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(54) **Gas heat pump system**

Gaswärmepumpensystem

Système de pompe à chaleur à gaz

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EP 2 629 031 B1

Description

[0001] The present invention relates to a gas heat pump system which uses a gas engine, and more particularly to a gas heat pump system for driving a compressor to realize a refrigerating cycle by using a gas engine.

[0002] In general, the refrigerating cycle is a cycle for supplying or absorbing heat to/from a required place by using a circulating cycle of the refrigerant. In order to realize the refrigerating cycle, a compressor, a condenser, an expansion valve, and an evaporator are used. The elements are connected to one another with a refrigerant pipeline, so that the condenser supplies heat to surroundings, or the evaporator absorbs the heat from the surroundings.

[0003] In this instance, the condenser and the evaporator are elements for enabling heat exchange between the refrigerant and air or other fluid. Therefore, the elements may be called as heat exchangers, and the condenser and the evaporator are defined depending on states of the refrigerant before and after the heat exchange.

[0004] A machine or system for heating or cooling room air by using the refrigerating cycle is called as an air conditioner. In the air conditioning system, in order to heat the room air, the refrigerant supplies the heat to the room air. Therefore, in this case, an indoor unit may be called as a condenser, and an outdoor unit may be called as an evaporator. Opposite to this, in the air conditioner, the refrigerant absorbs the heat from the room air for cooling the room. Therefore, in this case, the indoor unit may be called as an evaporator and the outdoor unit may be called as a condenser.

[0005] Different from domestic air conditioning, industrial or large building air conditioning requires a large capacity compressor. That is, in order to drive a compressor required for compressing a high flow rate of refrigerant to high temperature and high pressure gas, a gas heat pump which uses, not an electric motor, but a gas engine, is used, widely.

[0006] The gas heat pump system realizes the refrigerant cycle by generating power for driving the compressor with an engine which burns gas.

[0007] US 4 754 614 A relates to a prime-motor-driven room-warming/cooling and hot water supply having a heat exchanger which includes each part of a cooling water circulating circuit, a supplied water circuit, a refrigerant heating circuit and a supplied water heating circuit so as to perform mutual heat exchanging of cooling water for the prime motor in the water heating circuit, the refrigerant in the supplied water heating circuit and the refrigerant in the refrigerant heating circuit.

[0008] FIG. 1 illustrates a schematic view of a related art gas heat pump system.

[0009] Referring to FIG. 1, the related art gas heat pump system may be provided with a compressor 21, an indoor heat exchanger 11, an expansion valve 26, an outdoor heat exchanger 27, and a refrigerant pipeline 30 for connecting above elements together to enable the refrigerant to circulate. An arrangement of the elements and the refrigerant pipeline connecting the elements may be similar or identical to a general air conditioner.

[0010] However, the gas heat pump system includes a gas engine 22 for driving the compressor, additionally. Therefore, a cooling water pipeline 40 is required for cooling an overheated gas engine 22. Of course, a heat dissipating unit 44 is also used widely for cooling the cooling water heated as the cooling water cools down the gas engine, again.

[0011] Referring to FIG. 1, it may be said that, a left side of an A line is an indoor side, and a right side of the A line is an outdoor side. Therefore, a left side configuration may be an indoor unit 10 and a right side configuration may be an outdoor unit 20, at large. Of course, in view of heat exchange, of the indoor side configuration, an indoor heat exchanger 11 and a fan 12 may be the indoor unit, and an outdoor heat exchanger 27, the heat dissipation unit 44, and a fan 45 may be the outdoor unit.

[0012] Of course, excluding some of the refrigerant pipeline and valves, the indoor unit and the outdoor unit may be placed in a housing or a case. Therefore, it is possible that the indoor unit and the outdoor unit are connected with the refrigerant pipeline to fabricate the gas heat pump system.

[0013] A refrigerant flow and a cooling water flow at the time of room heating and cooling will be described, briefly.

[0014] In the room heating, the refrigerant compressed to high temperature and high pressure gas at the compressor 21 is introduced to the indoor heat exchanger 11 through a four way valve 24, and condensed at the indoor heat exchanger 11 to heat the room. The refrigerant condensed thus is expanded to low pressure refrigerant at the expansion valve 26, and is introduced to, and vaporize at, the outdoor heat exchanger 27. The refrigerant vaporized thus is introduced to the compressor through the four-way valve 24, thereby repeating the refrigerating cycle.

[0015] Since a temperature of the cooling water which cools down the gas engine 22 is not high in an initial engine driving, the cooling water is introduced to the engine through the three-way valve 41, again. If the temperature of the cooling water is elevated as the engine driving is continued, the cooling water is introduced to the engine after being supplied to a supplementary evaporator 43 through the three-way valve 41.

[0016] The supplementary evaporator 43 makes the high temperature cooling water to heat exchange with the refrigerant being introduced to the compressor 21. In a case the refrigerant fails to be vaporized adequately due to a low outdoor air temperature, the supplementary evaporator 43 can make adequate vaporization of the refrigerant. Accordingly, the supplementary evaporator 43 enables to expect various effects, such as a stable performance of the refrigerating cycle, noise reduction

of the compressor, and enhancement of a lifetime of the compressor.

