refrigerant in the evaporator 24, discharging the air after heat exchange to the outdoors. This outdoor fan 27 is a fan whose flow rate Wo of the air that is to be supplied to the evaporator 24 is capable of being varied and, in the present embodiment, is configured by an outdoor fan motor 27a that comprises a DC fan motor and a propeller fan 27b that is driven by the outdoor fan motor 27a.

[0043] The muffler 26 is connected between the liquid-gas heat exchanger 25 and a suction side of the compressor 21 and is a device for reducing the pulsation of the flow of the refrigerant. Further, the muffler 26 prevents the compressor 21 from becoming short of suction gas by ensuring the gas refrigerant that the compressor 21 sucks in and improves the volumetric efficiency of the compressor 21. The configuration of the muffler 26 will be described later.

[0044] Further, various types of sensors are disposed in the heat pump unit 2. Specifically, a discharge temperature sensor T1 that detects the discharge temperature of the compressor 21, an HPS 40 that serves as a pressure protection switch, an evaporation temperature sensor T2 that detects the temperature of the refrigerant (that is, the refrigerant temperature that corresponds to the evaporation temperature) that flows inside the evaporator 24 and an outdoor air temperature sensor T3 that detects the temperature of the outdoor air that flows into the inside of the unit are disposed in the heat pump unit 2. Further, in the circulation path 6, an exiting hot water temperature sensor T4 is disposed on the downstream side of the heat exchange path 61 (specifically, between the water heat exchanger 22 and the three-way valve), and an entering water temperature sensor T5 is disposed on the upstream side of the heat exchange path 61 (specifically, between the circulation pump 32 and the water heat exchanger 22). In the present embodiment, the discharge temperature sensor T1, the evaporation temperature sensor T2, the outdoor air temperature sensor T3, the exiting hot water temperature sensor T4 and the entering water temperature sensor T5 comprise thermistors.

[0045] In the present embodiment, a controller 7 is configured using a microcomputer that includes a CPU, a memory and an input/output interface, for example. Further, as shown in FIG. 2, the controller 7 is connected such that it can receive the detection signals of the various types of sensors T1 to T10 and 40 and is connected such that it can control the various types of devices and valves 21, 23, 27, 32 and 39 on the basis of these detection signals and the like.

(A) Swing Type Compressor

[0046] FIG. 3 is a plan general diagram of the swing type compressor pertaining to the embodiment of the present invention. This compressor 21 is used as a compressor of a refrigerating apparatus that uses a CO2 refrigerant. This compressor 21 includes a piston 44 where a substantially circular cylinder-shaped roller 42 and a blade 43 that projects outward in the radial direction of the roller 42 are integrally formed. The roller 42 fits together with an eccentric component 45 that is formed integrally with a drive shaft 41. The piston 44 is housed inside a cylinder chamber 48 that is formed in a cylinder 46 and has a substantially circular cross section. A bush fitting hole 47 is formed in the cylinder 46 close to the cylinder chamber 48, and substantially semicircular column-shaped bushes 49 are fitted into the bush fitting hole 47. The flat surfaces of the bushes 49 are caused to face each other, and both side surfaces of the blade 43 of the piston 44 are slidably held between the flat surfaces of the bushes 49. The cylinder chamber 48 is partitioned into two chambers by the piston 44, and the chamber on the right side of the blade 43 in FIG. 3(b) is one where a suction opening 50 opens to the inner peripheral surface of the cylinder chamber 48 to form a suction chamber 51. The chamber on the left side of the blade 43 in FIG. 3(b) is one where an unillustrated discharge opening opens to the inner peripheral surface of the cylinder chamber 48 to form a discharge chamber 52.

[0047] Next, operation of the compressor 21 will be described on the basis of FIG. 3(a) to (d). First, beginning with the state shown in FIG. 3(a), the eccentric component 45 eccentrically revolves about the drive shaft 41, and the roller 42 that is fitted together with the eccentric component 45 revolves while the outer peripheral surface of the roller 42 contacts the inner peripheral surface of the cylinder chamber 48. Normally, the compressor 21 is disposed horizontally and the roller 42 revolves within a horizontal plane. In accompaniment with the roller 42 revolving inside the cylinder chamber 48, the blade 43 moves back and forth while both side surfaces of the blade 43 are held by the bushes 49. Then, the low pressure gas refrigerant is sucked into the suction chamber 51 from the suction opening 50 (see FIG. 3(b)), is compressed to a high pressure in the discharge chamber 52, and is discharged from the unillustrated discharge opening (see FIG. 3(c) to (a)). Further, synthetic oil that serves as lubricating oil is mixed in with the high pressure gas refrigerant, and when the compressor 21 performs compression operation, the sliding surfaces inside the compressor 21 (e.g., the inner peripheral surface of the roller 42 and the outer peripheral surface of the eccentric component 45, the outer peripheral surface of the roller 42 and the inner peripheral surface of the cylinder chamber 48, etc.) are lubricated by the lubricating oil that is mixed in with the refrigerant.

