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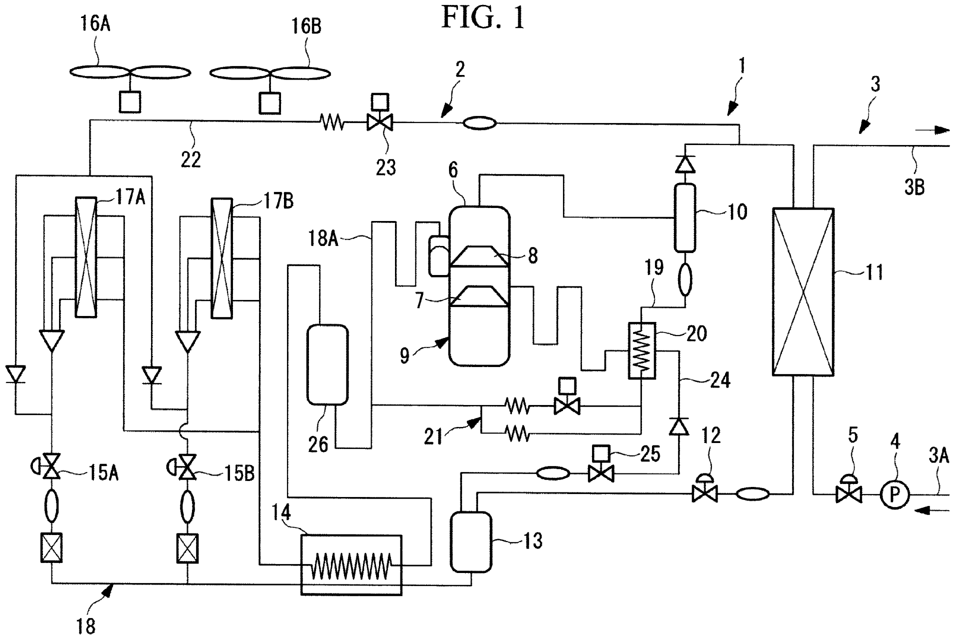
(54) Supercritical steam compression heat pump and hot-water supply unit

(57) An object is to provide a supercritical steam compression heat pump whose heating capacity can be increased by enabling the operation thereof without reducing a high pressure.

In a supercritical steam compression heat pump 2 in which CO_2 refrigerant is employed as a working medium and a refrigerant circulation circuit 18 is formed in which a compressor 9, a heat sink 11, an internal heat exchanger 14, depressurizing means 15A and 15B, evaporators 17A and 17B, and a low-pressure gas/liquid separator 26 are connected with pipes in this order, the low-pressure gas/liquid separator 26 is disposed in an intake pipe 18A that connects an outlet side of the internal heat exchanger 14 and the compressor 9.

FIG. 1



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Description

Technical Field

[0001] The present invention relates to a supercritical steam compression heat pump employing CO_2 refrigerant and to a hot-water supply unit to which the heat pump is applied.

{Background Art}

[0002] Among supercritical steam compression heat pumps that employ CO_2 refrigerant as refrigerant, heat-pump hot-water supply units in which refrigerant/water heat exchangers are employed as heat sinks thereof and in which heat exchange between the refrigerant and water is performed at the refrigerant/water heat exchangers, thereby heating water to produce hot water, have been known in the related art, as exemplified by Patent Literatures 1 and 2 or the like.

[0003] On the other hand, among supercritical steam compression refrigerating cycles in which CO_2 refrigerant serves as the working medium and air conditioners employing them, those in which refrigerant circulation circuits are formed by connecting compressors, heat sinks, internal heat exchangers, depressurizing means, evaporators, low-pressure gas/liquid separators, and so on in this order; the low-pressure gas/liquid separators are disposed in low-pressure gas pipes between the evaporators and the internal heat exchangers; and intermediate-pressure gas/liquid separators and gas injection circuits are also provided in the refrigerant circulation circuits have been known in the related art, as exemplified by Patent Literatures 3 to 5 or the like.