[0017] In the meantime, if use of the supplementary evaporator 43 is not necessary, the cooling water is introduced to the heat dissipation unit 44 through the three-way valve 42, cooled down at the heat dissipation unit 44, and is introduced to the engine 22.

[0018] In room cooling, the refrigerant compressed to high temperature and high pressure gas at the compressor 21 is introduced to the outdoor heat exchanger 27 through the four-way valve 24, and condensed at the outdoor heat exchanger 27. The refrigerant condensed thus is expanded to a low pressure at the expansion valve 26, and introduced to, and vaporizes at, the indoor heat exchanger 11, to cool down the room. The refrigerant vaporized thus is introduced to the compressor through the four-way valve 24, to repeat the refrigerating cycle. Therefore, it may be said that a flow direction of the refrigerant flowing along the refrigerant pipeline 30 at the time of room heating is opposite to a flow direction of the refrigerant at the time of room cooling.

[0019] It may be said that a flow direction of the cooling water which cools the gas engine 22 flowing along the cooling water pipeline 40 at the time of room heating is the same with a flow direction of the cooling water at the time of room cooling. However, since the refrigerant can be vaporized adequately at the indoor heat exchanger 11, supply of the cooling water to the supplementary evaporator 43 may not be required. Therefore, it may be said that, at the time of room cooling, the cooling water is introduced to the heat dissipating unit 44 through the three-way valve 42 and, therefrom, to the engine.

[0020] In order to enhance system efficiency, an oil separator 23, a receiver 25, and an accumulator 28 may be used, detailed description of which will be omitted since such a configuration is known widely. And, in general, since a configuration of an exhaust gas heat exchanger 46 which is provided to utilize heat of exhaust gas from the gas engine 22 is also know widely, detailed description of which will be omitted.

[0021] It may be said that, in the gas heat pump system described thus, the indoor heat exchanger 11 is an air conditioning system which makes heat exchange between the room air and the refrigerant with fan 12 drive. In view of a nature of the air conditioning, a temperature of the air introduced to the room after the heat exchange does not exceed 50°C. Therefore, it is very difficult to obtain high temperature water by using the gas heat pump system.

[0022] The inventor becomes to know that a highest temperature of the high temperature water obtainable as a result of test in which a chiller is connected to the gas heat pump system is 55°C. Therefore, it is very difficult to realize floor heating by using the gas heat pump system.

[0023] The floor heating is heating of a room space in which high temperature heating water is made to flow along a pipeline installed on a room floor to heat the room floor, thereby heating the room space. It may be said that a general lowest design temperature of room heating water or high temperature water required for the floor heating is 65°C. Therefore, it may be said that it is very difficult to produce the high temperature water enough to make the floor heating by using the gas heat pump system.

[0024] Of course, it may be viable that the high temperature water from the chiller is heated again to produce the high temperature water required for the floor heating. However, this case requires a separate boiler, with increased cost and difficulty in installation. In the meantime, if the separate boiler is used, even the realization of the floor heating by using gas heat pump system will not be required, strongly.

[0025] Accordingly, the present invention is directed to a gas heat pump system.

[0026] Basically, an object of the present invention is to provide a gas heat pump system which can solve problems of the gas heat pump system described before.

[0027] Another object of the present invention is to provide a gas heat pump system which enables to obtain high temperature water that can make floor heating easily by using a related art gas heat pump system with an embodiment of the present invention.

[0028] Another object of the present invention is to provide a gas heat pump system which can realize floor heating as well as air conditioning easily with an embodiment of the present invention.

[0029] Another object of the present invention is to provide a gas heat pump system which can produce warm water and make room cooling by air conditioning at the same time easily with an embodiment of the present invention.

[0030] Another object of the present invention is to provide a gas heat pump system which can realize room cooling with air conditioning and room heating with floor heating with an embodiment of the present invention.

[0031] Another object of the present invention is to provide a gas heat pump system which can perform room heating with air conditioning and floor heating at the same time with an embodiment of the present invention.

[0032] Additional advantages, objects, and features of the disclosure will be set forth in part in the description which follows and in part will become apparent to those having ordinary skill in the art upon examination of the following or may be learned from practice of the invention. The objectives and other advantages of the invention may be realized and attained by the structure particularly pointed out in the written description and claims hereof as well as the appended drawings.

[0033] To achieve these objects and other advantages and in accordance with the purpose of the invention, a gas heat pump system is provided in accordance with claim 1.

[0034] The high temperature and high pressure gaseous refrigerant from the compressor is condensed at the refrigerant heat exchanger. Therefore, the refrigerant discharges heat to absorb heat from a fluid, for an exam-

ple, water, at the refrigerant heat exchanger.

[0035] In this instance, the fluid may be water. Therefore, the water may be made to high temperature water for use as room heating water for floor heating, easily. And, the user may use the high temperature water as warm water, directly.