(B) Muffler

[0048] The muffler 26 is configured by a muffler body 26a and a filter 26b. The muffler body 26a comprises a cylindrical part that has a pipe inner diameter that is larger than a pipe inner diameter of the gas refrigerant pipe 29. In the muffler 26 that is disposed on a side of the compressor 21, as shown in FIG. 4, an inlet pipe 12 is attached to the top of the muffler body 26a and an outlet pipe 13 is attached to the bottom of the muffler body 26a. The inlet pipe 12 and the outlet pipe 13 are part of the gas refrigerant pipe 29. Additionally, the hemispherical filter 26b that crosses the inside of the muffler body 26a is attached between the inlet pipe 12 and the outlet pipe 13. The outer shape of the filter 26b when seen from above coincides with the inner diameter of the muffler body 26a. Further, the filter 26b traps foreign particles in the refrigerant that flows from the evaporator 24 side toward the compressor 21 side. Here, the gas refrigerant flows in from the inlet pipe 12 on the top of the muffler 26, foreign particles are removed therefrom as the gas refrigerant passes through the filter 26b, and the gas refrigerant flows in from the outlet pipe 13 on the bottom of the muffler 26 to the suction side of the compressor 21.

[0049] Further, the muffler 26 is fixed to, so as to become integrated with, a side wall portion of the compressor 21 body. Specifically, an attachment bracket 10 that comprises a plate material that is bent in a general sideways U shape when seen from above is fixed to the body upper portion of the compressor 21 body as a result of the intermediate portion of the attachment bracket 10 being welded to the outer peripheral surface of the compressor 21 body. Both end portions of the attachment bracket 10 project from the compressor 21 body and spread in circular arc shapes, with a threaded attachment portion 10a being formed in one end portion thereof and with an engagement hole 10b being formed in the other end portion. A fastening band 11 that comprises a long and narrow plate-shaped metal is wrapped around the muffler body 26a of the muffler 26, with one end portion of the fastening band 11 being engaged with the engagement hole 10b in the attachment bracket 10 and with the other end portion being attached to the threaded attachment portion 10a of the attachment bracket 10 by an attachment screw 14. Additionally, because of the fastening of the attachment screw 14, the fastening band 11 is pulled toward the attachment bracket 10, and the muffler body 26a is fixed to the compressor 21 body in a state where the muffler body 26a is held between the fastening band 11 and the attachment bracket 10. In other words, the muffler 26 is supported so as to become integrated with the compressor 21 body at two positions above and below by this attachment bracket 10 and the outlet pipe 13.

<Operation of Heat Pump Hot Water Supplier>

(1) Operation of Heat Pump Unit

[0050] First, the compressor 21 is driven and the circulation pump 32 is driven. On the refrigerant circuit 20 side, the low pressure gas refrigerant that has been sucked into the compressor 21 is compressed and becomes high pressure gas refrigerant. Thereafter, the high pressure gas refrigerant is sent to the water heat exchanger 22, performs heat exchange with unheated water that is supplied by the circulation pump 32, condenses, and becomes high pressure liquid refrigerant. Then, this high pressure liquid refrigerant flows into the liquid-gas heat exchanger 25, performs heat exchange with the gas refrigerant that has been evaporated in the evaporator 24, is cooled, and reaches a supercooled state. Then, the pressure of the high pressure liquid refrigerant that has reached a supercooled state is reduced until it becomes close to the suction pressure of the compressor 21 by the electrically powered expansion valve 23, the refrigerant becomes low pressure refrigerant in a gas-liquid two-phase state, is sent to the evaporator 24, performs heat exchange with outdoor air that is supplied by the outdoor fan 27 in the evaporator 24, evaporates, and becomes low pressure gas refrigerant.

[0051] Then, the low pressure gas refrigerant flows into the liquid-gas heat exchanger 25, performs heat exchange with the liquid refrigerant that has been condensed in the water heat exchanger 22, is heated, and reaches a superheated state. This low pressure gas refrigerant flows into the muffler 26, and the low pressure gas refrigerant that has flowed into the muffler 26 is again sucked into the compressor 21.

(2) Operation of Tank Unit

[0052] On the hot water storage tank 31 and circulation path 6 side, the stored water flows out from the water intake opening 35 that is disposed in the bottom portion of the hot water storage tank 31, and this flows through the heat exchange path 61 of the circulation path 6. In this manner, the unheated water that flows through the heat exchange path 61 of the circulation path 6 is heated (boiled) by the water heat exchanger 22 that functions as a condenser and reversely flows back to the upper portion of the hot water storage tank 31 from the hot water supply opening 36 via the three-way valve 39. Additionally, by continuously performing this operation, high temperature warm water is supplied to the hot water storage tank 31.