{Citation List}

{Patent Literature}

[0004]

{PTL 1} Publication of Japanese Patent No. 4287852
{PTL 2} Publication of Japanese Patent No. 4462103
{PTL 3} Japanese Examined Patent Application, Publication No. Hei 7-18602
{PTL 4} Japanese Unexamined Patent Application, Publication No. Hei 11-63694
{PTL 5} Publication of Japanese Patent No. 3614330

{Summary of Invention}

{Technical Problem}

[0005] In supercritical steam compression refrigerating cycles employing CO_2 refrigerant, it is widely known the operating efficiency thereof can be improved by providing internal heat exchangers and gas injection circuits, and, in the case of equipment that utilizes heat exchange of low-boiling-point refrigerant on a low-pressure side (equipment for air-cooling, freezing/refrigerating, etc.), disposing a low-pressure gas/liquid separator between an evaporator and an internal heat exchanger as described above is ideal (allows the enthalpy difference to be increased). However, in the case of equipment that utilizes heat exchange on a high-pressure side (equipment for air-heating, supplying hot water, etc.), even with those having an identical cycle configuration, a problem occurs in that the discharge temperature of a compressor increases, especially under operating conditions where the external air temperature is low (low pressure is low).

[0006] Specifically, in the case in which the low-pressure gas/liquid separator is disposed between the evaporator and the internal heat exchanger, because low-pressure gaseous refrigerant is heated by undergoing heat exchange with high-pressure side refrigerant at the internal heat exchanger and is taken into the compressor with increased superheating, the discharge temperature from the compressor increases, as indicated by a broken line in Fig. 2. Because the chemical stability of constituent materials in equipment forming the refrigerant circuit and that of freezer oil may be lost if the discharge temperature is increased excessively, the discharge temperature is restricted to about 140 °C. As a result, there is a problem in that the high pressure inevitably needs to be lowered so that the discharge temperature does not exceed 140 °C, and thus, there is a corresponding reduction in the heating capacity.

[0007] The present invention has been conceived in light of the above-described circumstances, and an object thereof is to provide, for a supercritical steam compression heat pump employing CO_2 refrigerant that utilizes heat exchange on a high-pressure side, as in supplying hot water or the like, a supercritical steam compression heat pump and a hot-water supply unit whose heating capacity can be increased by enabling the operation thereof without reducing the high pressure.

{Solution to Problem}

[0008] A supercritical steam compression heat pump and a hot-water supply unit of the present invention employ the following solutions in order to solve the above-described problems.
Specifically, a supercritical steam compression heat pump according to the present invention is a supercritical steam compression heat pump in which CO_2 refrigerant is employed as a working medium includes a compressor that compresses the refrigerant, a heat sink that releases the heat of high-temperature, high-pressure refrigerant, an internal heat exchanger that performs heat exchange between the refrigerant that has flowed out from the heat sink and low-pressure refrigerant that is taken into the compressor, depressurizing means for depressurizing the refrigerant that has passed through the internal heat exchanger, an evaporator that evaporates gas/liquid two-phase refrigerant that has been depressurized by the depressurizing means, and a low-pressure gas/liquid sep-

arator that allows the compressor to take in only gaseous refrigerant by performing gas/liquid separation of the refrigerant that has been evaporated at the evaporator wherein a refrigerant circulation circuit is formed in which the compressor, the heat sink, the internal heat exchanger, the depressurizing means , the evaporator, and the low-pressure gas/liquid separator are connected with pipes in this order, and wherein the low-pressure gas/ liquid separator is disposed in an intake pipe that connects an outlet side of the internal heat exchanger and the compressor.

[0009] With the present invention, because the low-pressure gas/liquid separator in the supercritical steam compression heat pump employing CO_2 refrigerant is disposed in the intake pipe that connects the outlet side of the internal heat exchanger and the compressor, by bringing the low-pressure refrigerant at the outlet of the internal heat exchanger to a saturated state, it is possible to control superheating of the refrigerant that is taken into the compressor via the low-pressure gas/liquid separator to be a comparatively small level as compared with a unit in which the low-pressure gas/liquid separator is provided between the evaporator and the internal heat exchanger, which makes it possible to suppress an increase in the discharge temperature of the compressor. Therefore, even if the discharge temperature of the compressor is restricted, by increasing the heating capacity by performing the operation where the high-pressure pressure is set comparatively high but so as not to exceed the temperature limit, it is possible to achieve a performance enhancement for the heat pump.

[0010] Furthermore, with the supercritical steam compression heat pump of the present invention, in the above-described supercritical steam compression heat pump, intermediate-pressure depressurizing means and an intermediate-pressure gas/liquid separator are provided between the heat sink and the internal heat exchanger, and a gas injection circuit for injecting refrigerant gas separated at the intermediate-pressure gas/liquid separator into the compressor is provided.