[0036] The high temperature heat exchanger is provided in the chiller. Therefore, since a plurality of heat exchangers are provided in one heat exchanger, installation and maintenance is very easy. And, configuration of various pipelines, and manipulation of connection and communication with the configuration of various pipelines are very easy.

[0037] It is preferable that the chiller has a heating fluid inlet for introduction of a low temperature fluid therethrough, and a heating fluid outlet for discharging a high temperature fluid therethrough. The low temperature fluid may be a fluid which performs floor heating in the room space, for an example, low temperature heating water. Therefore, the low temperature heating water may be heated to high temperature heating water at the chiller or the cooling water heat exchanger. The heating water heated thus may be introduced to the room space again to perform the floor heating or to be used as the warm water. Therefore, a room pipeline for the floor heating may be provided. The room pipeline may include a warm water pipeline for using the warm water.

[0038] The fluid introduced through the heating fluid inlet may be discharged through the heating fluid outlet passed through the refrigerant heat exchanger and the high temperature heat exchanger in succession.

[0039] The chiller may have a cooling water inlet for introduction of the cooling water therethrough and a cooling water outlet for discharging the cooling water therethrough, and the cooling water introduced through the cooling water inlet may be discharged through the cooling water outlet passed through the high temperature heat exchanger.

[0040] The chiller may have a refrigerant inlet for introduction of the refrigerant therethrough, and a refrigerant outlet for discharging the refrigerant therethrough, and the refrigerant introduced through the refrigerant inlet may be discharged through the refrigerant outlet passed through the refrigerant heat exchanger.

[0041] Accordingly, the high temperature water for the floor heating may be produced by one chiller.

[0042] The high temperature heat exchanger may be a plate type heat exchanger. That is, a stack of a plurality of plates can make easy heat exchange.

[0043] The gas heat pump system further includes a supplementary evaporator for heat exchange between the refrigerant being introduced to the compressor and the cooling water pipeline.

[0044] The gas heat pump system may further include an outdoor unit for heat exchange with outdoor air, and an indoor unit for heat exchange with room air.

[0045] It is preferable that the outdoor unit includes the compressor and the gas engine.

[0046] The indoor unit may be in selective communication with the refrigerant heat exchanger.

[0047] The cooling water pipeline may be in selective communication with the high temperature heat exchanger.

[0048] The chiller may have the refrigerant heat exchanger and the high temperature heat exchanger provided therein, and the chiller may be in selective communication with the refrigerant pipeline.

[0049] The chiller may be in selective communication with the cooling water pipeline.

[0050] The gas heat pump system may further include an indoor unit for heat exchange between the room air and the refrigerant. Therefore, room heating or cooling with air conditioning is made possible by the indoor unit.

[0051] The indoor unit and the refrigerant heat exchanger may be in communication with the refrigerant pipeline, exclusively to each other. For an example, at the time of room heating, only the refrigerant heat exchanger may be made to be in communication with the refrigerant pipeline, and at the time of room cooling, only the indoor unit may be made to be in communication with the refrigerant pipeline.

[0052] A gas heat pump system can be provided, which enables to obtain high temperature water that can make floor heating easily by using a related art gas heat pump system with an embodiment of the present invention.

[0053] A gas heat pump system can be provided, which can realize floor heating as well as air conditioning easily with an embodiment of the present invention.

[0054] A gas heat pump system can be provided, which can produce warm water and make room cooling by air conditioning at the same time easily with an embodiment of the present invention.

[0055] A gas heat pump system can be provided, which can realize room cooling with air conditioning and room heating with floor heating with an embodiment of the present invention.

[0056] A gas heat pump system can be provided, which can realize room cooling with air conditioning and room heating with floor heating with an embodiment of the present invention.

[0057] A gas heat pump system can be provided, which can perform room heating with air conditioning and floor heating at the same time with an embodiment of the present invention.

[0058] It is to be understood that both the foregoing general description and the following detailed description of the present invention are exemplary and explanatory and are intended to provide further explanation of the invention as claimed.

BRIEF DESCRIPTION OF THE DRAWINGS

[0059] The accompanying drawings, which are included to provide a further understanding of the disclosure and are incorporated in and constitute a part of this patent, illustrate embodiment (s) of the disclosure and to-

gether with the description serve to explain the principle of the disclosure. In the drawings:

FIG. 1 illustrates a schematic view of a related art gas heat pump system.

FIG. 2 illustrates a schematic view of a gas heat pump system in accordance with a preferred embodiment of the present invention.

FIG. 3 illustrates a schematic view of a gas heat pump system in accordance with another preferred embodiment of the present invention.

[0060] Reference will now be made in detail to the specific embodiments of the present invention, examples of which are illustrated in the accompanying drawings.

[0061] Basically, the embodiments of the present invention are provided to realize objects of the present invention without changing the related art gas heat pump system. Therefore, many of elements of the gas heat pump system of the present invention may be identical or similar to the related art gas heat pump system. Accordingly, wherever possible, the same reference numbers will be used throughout the drawings to refer to the same or like parts, and detailed description of which may be omitted.