[0053] Incidentally, when the exiting hot water temperature sensor T4 detects that the boiling temperature is equal to or less than a predetermined temperature, the controller 7 detects that control signal and switches the three-way valve 39 such that the warm water inside the circulation path circulates through the bypass-use flow path 62. That is, when the boiling temperature is equal to or less than the predetermined temperature, the controller 7 performs bypass operation and causes warm water of a low temperature that is equal to or less than the predetermined temperature to reversely flow back to the hot water storage tank 31 from the water return opening 37 without causing the warm water to reversely flow back to the hot water storage tank 31 from the hot water supply opening 36. When the boiling temperature is a low temperature, water (warm water) of a low temperature reversely flows back toward the lower portion of the hot water storage tank 31, whereby it is ensured that the water (warm water) of a low temperature does not mix with the warm water of a high temperature in the upper portion of the hot water storage tank 31. Then, when this boiling temperature exceeds the predetermined temperature, the controller 7 performs switching of the three-way valve 39 to switch to a normal operating state where the warm water is not caused to circulate through the bypass-use flow path 62. In other words, the warm water that has reached a high temperature is caused to reversely flow back to the hot water storage tank 31 via the hot water supply opening 36 such that the warm water in the upper portion of the hot water storage tank 31 is maintained at a high temperature.

[0054] Further, data from the various types of temperature sensors T1 to T10 are inputted to the controller 7, and the controller 7 performs various types of control on the basis of these data. For example, the controller 7 adjusts the opening of the electrically powered expansion valve 23 such that the boiling temperature that has been detected by the exiting hot water temperature sensor T4 is made into a target boiling temperature. Further, when the temperature of the entering water temperature sensor T5 is equal to or greater than a predetermined temperature, the controller 7 determines that the hot water inside the hot water storage tank 31 is boiling and stops operation, and, on the basis of the outdoor air temperature sensor T3, the controller 7 controls the operating frequency of the compressor 21 to adjust its hot water heating capability and the like.

<Characteristics>

[0055]

(1)
In this heat pump hot water supplier 1, the muffler 26 that does not have a refrigerant liquid accumulating function is installed instead of an accumulator, whereby it can be ensured that surplus refrigerant does not occur in the refrigerant circuit 20, and the compressor 21 can be prevented from becoming short of suction gas. Further, the occurrence of abnormal noise in the vicinity of the compressor 21 can be suppressed.
(2)
In this heat pump hot water supplier 1, the muffler 26 and the compressor 21 are fixed so as to become integrated, whereby the vibration of the compressor 21 can be suppressed. For this reason, the occurrence of noise in the compressor 21 can be suppressed.
(3)
In this heat pump hot water supplier 1, foreign particles in the refrigerant that flows from the evaporator 24 toward the compressor 21 are trapped by the filter 26b that is disposed inside the muffler body 26a. Further, the muffler body 26a in which the filter 26b is disposed has a flow path cross-sectional area that is larger than the flow path cross-sectional area of the inlet pipe 12, so the flow path cross-sectional area of the filter 26b can be enlarged.
For this reason, foreign particles in the refrigerant can be prevented from circulating inside the refrigerant circuit 20, and damage to the devices or a drop in the capability of the devices can be prevented from being triggered by foreign particles. Further, an increase in pressure loss in the filter 26b can be suppressed.
(4)
In this heat pump hot water supplier 1, the muffler 26 is disposed vertically such that the muffler 26 takes in the low pressure gas refrigerant from its top portion and causes the low pressure gas refrigerant to flow out from its bottom portion to the compressor 21.
For this reason, even when the liquid refrigerant is mixed in with the gas refrigerant and flows into the inside of the muffler 26 at the time of a low outdoor air temperature or the like, the muffler 26 has a structure where it is difficult for the liquid refrigerant to accumulate and the muffler 26 can efficiently use the refrigerant that fills the inside of the refrigerant circuit 20. For this reason, a shortage of suction gas in the compressor 21 can be suppressed, and the used refrigerant can be reduced.
(5)
In this heat pump hot water supplier 1, the heat pump hot water supplier 1 is disposed with the liquid-gas heat exchanger 25, whereby the refrigerant gas that is to be sent to the compressor 21 is placed in a superheated state such that wet compression and liquid compression can be prevented. Thus, an abnormal rise in the internal pressure of the compressor 21 can be suppressed, and damage to the compressor 21 can be prevented. Further, the supercooling degree of the liquid refrigerant that is to be sent to the evaporator 24 is increased, whereby the occurrence of flash gas in the liquid refrigerant pipe 28 can be prevented. Thus, a drop in the capability of the electrically powered expansion valve 23 can be prevented.
(6)
In this heat pump hot water supplier 1, the water heat exchanger 22 is used as a first heat exchanger and heats the water by causing the refrigerant to exchange heat with the water to obtain hot water.
Consequently, even in the case of this heat pump hot water supplier 1, surplus refrigerant can be eliminated from the refrigerant circuit 20, and a shortage of suction gas in the compressor 21 can be prevented. Further, the occurrence of noise in the vicinity of the compressor 21 can be suppressed.

<Modifications>

[0056] A specific mode of implementing this invention has been described above, but this invention is not limited to the preceding mode and can be variously altered and implemented within the scope of this invention.