[0011] With the present invention, because the intermediate-pressure depressurizing means and the intermediate-pressure gas/liquid separator are provided between the heat sink and the internal heat exchanger, and because the gas injection circuit for injecting the refrigerant gas separated at the intermediate-pressure gas/ liquid separator into the compressor is provided, it is possible to enhance the COP (coefficient of performance) and to enhance the heating capacity through the supercooling effect of the refrigerant achieved by means of the internal heat exchanger and the gas injection effect (economizer effect) achieved by means of the gas injection circuit. Therefore, a further performance enhancement can be achieved for the heat pump.

[0012] Furthermore, with the supercritical steam compression heat pump of the present invention, in the above-described supercritical steam compression heat pump, a two-stage compressor in which a lower-stage compressor and a higher-stage compressor are provided in a sealed housing is employed as the compressor, and the refrigerant gas from the gas injection circuit is injected into intermediate-pressure refrigerant that is taken into the higher-stage compressor.

[0013] With the present invention, because the two-stage compressor in which the lower-stage compressor and the higher-stage compressor are provided in the sealed housing is employed as the compressor, and because the refrigerant gas from the gas injection circuit is injected into the intermediate-pressure refrigerant gas that is taken into the higher-stage compressor, pressure loss can be kept to a minimum for the intermediate-pressure refrigerant gas that is separated at the intermediate-pressure gas/liquid separator and used for the gas injection via the gas injection circuit, thus making it possible to achieve a high heating capacity and a high COP (coefficient of performance) through the gas injection effect. Therefore, it is possible to achieve a further performance enhancement for the heat pump through the efficiency enhancement achieved by the two-stage compression and the gas injection effect.

[0014] Furthermore, with a hot-water supply unit according to the present invention, a refrigerant/water heat exchanger that heats water by performing heat exchange between refrigerant and water is employed as the heat sink in the supercritical steam compression heat pump according to any one of Claims 1 to 3 and hot water can be produced by means of the refrigerant/water heat exchanger.

[0015] With the present invention, because a refrigerant/water heat exchanger that performs heat exchange between the refrigerant and water to heat the water is employed as the heat sink in any one of the supercritical steam compression heat pumps described above, and because hot water can be produced via the refrigerant/ water heat exchanger, it is possible to increase the capacity for heating water with the refrigerant at the refrigerant/water heat exchanger due to the fact that operation is possible while maintaining the high-pressure pressure comparatively high on the heat pump side during the hot-water supplying operation, in which hot water is produced by operating the supercritical steam compression heat pump. Therefore, it is possible to enhance the hot-water supply capacity and to achieve a performance enhancement for the hot-water supply unit.

{Advantageous Effects of Invention}

[0016] With a supercritical steam compression heat pump of the present invention, by bringing low-pressure refrigerant at an outlet of an internal heat exchanger to a saturated state, it is possible to control superheating of refrigerant that is taken into a compressor via the low-pressure gas/liquid separator to a comparatively small level as compared with a unit in which the low-pressure gas/liquid separator is provided between the evaporator and the internal heat exchanger, which makes it possible to suppress an increase in the discharge temperature of the compressor; therefore, even if the discharge temperature of the compressor is restricted, by increasing the heating capacity by performing the operation where the high-pressure pressure is set comparatively high but so as not to exceed the temperature limit, it is possible to achieve a performance enhancement for the heat pump.

[0017] With a hot-water supply unit of the present invention, because it is possible to increase the capacity for heating water with refrigerant at a refrigerant/water heat exchanger due to the fact that the operation is possible while maintaining the high-pressure pressure comparatively high on a heat-pump side during the hot-water supplying operation, in which hot water is produced by operating a supercritical steam compression heat pump, it is possible to enhance the hot-water supply capacity and to achieve a performance enhancement for the hot-water supply unit.

{Brief Description of Drawings}

[0018]

> Fig. 1 is a diagram showing, in outline, the configuration of a hot-water supply unit employing a supercritical steam compression heat pump according to an embodiment of the present invention.
> Fig. 2 is a Mollier diagram for the supercritical steam compression heat pump shown in Fig. 1.

{Description of Embodiment}

[0019] An embodiment of the present invention will be described below with reference to Figs. 1 and 2.

Fig. 1 is a diagram showing, in outline, the configuration of a hot-water supply unit employing a supercritical steam compression heat pump according to the embodiment of the present invention, and Fig. 2 is a Mollier diagram for that heat pump.