[0062] Referring to FIG. 2, the gas heat pump system includes a refrigerant heat exchanger 161 for heat exchange between refrigerant and a fluid. In this instance, the gas heat pump system includes a refrigerant pipeline 130 through which the refrigerant flows. The refrigerant undergoes phase changes while circulating through the refrigerant pipeline 130 to make a refrigerating cycle.

[0063] The gas heat pump system includes a compressor 121 for compressing the refrigerant and a gas engine 122 for driving the compressor. And, the gas heat pump system also includes a cooling water pipeline 140 through which cooling water flows for cooling the gas engine 122.

[0064] A temperature of the gas engine is elevated very high as the gas engine 122 is operated. The cooling water absorbs heat from the gas engine 122 to prevent the gas engine 122 from overheating.

[0065] In this instance, the gas heat pump system includes a high temperature heat exchanger for heat exchange between the cooling water and a fluid heat exchanged at the refrigerant heat exchanger 16. The high temperature heat exchanger may be a plate type heat exchanger.

[0066] Accordingly, the fluid has a temperature thereof elevated as the fluid heat exchanges with the refrigerant for a first time, and a temperature thereof elevated further as the fluid heat exchanges with high temperature cooling water for a second time.

[0067] The fluid is a fluid used for the floor heating while circulating along a room pipeline 50 laid out on a room floor. Therefore, the fluid may be refrigerant, such as R-11 or R-22. However, it is preferable that the fluid is water taking availability and, in general, the room pipeline for the floor heating being water pipeline into account.

[0068] Therefore, by making the water to heat exchange with the refrigerant of the refrigerating cycle and the cooling water which cools the gas engine in succession, heating water for the floor heating can be produced.

[0069] As described before, a highest temperature obtainable by heat exchange between the refrigerant and the water at the refrigerant heat exchanger 161 is in a range of 55°C. In the meantime, the temperature of the cooling water obtainable from the gas engine 122 is higher than 70°C. Therefore, it is very desirable that the temperature of the high temperature water is elevated by using the cooling water further, because no separate boiler is required, and it is realizable easily without big change of a configuration.

[0070] In detail, water at a room temperature or a low temperature heat exchanges with the refrigerant at the refrigerant heat exchanger 161. Therefore, the highest temperature of the water obtainable from the refrigerant heat exchanger 161 is in a range of 55°C. Since the temperature does not come up to 65°C which is the lowest design temperature required for the floor heating, the water may be called as middle temperature water. The middle temperature water may heat exchange with the cooling water being supplied from the gas engine 122 such that the middle temperature water is heated to the high temperature water at a temperature higher than 65°C good for floor heating. That is, the middle temperature water is heated to the high temperature water at a cooling water heat exchanger 162 and is introduced to the room through a room pipeline.

[0071] The high temperature water circulates such that the high temperature water flows along the room pipeline to heat the room, and is introduced to the refrigerant heat exchanger 161 and the cooling water heat exchanger 162 again.

[0072] Of course, the user may use the high temperature water as necessary, and the water for the floor heating may be added through a utility water line (Not shown). Since matters related to this are generally known, detailed description will be omitted.

[0073] Accordingly, according to the embodiment of the present invention, the floor heating can be realized easily by using the related art gas heat pump system. Especially, since no supplementary heat source, such as the boiler, is introduced, the floor heating can be realized very economically and easily.

[0074] The embodiment of the present invention can be realized by a general chiller or a simple change of the chiller. That is, by using the general chiller as the refrigerant heat exchanger 161, and adding the cooling water heat exchanger 162 thereto, the embodiment of the present invention can be realized. And, by providing the cooling water heat exchanger 162 in the general chiller, the embodiment of the present invention can be realized.

[0075] The chiller is a heat exchanger for obtaining cold water by using the refrigerating cycle. In general, the chiller functions as an evaporator in which the refrigerant

vaporizes as the refrigerant heat exchanges with the water. Therefore, in general, the chiller functions as an evaporator in view of the refrigerant. The water cooled thus by using the refrigerant is used at cold water required places.

[0076] Opposite to this, the chiller of the embodiment may be made to function as a condenser in which the chiller heat exchanges with the refrigerant to condense the refrigerant. That is, the refrigerant may be condensed as the refrigerant heat exchanges with the water, by which the water may absorb heat from the refrigerant. Therefore, different from a general chiller function, the chiller of the embodiment may be called as a condenser in view of the refrigerant.

[0077] FIG. 1 illustrates an example in which the refrigerant heat exchanger 161 and the cooling water heat exchanger 162 are provided in the chiller 160. As illustrated, once the chiller 160 is connected to the refrigerant pipeline 130, the cooling water pipeline 140 and the room pipeline 50, the high temperature water for the floor heating is obtainable, easily.

[0078] In this instance, it may said that, since the room pipeline 50 is provided on a right side of the A line, the room pipeline 50 is mounted in the room. And, a right side of B line illustrates an outdoor configuration, which may be the outdoor unit. Therefore, the chiller 160 between the A line and the B line may be provided to the indoor side or the outdoor side. That is, a position of installation of the chiller 160 may not be limited to a particular position due to requirements or an installation environment. Therefore, the chiller 160 can be coupled to the related art or an existing gas heat pump system, easily. Along with this, since the chiller can be fabricated as an independent unit, installation and maintenance of the chiller is very easy.