(1)
In the preceding embodiment, the refrigerating apparatus is configured by a heat pump hot water supplier, but the refrigerating apparatus is not limited to this and may also be configured by an air-conditioning device such as a multi type air-conditioning device, a room air conditioner or a central type air-conditioning device.
(2)
In the preceding embodiment, there is used the swing type compressor 21 where the roller 42 and the blade 43 are integrally formed, but as shown in FIG. 5, the compressor may also be a rotary type compressor that is configured such that a vane 43a that corresponds to the blade and a roller 42a are separate bodies, the vane 43a is energized toward the roller 42a by a spring 53 that is disposed inside a vane groove 47a, and the vane 43a advances and withdraws inside the vane groove 47a in accompaniment with the rotation of the drive shaft 41 in a state where the distal end of the vane 43a is always in contact with the outer peripheral surface of the roller 42a.

(3)

In the preceding embodiment, the refrigerating apparatus is one that includes the hot water storage tank 31, but because it suffices for the refrigerating apparatus to be one where, during normal boiling operation, unheated water flows into the heat exchange path 61 that is configured by the water heat exchanger 22, the unheated water is heated when it flows through this heat exchange path 61, and high temperature water flows out from this heat exchange path 61, the refrigerating apparatus may also be one that does not include the hot water storage tank 31.

(4)

In the preceding embodiment, the temperature detecting means are configured by thermistors, but the temperature detecting means are not limited to thermistors.

(5)

In the preceding embodiment, the refrigerant that is used is carbon gas, but the refrigerant is not limited to carbon gas and may also be a refrigerant that is used in a supercritical state such as ethylene, ethane, or nitrogen oxide; moreover, rather than a refrigerant that is used in a supercritical state, a refrigerant such as dichlorodifluoromethane (R-12) or chlorodifluoromethane (R-22) may also be used.

INDUSTRIAL APPLICABILITY

[0057] The refrigerating apparatus pertaining to the present invention can suppress a shortage of suction gas in a compressor and the occurrence of noise in the vicinity of the compressor and is useful as a refrigerating apparatus and the like that is disposed with a rotary type compressor (including a swing type).

Claims

1. A refrigerating apparatus (1) comprising:

a rotary type compressor (21) that compresses a refrigerant;
a first heat exchanger (22) that causes the refrigerant of a high temperature and a high pressure that has been compressed by the compressor to exchange heat with a first fluid;
an expansion mechanism (23) that reduces the pressure of the refrigerant that has been condensed inside the first heat exchanger;
a second heat exchanger (24) that causes the refrigerant whose pressure has been reduced by the expansion mechanism to exchange heat with a second fluid; and
a muffler (26) that is disposed between the second heat exchanger and the compressor and reduces the pulsation of the flow of the refrigerant.

2. The refrigerating apparatus (1) of claim 1, wherein the muffler is disposed on a side of the compressor and is fixed to, so as to become integrated with, a side wall portion of the compressor.

3. The refrigerating apparatus (1) of claim 1 or 2, wherein the muffler includes
a cylindrical muffler body component (26a) that has a flow path cross-sectional area that is larger than a flow path cross-sectional area of a gas refrigerant pipe (29) that interconnects the second heat exchanger and the compressor and
a filter component (26b) that is supported inside the muffler body component and traps foreign particles in the refrigerant that flows from the second heat exchanger toward the compressor.

4. The refrigerating apparatus (1) of any of claims 1 to 3, wherein the muffler takes in, from a top portion of the muffler, the low pressure gas refrigerant that has flowed out from the second heat exchanger and causes the low pressure gas refrigerant to flow out from a bottom portion of the muffler to the compressor.

5. The refrigerating apparatus (1) of any of claims 1 to 4, further comprising a liquid-gas heat exchanger (25) that performs heat exchange between the liquid refrigerant that flows out from the first heat exchanger and flows into the expansion mechanism and the gas refrigerant that flows out from the second heat exchanger and flows into the compressor.

6. The refrigerating apparatus (1) of any of claims 1 to 5, wherein
the first fluid is water, and
the first heat exchanger is a heat exchanger for hot water supply that heats the water by causing the refrigerant to exchange heat with the water.