A hot-water supply unit 1 is provided with a supercritical steam compression heat pump 2 employing CO_2 refrigerant and a water circulation pathway 3 that is connected to a hot-water storage tank unit (not shown). The water circulation pathway 3 is provided with a water supply-side pathway 3A that is connected to a water-side flow path of a heat sink (refrigerant/water heat exchanger) 11 in the supercritical steam compression heat pump 2 and a hot-water extraction-side pathway 3B for extracting hot water produced at the refrigerant/water heat exchanger 11, and the water supply-side pathway 3A is provided with a water pump 4 and a flow-volume control valve 5.

[0020] The above-described heat pump 2 is provided with a closed-cycle refrigerant circulation circuit 18 where a two-stage compressor (compressor) 9 in which a lower-stage compressor 7 and a higher-stage compressor 8 are built into a sealed housing 6; an oil separator 10 that separates lubricant contained in refrigerant gas; the heat sink (refrigerant/water heat exchanger) 11 that releases the heat of the refrigerant gas; an electronic expansion valve (intermediate-pressure depressurizing means) 12 that depressurizes the refrigerant to intermediate pressure; an intermediate-pressure receiver (intermediate-pressure gas/liquid separator) 13 equipped with a gas/liquid separating function; an internal heat exchanger 14 that performs heat exchange between intermediate-pressure refrigerant and low-pressure refrigerant that is taken into the two-stage compressor 9; main electronic expansion valves (depressurizing means) 15A and 15B that depressurize the intermediate-pressure refrigerant to low-temperature, low-pressure gas/liquid two-phase refrigerant; and multiple systems of evaporators (air heat exchangers) 17A and 17B that perform heat exchange between the refrigerant and the external air blown by two fans 16A and 16B are connected by pipes in this order. Note that such a refrigerant circulation circuit 18 is commonly known.

[0021] The heat sink 11 of the heat pump 2 described above serves as a refrigerant/water heat exchanger in which heat exchange is performed between water and the refrigerant gas by making high-temperature, high-pressure refrigerant gas discharged from the two-stage compressor 9 circulate in a refrigerant-side flow path on one side thereof and making water circulate in the water-side flow path on the other side via the water circulation pathway 3. Then, water is heated by the high-temperature, high-pressure refrigerant gas at this refrigerant/water heat exchanger 11, thus producing hot water.

[0022] In addition, the above-described heat pump 2 is provided with an oil-return circuit 19 that returns oil separated at the oil separator 10 to an intake pipe 18A side in the two-stage compressor 9, and this oil-return circuit 19 is provided with a double-pipe heat exchanger 20 and an oil-level adjusting mechanism 21 formed of an electromagnetic valve, a capillary tube, and so forth. Furthermore, the above-described heat pump 2 is provided with a hot-gas bypass circuit 22 for removing frost by introducing the high-temperature, high-pressure hot gaseous refrigerant discharged from the two-stage compressor 9 into the evaporators 17A and 17B in the event of frost forming on surfaces of the evaporators 17A and 17B during operation at a low outside air temperature. The hot-gas bypass circuit 22 is provided with an electromagnetic valve 23 that is opened/closed by detecting the frost formation.

[0023] In addition, the above-described heat pump 2 is provided with a gas injection circuit 24 for injecting the intermediate-pressure refrigerant gas separated at the intermediate-pressure receiver (intermediate-pressure gas/liquid separator) 13 equipped with the gas/liquid separating function into the sealed housing 6 in which the atmosphere is of the intermediate-pressure gas that is taken into the higher-stage compressor 8 in the two-stage compressor 9 via the double-pipe heat exchanger 20 provided in the oil-return circuit 19. This gas injection circuit 24 is provided with an electromagnetic valve 25 so that the gas injection circuit 24 can be opened/closed as needed.

[0024] Furthermore, the above-described refrigerant circulation circuit 18 has a configuration in which a low-pressure gas/liquid separator (accumulator) 26 is disposed in an intake pipe 18A that connects the outlet side of the internal heat exchanger 14 and the two-stage compressor 9. This low-pressure gas/liquid separator (accumulator) 26 functions so that a liquid component contained in the low-pressure refrigerant gas is separated therein and only the gaseous refrigerant is taken into the two-stage compressor 9.

[0025] With the above-described configuration, this embodiment affords the following operational advantages.