[0079] In detail, the chiller 160 has a heating fluid inlet 163 and a heating fluid outlet 164 provided thereto. A low temperature fluid, for an example, the low temperature water, is introduced to an inside of the chiller through the heating fluid inlet 163. It may be said that the low temperature water is introduced to the inside of the chiller after making floor heating through the room pipeline 50.

[0080] The low temperature water passes through the refrigerant heat exchanger 161 and the cooling water heat exchanger 162 in succession and is discharged through the heating fluid outlet. The high temperature water discharged thus is introduced to the room pipeline 50 again, and makes floor heating.

[0081] The chiller 160 has a cooling water inlet 167 and a cooling water outlet 168. The high temperature cooling water is introduced to the inside of the chiller 160 through the cooling water inlet 167, and discharged through the cooling water outlet 168 via the cooling water heat exchanger 162.

[0082] The chiller 160 has a refrigerant inlet 165 and a refrigerant outlet 166 provided thereto. High temperature and high pressure gaseous refrigerant is introduced to the inside of the chiller 160 through the refrigerant inlet 165, condensed at the refrigerant heat exchanger 161, and discharged through the refrigerant outlet 166.

[0083] The inlets 163, 167, and 165 and the outlets 164, 166, and 168 may be provided to the chiller 160. Therefore, the room pipeline 50, the refrigerant pipeline 130, and the cooling water pipeline 140 can be connected to the chiller 160 through the inlets and the outlets, easily.

[0084] In this instance, the inlets and the outlets enable to make, not only easy installation of the chiller 160, but also easy and selective or exclusive communication between the chiller 160 and the pipelines according to various requirements. That is, by using various valves, the selective communication between the chiller 160 and the cooling water pipeline 140 can be made, or the selective communication between the chiller 160 and the refrigerant pipeline 130 can be made. In detail, the selective communication can be realized according to heating or cooling. Matters related to this will be described, later.

[0085] Embodiment described before may be applicable to a case when room heating is made by using the gas heat pump system, because the floor heating may mean room heating.

[0086] Flows of the refrigerant, the cooling water, and heating water, i.e., warm water, at the time of room heating will be described with reference to FIG. 2.

[0087] The refrigerant pipeline and the room pipeline are shown in solid lines and the cooling water pipeline is shown in dashed lines.

[0088] The refrigerant compressed to high temperature and high pressure gas at the compressor 121 is introduced to the refrigerant inlet 165 of the chiller 160 through the four way valve 124. The refrigerant condensed at the refrigerant heat exchanger 161 in the chiller 160 is discharged through the refrigerant outlet 166. The refrigerant discharged thus passes through the expansion valve 126, is vaporized at the outdoor heat exchanger 127, and introduced to the compressor 121 through the four way valve 124.

[0089] The cooling water which becomes high temperature as the cooling water cools the gas engine 122 is introduced to the inside of the chiller 160 through the cooling water inlet 167 via the three way valve 141. The cooling water introduced thus has heat thereof taken by the cooling water heat exchanger 162, and is discharged through the cooling water outlet 168. The cooling water discharged thus is introduced to the supplementary evaporator 143 or the heat dissipating unit 144 through the three way valve 142. Then, the cooling water having a temperature thereof dropped is introduced to the engine 122 after having a temperature thereof elevated at the exhaust gas heat exchanger 146.

[0090] The low temperature water or heating water, having a temperature thereof dropped as the low temperature water supplies heat to the room, is introduced to the inside of the chiller 160 through the heating fluid inlet 163. The heating water introduced thus heat exchanges with the high temperature refrigerant at the refrigerant heat exchanger 161. The heating water having

become the middle temperature water after the heat exchange becomes the high temperature water at the cooling water heat exchanger 162. The heating water having become the high temperature water is discharged through the heating fluid outlet 164 and introduced to the room pipeline 50, again.

[0091] In the meantime, the embodiment described with reference to FIG. 2 may not realize room cooling, easily. Of course, the room cooling may be realized by floor cooling. As an example, in the gas heat pump system illustrated in FIG. 2, a direction of refrigerant circulation may be reversed by the four way valve 124.

[0092] In this case, the refrigerant absorbs heat from the heating water at the refrigerant heat exchanger 161. Therefore, by making very cold water to flow through the room pipeline 50, the room cooling may be realized. Of course, in this case, it is required to prevent heat exchange between the heating water and the cooling water.

[0093] Therefore, though not shown at the time of the room cooling, it is preferable that communication between the cooling water pipeline 140 and the cooling water heat exchanger 162 is blocked with valves (See FIG. 3). Of course, if warm water is in need, the heating water which is not passed through the refrigerant heat exchanger 161 may be supplied to the user only through the cooling water heat exchanger 162. In this case, it is required to provide a room pipeline for floor cooling and a pipeline for the warm water supply separately by means of bypass or the like.