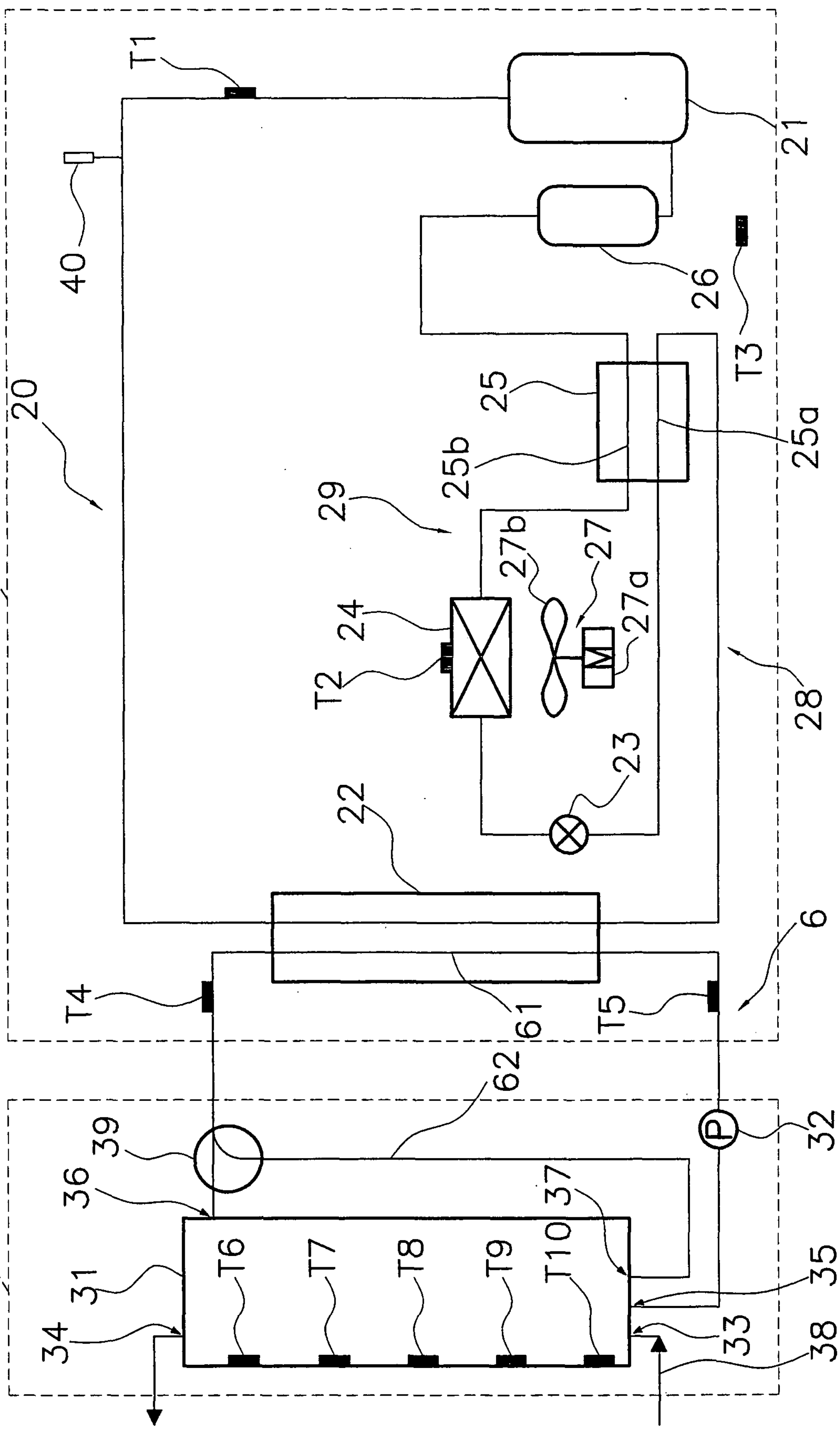
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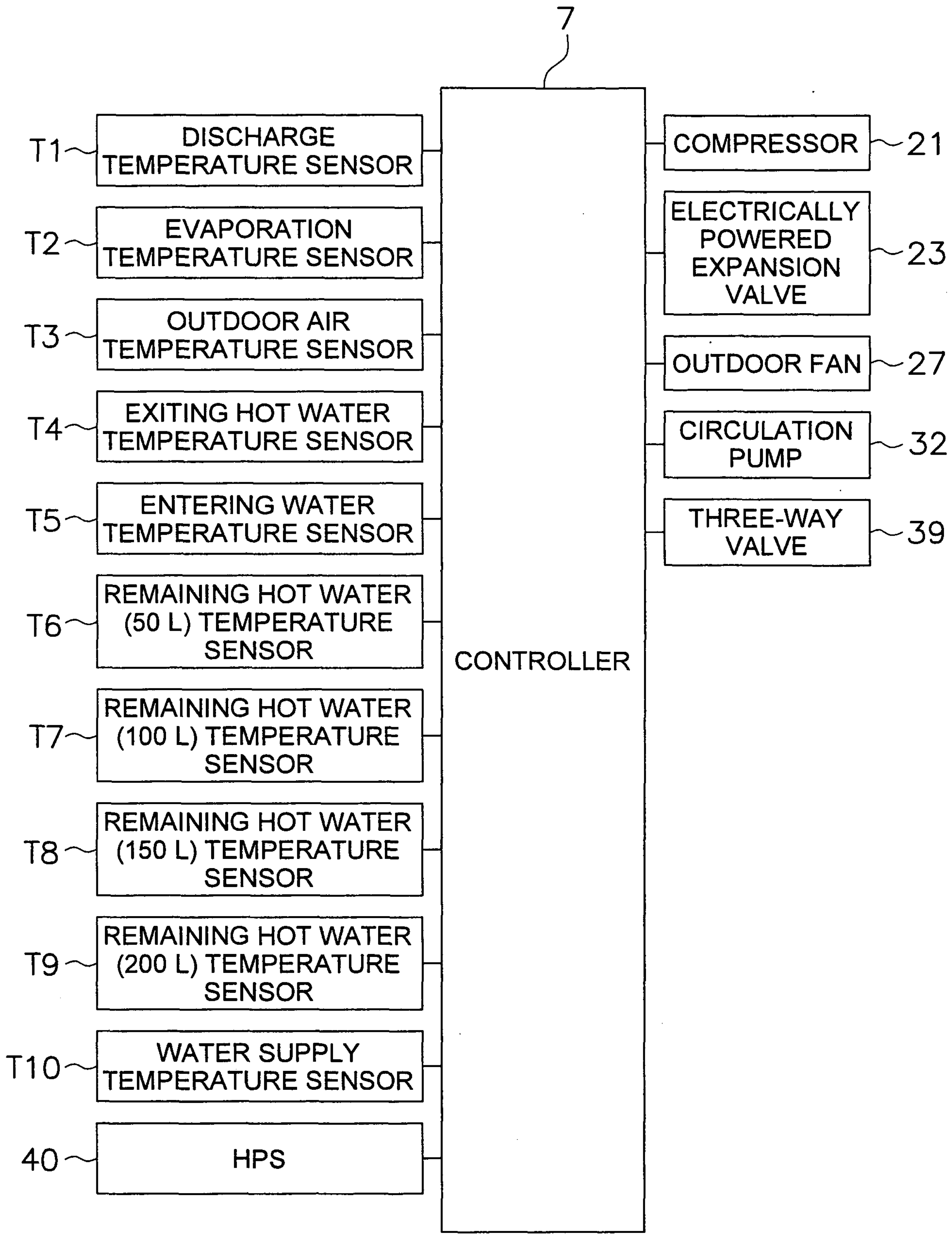
FIG. 1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CONTROLLER
T1
DISCHARGE TEMPERATURE SENSOR
T2
EVAPORATION TEMPERATURE SENSOR
T3
OUTDOOR AIR TEMPERATURE SENSOR
T4
EXITING HOT WATER TEMPERATURE SENSOR
T5
ENTERING WATER TEMPERATURE SENSOR
T6
REMAINING HOT WATER (50 L) TEMPERATURE SENSOR
T7
REMAINING HOT WATER (100 L) TEMPERATURE SENSOR
T8
REMAINING HOT WATER (150 L) TEMPERATURE SENSOR
T9
REMAINING HOT WATER (200 L) TEMPERATURE SENSOR
T10
WATER SUPPLY TEMPERATURE SENSOR
40
HPS
COMPRESSOR
21
ELECTRICALLY POWERED EXPANSION VALVE
23
OUTDOOR FAN
27
CIRCULATION PUMP
32
THREE-WAY VALVE
39