Once the supercritical steam compression heat pump 2 employing CO_2 refrigerant is activated in the above-described hot-water supply unit 1, the high-temperature, high-pressure refrigerant gas that has undergone the two-stage compression at the two-stage compressor 9 is introduced into the heat sink (refrigerant/water heat exchanger) 11 after the oil contained in the refrigerant is separated at the oil separator 10, and the refrigerant gas undergoes heat exchange therein with water that is circulated in the water-side flow path from the water supply-side pathway 3A of the water circulation pathway 3. This water is heated and increased in temperature by the heat released from the high-temperature, high-pressure refrigerant gas and is subsequently returned to the hot-water storage tank (not shown) via the how-water extraction-side pathway 3B; and the heat exchange between the refrigerant and water is continued at the heat sink (refrigerant/water heat exchanger) 11 continuously until the hot-water storage level in the hot-water storage tank reaches a predetermined level, and the hot-water storing operation is ended when the hot-water storage level reaches the predetermined level.

[0026] The refrigerant that has been cooled by means of heat exchange with water at the heat sink 11 is depressurized at the intermediate-pressure electronic expansion valve (intermediate-pressure depressurizing means) 12, reaches the intermediate-pressure receiver 13, and undergoes gas/liquid separation therein. The intermediate-pressure gaseous refrigerant separated at the intermediate-pressure receiver 13 passes through the electromagnetic valve 25 and the double-pipe heat exchanger 20, is injected into the intermediate-pressure refrigerant gas in the sealed housing 6 of the two-stage compressor 9 by means of the gas injection circuit 24, and is taken into the higher-stage compressor 8 where it is recompressed. The hot-water supply capacity can be increased by enhancing the heating capacity and the coefficient of performance (COP) of the heat pump 2 by means of the economizer effect due to this gas injection.

[0027] On the other hand, the liquid refrigerant separated at the intermediate-pressure receiver 13 is supercooled by means of heat exchange with the low-pressure refrigerant gas evaporated at the evaporators 17A and 17B at the internal heat exchanger 14, is subsequently depressurized at the main electronic expansion valves (depressurizing means) 15A and 15B, and flows into the evaporators (air heat exchangers) 17A and 17B in the form of low-temperature, low-pressure, gas/liquid two-phase refrigerant. The refrigerant that has flowed into the evaporators (air heat exchangers) 17A and 17B undergoes heat exchange with the external air blown thereto by the fans 16A and 16B and is evaporatively gasified by absorbing heat from the external air.

[0028] The refrigerant that has been gasified at the evaporators 17A and 17B undergoes heat exchange with the intermediate-pressure liquid refrigerant at the internal heat exchanger 14, is utilized to supercool the intermediate-pressure liquid refrigerant, and subsequently reaches the low-pressure gas/liquid separator (accumulator) 26 where it undergoes gas/liquid separation. By doing so, only the gaseous refrigerant from which the liquid component has been separated is taken into the two-stage compressor 9 and is recompressed therein. Thereafter, the refrigerant is utilized to produce hot water by repeating the same operation. Note that, in the event that frost accumulates on the evaporators 17A and 17B during the hot-water storing operation, this is detected, and the electromagnetic valve 23 is opened, which makes it possible to perform a defrosting operation by introducing hot gaseous refrigerant discharged from the two-stage compressor 9 into the evaporators 17A and 17B from downstream of the oil separator 10 via the hot-gas bypass circuit 22.

[0029] In this way, this embodiment is configured such that the low-pressure gas/liquid separator 26 that allows the two-stage compressor 9 to take in only the gaseous refrigerant by performing gas/liquid separation of the refrigerant evaporated at the evaporators 17A and 17B is disposed in the intake pipe 18A that connects the two-stage compressor 9 and the low-pressure-refrigerant outlet side of the internal heat exchanger 14 that is provided in the intake pipe 18A on the downstream side of the evaporators 17A and 17B. Because of this, by bringing the low-pressure refrigerant at the outlet of the internal heat exchanger 14 to a saturated state, it is possible to control superheating of the refrigerant that is taken into the two-stage compressor 9 via the low-pressure gas/liquid separator 26 to a comparatively small level as compared with a unit in which the low-pressure gas/liquid separator 26 is provided between the internal heat exchanger 14 and the evaporators 17A and 17B, which makes it possible to suppress an increase in the discharge temperature of the refrigerant from the two-stage compressor 9.