[0094] However, the effective room cooling by means of the floor cooling may not be possible. Therefore, specifically, it may be said that the foregoing embodiment is on the assumption of room heating. That is, the embodiment is an embodiment preferably applicable to a place which requires heating without fail in winter, but requires no cooling as the place is cool in summer.

[0095] Of course, since the floor heating as well as, when required, supply of the warm water is possible with the embodiment described before too, the embodiment may be very economic and convenient depending on places of installation.

[0096] Along with this, though not shown, it may be possible to connect the indoor unit 10 in FIG. 1 and the chiller 160 in parallel. That is, it may be possible that the refrigerant from the compressor is divided into the indoor unit 10 and the chiller 160, by means of which the room heating with the indoor unit 10 and the floor heating with the room pipeline 50 may be possible, at the same time. And, even a floor heating space and a space which uses the heated air may be separated.

[0097] Of course, by means of a separate room pipeline for use the warm water, room heating, floor heating, and warm water use may also be realized at the same time by using the indoor unit. Such characteristics can be realized in more detail in an embodiment described with reference to FIG. 3.

[0098] Another embodiment of the present invention will be described with reference to FIG. 3.

[0099] The embodiment is characterized in that room cooling as well as floor heating is possible with air conditioning.

[0100] In detail, a configuration or a system which enables room cooling possible with the air conditioning may be identical or similar to the gas heat pump system shown in FIG. 1. Therefore, by changing a flow direction of the refrigerant with the four way valve 124, the room cooling and room heating with air conditioning is possible.

[0101] In this instance, in the embodiment, the indoor unit 110 and the chiller 160 may be connected in parallel. In detail, the chiller 160 and the indoor unit 110 may be in communication with the refrigerant pipeline 110, selectively or exclusively.

[0102] For an example, in room heating, both the indoor unit 110 and the chiller 160 may be in communication with the refrigerant pipeline 130. In this case, both room heating and floor heating with the indoor unit 110 can be realized.

[0103] In the meantime, in room heating, either the indoor unit 110 or the chiller 160 may be in communication with the refrigerant pipeline 130. In this case, room heating may be carried out only with one of the two. Therefore, one of room heating with air conditioning and floor heating may be selected. Of course, in room heating, it can be made that only the chiller 160 is in communication with the refrigerant pipeline 130, exclusively. In this case, the room heating may be carried out by floor heating.

[0104] In room cooling, it is preferable that the indoor unit 110 is in communication with the refrigerant pipeline 130, exclusively. Eventually, more comfortable and effective room cooling is possible with the indoor unit 110.

[0105] Of course, the warm water may be in need at the time of room cooling. In this case, the cooling water heat exchanger 162 may be used for production of the warm water. If the cooling water heat exchanger 162 is provided to the chiller 160, the chiller 160 may be used for production of the warm water. Of course, it is preferable that the refrigerant heat exchanger 161 provided in the chiller 160 is not used for production of the warm water.

[0106] For this selective communication, it is preferable that the chiller 160 has a plurality of inlets and outlets. And, it is preferable that the chiller 160 has valves and the like for selective open/close of the inlets and outlets as required.

[0107] Referring to FIG. 3, valves 113 and 114 may be provided for making the refrigerant pipeline 130 and the indoor unit 110 in selective communication, and valves 169a and 169b may be provided for making the refrigerant pipeline 130 and the chiller 160, specifically, the refrigerant heat exchanger 161, in selective communication.

[0108] Of course, at the time of room cooling with the indoor unit 110, there may be a case when no warm water is in need. In this case, it is necessary not to use the cooling water heat exchanger 162. Therefore, a valve (Not shown) may be provided for making the cooling wa-

ter heat exchanger 162 and the cooling water pipeline 140 in selective communication.

[0109] According to the foregoing embodiment, realization of room cooling and room heating as well as floor heating, if required, is possible by air conditioning. And, production of warm water even without a separate heat source is possible. Accordingly, the foregoing embodiment can meet different demands.

[0110] Along with this, the availability of the chiller together with a plurality of the indoor units enables to meet different conditions, such as a case the room space which requires room heating or room cooling is plural, a case room heating or room cooling type, i.e., air conditioning, or floor heating/cooling varies, and a case warm water may or may not be required at the time of room cooling, effectively.

[0111] Embodiments described before have been described centered on provision of the refrigerant heat exchanger 161 and the cooling water heat exchanger 162 in the chiller 160 for making installation easy. However, the system is not limited to this, but the refrigerant heat exchanger 161 and the cooling water heat exchanger 162 may be provided, separately.

[0112] As embodied and broadly described herein, a gas heat pump system includes a refrigerant pipeline, a compressor for compressing refrigerant, a gas engine for driving the compressor, a cooling water pipeline provided to cool down the gas engine, a chiller including a refrigerant heat exchanger for heat exchange between the refrigerant from the compressor and a fluid and a high temperature heat exchanger for heat exchange between the fluid having heat exchanged in the refrigerant heat exchanger and the cooling water.

[0113] The fluid may be water.

[0114] The high temperature heat exchanger may be provided in the chiller.