FIG. 2

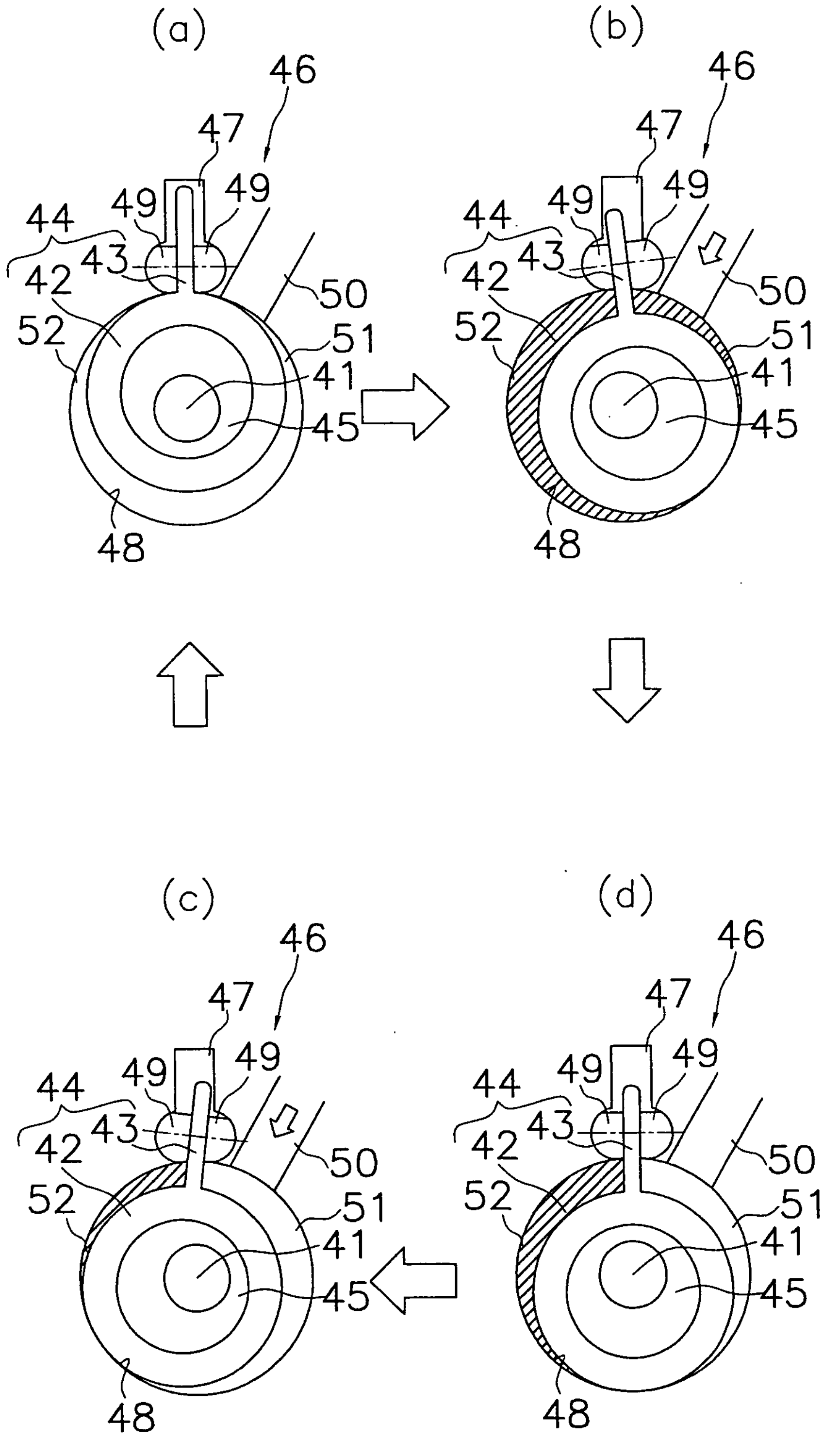

FIG. 3

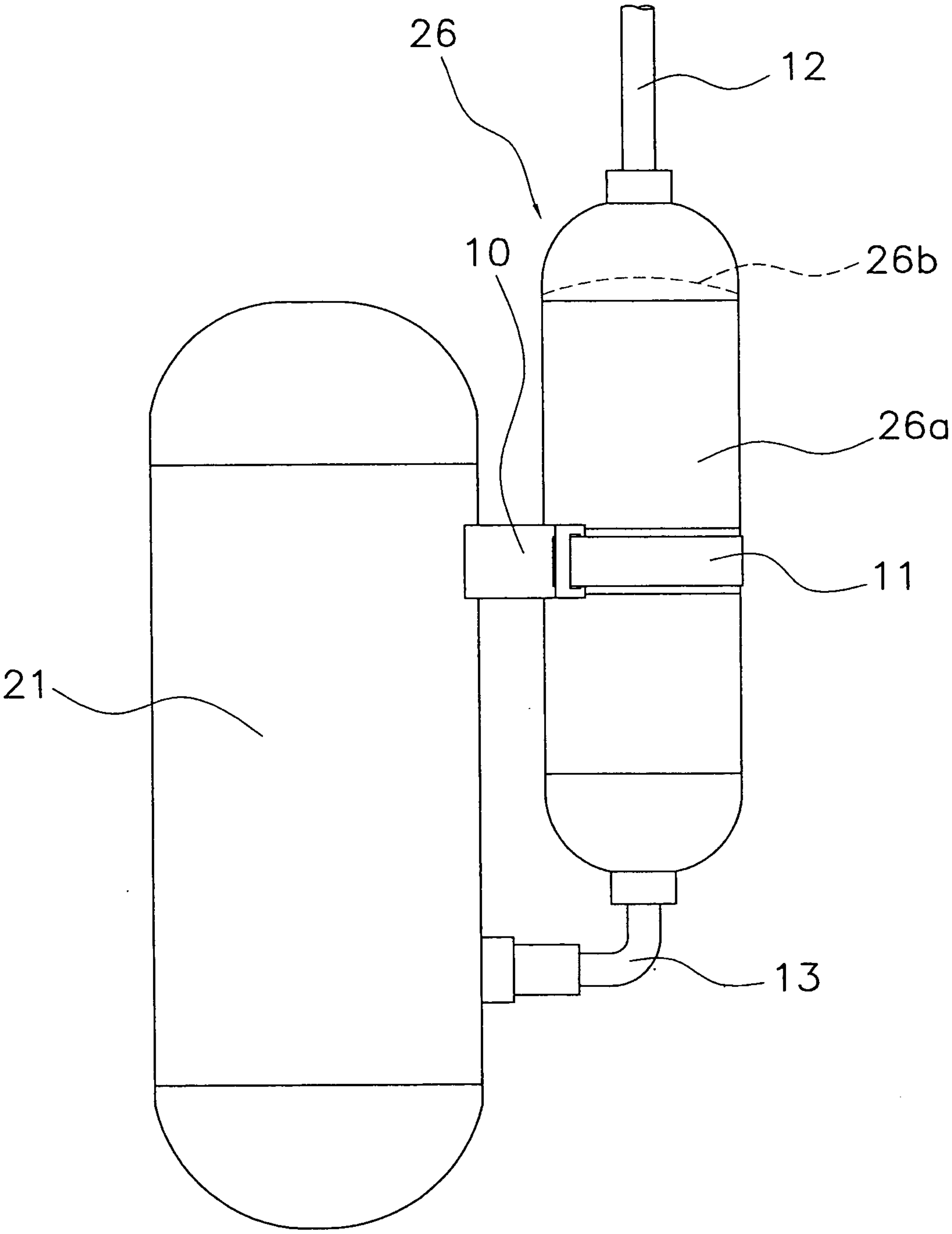

FIG. 4(a)