[0030] Specifically, as indicated by the Mollier diagram for the supercritical cycle employing CO_2 refrigerant in Fig. 2, by providing the low-pressure gas/liquid separator 26 on the downstream side of the internal heat exchanger 14, the refrigerant can be brought to a substantially saturated state at an inlet point A and an outlet point B of the internal heat exchanger 14 and an intake point C of the two-stage compressor 9 in the supercritical cycle in

Fig. 1, as indicated by points A, B, and C in the Mollier diagram, which makes it possible to control superheating of the refrigerant that is taken into the two-stage compressor 9 to a comparatively small level; by doing so, as compared with a conventional unit in which the low-pressure gas/liquid separator is provided between the evaporator and the internal heat exchanger indicated by the broken line in Fig. 2, even in the case in which the upper limit of the discharged refrigerant temperature is restricted to, for example, 140 °C, operation in which the high-pressure pressure is kept comparatively high in a range that does not exceed 140 °C becomes possible.

[0031] As a result, even if the discharge temperature of the two-stage compressor 9 is restricted, by increasing the heating capacity by performing the operation where the high-pressure pressure is set comparatively high so as not to exceed the temperature limit, performance enhancement can be achieved for the supercritical steam compression heat pump 2, and consequently, for the hot-water supply unit 1.

[0032] In addition, in this embodiment, because the intermediate-pressure electronic expansion valve (intermediate-pressure depressurizing means) 12 and the intermediate-pressure receiver (intermediate-pressure gas/liquid separator) 13 equipped with the gas/liquid separating function are provided between the heat sink (refrigerant/water heat exchanger) 11 and the internal heat exchanger 14, and because the gas injection circuit 24 for injecting the refrigerant gas separated at the intermediate-pressure receiver 13 into the two-stage compressor 9 is provided, it is possible to enhance the COP (coefficient of performance) and to enhance the heating capacity through a supercooling effect of the refrigerant achieved by means of the internal heat exchanger 14 and the gas injection effect (economizer effect) achieved by means of the gas injection circuit 24. Therefore, it is possible to achieve a further performance enhancement for the supercritical steam compression heat pump 2 and the hot-water supply unit 1.

[0033] Furthermore, the two-stage compressor 9 in which the lower-stage compressor 7 and the higher-stage compressor 8 are provided in the sealed housing 6 is employed as the compressor applied to the heat pump 2, and the refrigerant gas from the gas injection circuit 24 is injected into the intermediate-pressure refrigerant gas that is taken into the higher-stage compressor 8. Because of this, pressure loss can be kept to a minimum for the intermediate-pressure refrigerant gas that is separated at the intermediate-pressure receiver (intermediate-pressure gas/liquid separator) 13 and used for gas injection via the gas injection circuit 24, thus making it possible to achieve a high heating capacity and a high COP (coefficient of performance) through the gas injection effect. Therefore, it is possible to achieve further performance enhancement for the supercritical steam compression heat pump 2 and the hot-water supply unit 1 through the efficiency enhancement achieved by the two-stage compressor 9 and the gas injection effect.

[0034] Note that the present invention is not limited to the invention according to the above-described embodiment, and appropriate modifications are possible within a range that does not depart from the spirit thereof. For example, although the above-described embodiment has been described in terms of an example in which the two-stage compressor 9 is employed as the compressor, it is needless to mention that the present invention is similarly applicable to a unit in which a single-stage compressor is employed, and, furthermore, even in the case in which a single-stage compressor is employed, it is, of course, possible to provide the gas injection circuit 24 therein.

[0035] In addition, although the above-described embodiment has been described in terms of an example in which multiple systems of the main electronic expansion valves 15A and 15B and the evaporators 17A and 17B are connected in parallel and two fans 16A and 16 are installed so as to correspond to the evaporators 17A and 17B, the system may, of course, be one system.

{Reference Signs List}

[0036]

1 hot-water supply unit
2 supercritical steam compression heat pump
3 water circulation pathway
6 sealed housing
7 lower-stage compressor
8 higher-stage compressor
9 two-stage compressor (compressor)
11 heat sink (refrigerant/water heat exchanger)
12 intermediate-pressure electronic expansion valve (intermediate-pressure depressurizing means)
13 intermediate-pressure receiver (intermediate-pressure gas/liquid separator)
14 internal heat exchanger
15A, 15B main electronic expansion valve (depressurizing means)
17A, 17B evaporator
18 refrigerant circulation circuit
18A intake pipe
24 gas injection circuit
26 low-pressure gas/liquid separator (accumulator)