[0115] The chiller may have a heating fluid inlet for introduction of a low temperature fluid therethrough, and a heating fluid outlet for discharging a high temperature fluid therethrough. The fluid introduced through the heating fluid inlet is discharged through the heating fluid outlet passed through the refrigerant heat exchanger and the high temperature heat exchanger in succession.

[0116] The chiller may have a cooling water inlet for introduction of the cooling water therethrough and a cooling water outlet for discharging the cooling water therethrough. And, the cooling water introduced through the cooling water inlet may is discharged through the cooling water outlet passed through the high temperature heat exchanger.

[0117] The chiller may have a refrigerant inlet for introduction of the refrigerant therethrough, and a refrigerant outlet for discharging the refrigerant therethrough. And the refrigerant introduced through the refrigerant inlet is discharged through the refrigerant outlet passed through the refrigerant heat exchanger.

[0118] The high temperature heat exchanger may be a plate type heat exchanger.

[0119] The gas heat pump system further includes a supplementary evaporator for heat exchange between the refrigerant being introduced to the compressor and the cooling water pipeline.

[0120] The gas heat pump system may further include an outdoor unit for heat exchange with outdoor air, and an indoor unit for heat exchange with room air.

[0121] The outdoor unit may include the compressor and the gas engine. And, the indoor unit is in selective communication with the refrigerant heat exchanger.

[0122] The cooling water pipeline may be in selective communication with the high temperature heat exchanger.

[0123] The chiller may have the refrigerant heat exchanger and the high temperature heat exchanger provided therein. And the chiller is in selective communication with the refrigerant pipeline.

[0124] The chiller may be in selective communication with the cooling water pipeline.

[0125] A gas heat pump system, including a refrigerant pipeline, an outdoor unit including a compressor for compressing refrigerant, a gas engine for driving the compressor, and a cooling water pipeline provided to cool down the gas engine, may further comprise a refrigerant heat exchanger for heat exchange between the refrigerant from the compressor and low temperature water and a high temperature heat exchanger for heat exchange between middle temperature water having heat exchanged at the refrigerant heat exchanger and the cooling water to produce high temperature water required for floor heating.

[0126] The gas heat pump system may further comprise an indoor unit for heat exchange between the room air and the refrigerant. Preferably, the indoor unit and the refrigerant heat exchanger are in communication with the refrigerant pipeline, exclusively to each other.

[0127] It will be apparent to those skilled in the art that various modifications and variations can be made in the present invention without departing from the scope of the invention which is solely limited by the appended claims.

Claims

1. A gas heat pump system comprising:

a refrigerant pipeline (130);
a compressor (121) for compressing refrigerant,
a gas engine (122) for driving the compressor;
a cooling water pipeline (140) provided to cool down the gas engine (122),
a chiller (160) including a refrigerant heat exchanger (161) for heat exchange between the refrigerant from the compressor (121) and a fluid, and a high temperature heat exchanger (162) for heat exchange between the fluid having heat exchanged in the refrigerant heat exchanger (161) and the cooling water, and

a supplementary evaporator (143) for heat exchange between the refrigerant being introduced to the compressor (121) and the cooling water pipeline (141),
characterized in that
the cooling water pipeline (140) is provided with a three way valve (142) downstream of the high temperature heat exchanger (162) and a heat dissipating unit (144) for cooling the cooling water; and
wherein the three way valve (142) is configured to selectively direct the cooling water either to the heat dissipating unit (144) or to the supplementary evaporator (143) .

2. The gas heat pump system as claimed in claim 1, wherein the fluid is water.

3. The gas heat pump system as claimed in claim 1 or 2, wherein the high temperature heat exchanger (162) is provided in the chiller (160).

4. The gas heat pump system as claimed in claim 3, wherein the chiller (160) has a heating fluid inlet (163) for introduction of a low temperature fluid therethrough, and a heating fluid outlet (164) for discharging a high temperature fluid therethrough, and wherein the fluid introduced through the heating fluid inlet (163) is discharged through the heating fluid outlet (164) passed through the refrigerant heat exchanger (161) and the high temperature heat exchanger (162) in succession.

5. The gas heat pump system as claimed in claim 3 or 4, wherein the chiller (160) has a cooling water inlet (167) for introduction of the cooling water therethrough and a cooling water outlet (168) for discharging the cooling water therethrough, and the cooling water introduced through the cooling water inlet (167) is discharged through the cooling water outlet (168) passed through the high temperature heat exchanger (162).

6. The gas heat pump system as claimed in any of claims 1 to 5, wherein the chiller (160) has a refrigerant inlet (165) for introduction of the refrigerant therethrough, and a refrigerant outlet (166) for discharging the refrigerant therethrough, and the refrigerant introduced through the refrigerant inlet (165) is discharged through the refrigerant outlet (166) passed through the refrigerant heat exchanger (161).

7. The gas heat pump system as claimed in any of claims 1 to 6, wherein the high temperature heat exchanger (162) is a plate type heat exchanger.

8. The gas heat pump system as claimed in any of claims 1 to 7, further comprising an outdoor unit for heat exchange with outdoor air, and an indoor unit for heat exchange with room air.