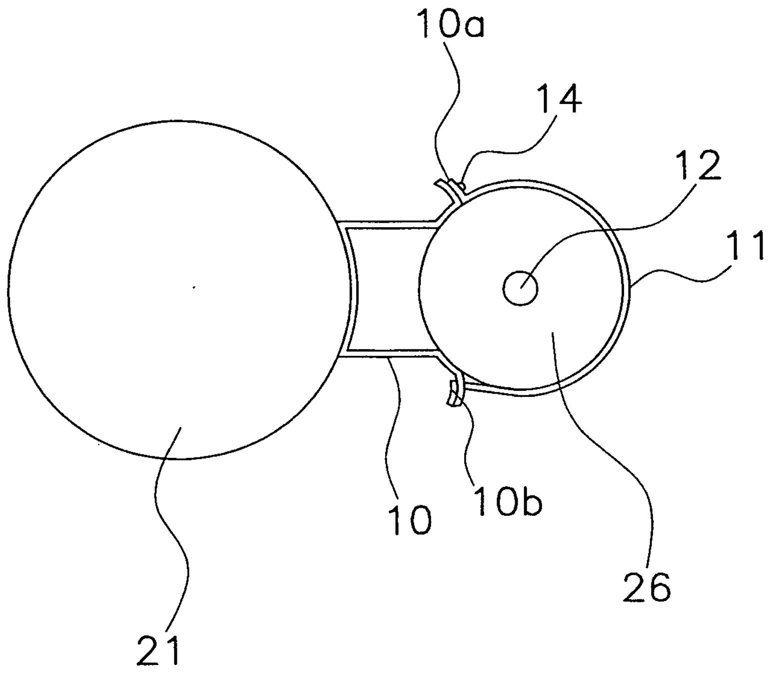

FIG. 4(b)

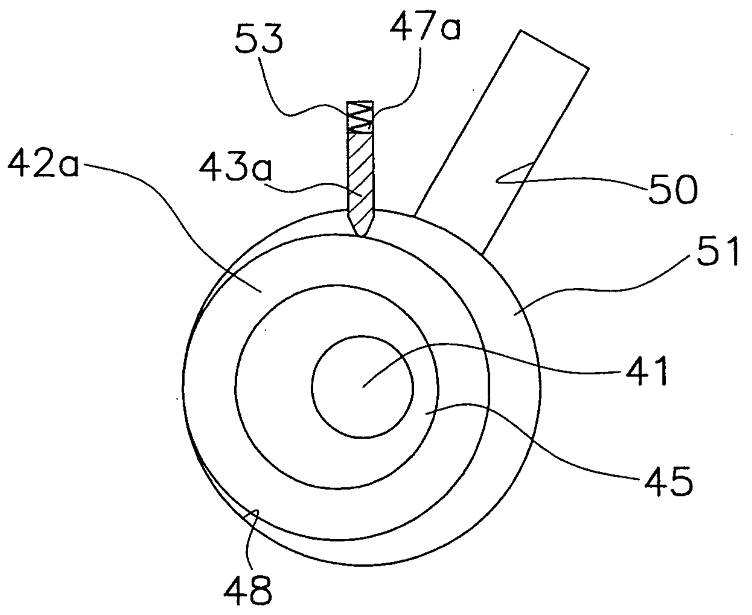

FIG. 5

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2007/056711

A. CLASSIFICATION OF SUBJECT MATTER
F25B41/00(2006.01)i, *F04B39/00*(2006.01)i, *F04C29/06*(2006.01)i, *F24H1/00*(2006.01)i, *F25B1/00*(2006.01)i, *F25B1/04*(2006.01)i, *F25B43/00*(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)
F25B41/00, F04B39/00, F04C29/06, F24H1/00, F25B1/00, F25B1/04, F25B43/00

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	1996-2007
Kokai Jitsuyo Shinan Koho	1971-2007	Toroku Jitsuyo Shinan Koho	1994-2007

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	JP 2005-127711 A (Daikin Industries, Ltd.), 19 May, 2005 (19.05.05), Fig. 1 & US 2004/0134225 A1 & EP 1396689 A1 & WO 2002/101304 A1	1-6
Y	JP 2004-293805 A (Daikin Industries, Ltd.), 21 October, 2004 (21.10.04), Par. Nos. [0006], [0007], [0020] to [0023]; Figs. 1, 2 (Family: none)	1-6
Y	JP 1-244181 A (Mitsubishi Electric Corp.), 28 September, 1989 (28.09.89), Page 1, right column, lines 10 to 12; page 2, left column, lines 2 to 5; Figs. 1 to 4 (Family: none)	2,4

☐ 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
02 May, 2007 (02.05.07)	15 May, 2007 (15.05.07)

Name and mailing address of the ISA/	Authorized officer
Japanese Patent Office	
Facsimile No.	Telephone No.

Form PCT/ISA/210 (second sheet) (April 2005)

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Patent documents cited in the description

- JP 2003247490 A **[0002]**