Claims

1. A supercritical steam compression heat pump in which CO_2 refrigerant is employed as a working medium comprising:

   a compressor (9) that compresses the refrigerant;
   a heat sink (11) that releases the heat of high-temperature, high-pressure refrigerant;

an internal heat exchanger (14) that performs heat exchange between the refrigerant that has flowed out from the heat sink and low-pressure refrigerant that is taken into the compressor;
depressurizing means (15A, 15B) for depressurizing the refrigerant that has passed through the internal heat exchanger (14);
an evaporator (17A, 17B) that evaporates gas/liquid two-phase refrigerant that has been depressurized by the depressurizing means (15A, 15B); and
a low-pressure gas/liquid separator (26) that allows the compressor (9) to take in only gaseous refrigerant by performing gas/liquid separation of the refrigerant that has been evaporated at the evaporator (17A, 17B);
wherein a refrigerant circulation circuit is formed in which the compressor (9), the heat sink (11), the internal heat exchanger (14), the depressurizing means (15A, 15B), the evaporator (17A, 17B), and the low-pressure gas/liquid separator (26) are connected with pipes in this order, and wherein the low-pressure gas/liquid separator (26) is disposed in an intake pipe that connects an outlet side of the internal heat exchanger (14) and the compressor (9).

2. A supercritical steam compression heat pump according to Claim 1, wherein intermediate-pressure depressurizing means (12) and an intermediate-pressure gas/liquid separator (13) are provided between the heat sink and the internal heat exchanger (14), and a gas injection circuit (24) for injecting refrigerant gas separated at the intermediate-pressure gas/liquid separator into the compressor (9) is provided.

3. A supercritical steam compression heat pump according to Claim 2, wherein a two-stage compressor in which a lower-stage compressor (7) and a higher-stage compressor (8) are provided in a sealed housing (6) is employed as the compressor (9), and the refrigerant gas from the gas injection circuit (24) is injected into intermediate-pressure refrigerant gas that is taken into the higher-stage compressor (8).

4. A hot-water supply unit wherein a refrigerant/water heat exchanger (11) that heats water by performing heat exchange between refrigerant and water is employed as the heat sink in the supercritical steam compression heat pump according to any one of Claims 1 to 3 and hot water can be produced by means of the refrigerant/water heat exchanger (11).

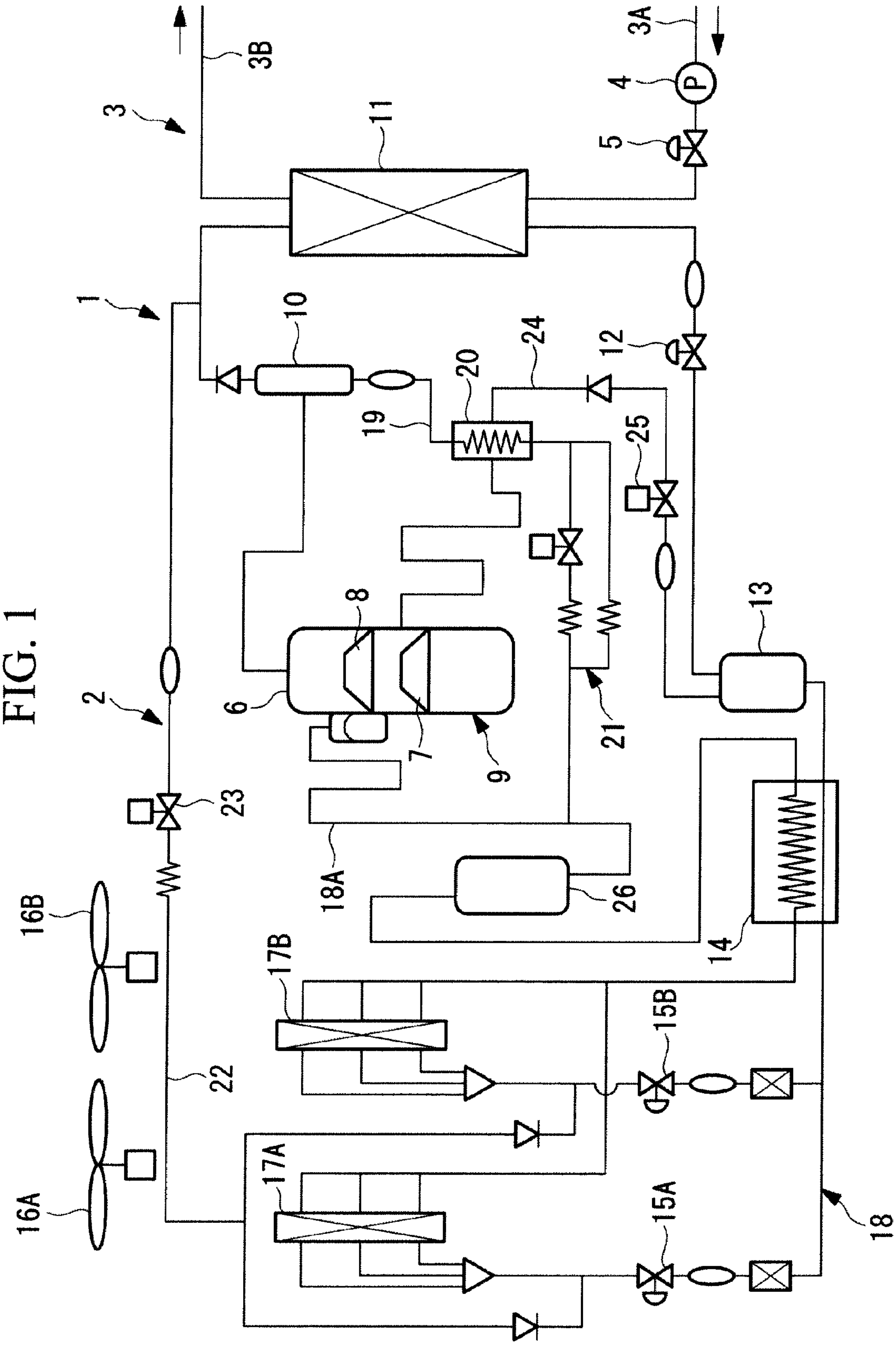
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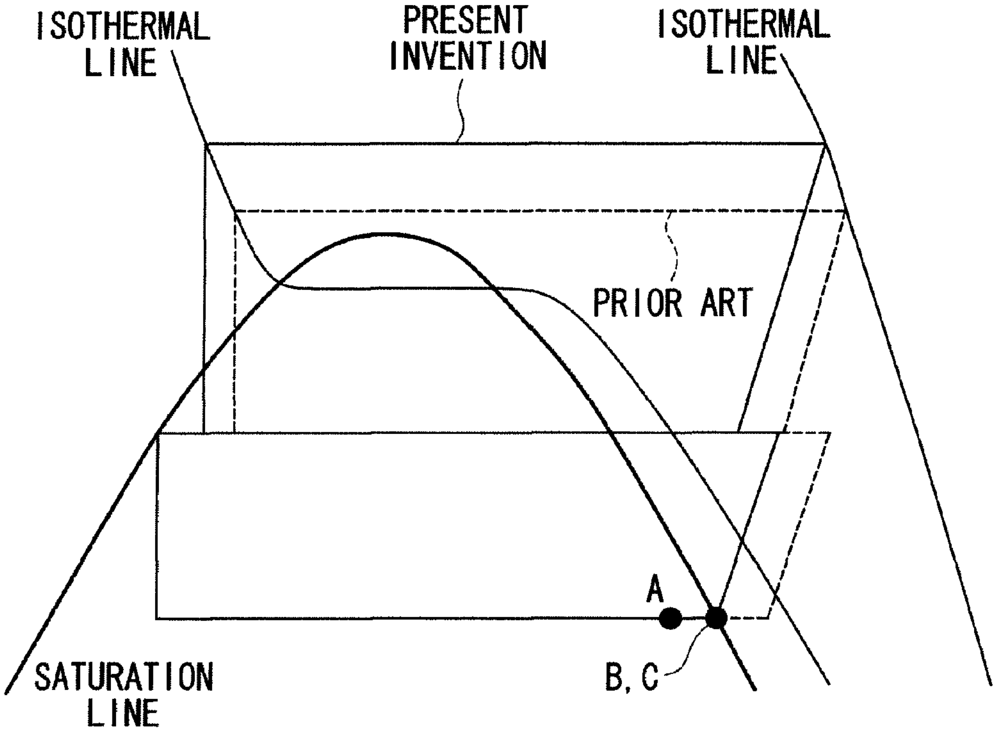
FIG. 1

FIG. 2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EUROPEAN SEARCH REPORT

Application Number
EP 12 16 7898

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Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
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			TECHNICAL FIELDS SEARCHED (IPC)
			F25B

The present search report has been drawn up for all claims

1

Place of search	Date of completion of the search	Examiner
Munich	26 July 2012	Ritter, Christoph

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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