9. The gas heat pump system as claimed in claim 8, wherein the outdoor unit includes the compressor (121) and the gas engine (122) and, wherein the indoor unit is in selective communication with the refrigerant heat exchanger (161).

10. The gas heat pump system as claimed in any of claims 1 to 9, wherein the cooling water pipeline (140) is in selective communication with the high temperature heat exchanger (162).

11. The gas heat pump system as claimed in any of claims 1 to 10, wherein the chiller (160) has the refrigerant heat exchanger (161) and the high temperature heat exchanger (162) provided therein, and the chiller (160) is in selective communication with the refrigerant pipeline (130).

12. The gas heat pump system as claimed in any of claims 1 to 11, wherein the chiller (160) is in selective communication with the cooling water pipeline (140).

Patentansprüche

1. Gaswärmepumpensystem, das aufweist:

eine Kältemittelleitung (130);
einen Verdichter (121) zum Verdichten eines Kältemittels,
einen Gasmotor (122) zum Antreiben des Verdichters;
eine Kühlwasserleitung (140), die zum Kühlen des Gasmotors (122) vorgesehen ist,
einen Kühler (160), der einen Kältemittel-Wärmetauscher (161) zum Wärmeaustausch zwischen dem Kältemittel aus dem Verdichter (121) und einem Fluid und einen Hochtemperatur-Wärmetauscher (162) für den Wärmeaustausch zwischen dem Fluid, das im Kältemittel-Wärmetauscher (161) Wärme ausgetauscht hat, und dem Kühlwasser aufweist, und
einen zusätzlichen Verdampfer (143) zum Wärmeaustausch zwischen dem Kältemittel, das in den Verdichter (121) eingeleitet wird, und der Kühlwasserleitung (141),
dadurch gekennzeichnet, dass
die Kühlwasserleitung (140) mit einem Dreiwegeventil (142) stromabwärts des Hochtemperatur-Wärmetauschers (162) und einer Wärmeableitungseinheit (144) zum Kühlen des Kühlwassers versehen ist; und
wobei das Dreiwegeventil (142) konfiguriert ist, das Kühlwasser selektiv entweder zur Wärme-

ableitungseinheit (144) oder zum zusätzlichen Verdampfer (143) zu leiten.

2. Gaswärmepumpensystem nach Anspruch 1, wobei das Fluid Wasser ist.

3. Gaswärmepumpensystem nach Anspruch 1 oder 2, wobei der Hochtemperatur-Wärmetauscher (162) im Kühler (160) vorgesehen ist.

4. Gaswärmepumpensystem nach Anspruch 3, wobei der Kühler (160) einen Heizfluideinlass (163) zum Einleiten eines Niedertemperaturfluids und einen Heizfluidauslass (164) zum Abgeben eines Hochtemperaturfluids aufweist, und wobei das durch den Heizfluideinlass (163) eingeleitete Fluid durch den Heizfluidauslass (164) abgegeben wird, das nacheinander durch den Kältemittel-Wärmetauscher (161) und den Hochtemperatur-Wärmetauscher (162) gegangen ist.

5. Gaswärmepumpensystem nach Anspruch 3 oder 4, wobei der Kühler (160) einen Kühlwassereinlass (167) zum Einleiten des Kühlwassers und einen Kühlwasserauslass (168) zum Abgeben des Kühlwassers aufweist und das durch den Kühlwassereinlass (167) eingeleitete Kühlwasser durch den Kühlwasserauslass (168) abgegeben wird, das durch den Hochtemperatur-Wärmetauscher (162) gegangen ist.

6. Gaswärmepumpensystem nach einem der Ansprüche 1 bis 5, wobei der Kühler (160) einen Kältemitteleinlass (165) zum Einleiten des Kältemittels und einen Kältemittelauslass (166) zum Abgeben des Kältemittels aufweist und das durch den Kältemitteleinlass (165) eingeleitete Kältemittel durch den Kältemittelauslass (166) abgegeben wird, das durch den Kältemittel-Wärmetauscher (161) gegangen ist.

7. Gaswärmepumpensystem nach einem der Ansprüche 1 bis 6, wobei der Hochtemperatur-Wärmetauscher (162) ein Plattenwärmetauscher ist.

8. Gaswärmepumpensystem nach einem der Ansprüche 1 bis 7, das ferner eine Außeneinheit für den Wärmeaustausch mit der Außenluft und eine Inneneinheit für den Wärmeaustausch mit der Raumluft aufweist.

9. Gaswärmepumpensystem nach Anspruch 8, wobei die Außeneinheit den Verdichter (121) und den Gasmotor (122) aufweist und wobei die Inneneinheit in selektiver Verbindung mit dem Kältemittel-Wärmetauscher (161) steht.

10. Gaswärmepumpensystem nach einem der Ansprüche 1 bis 9, wobei die Kühlwasserleitung (140) in selektiver Verbindung mit dem Hochtemperatur-Wärmetauscher (162) steht.

11. Gaswärmepumpensystem nach einem der Ansprüche 1 bis 10, wobei im Kühler (160) der Kältemittel-Wärmetauscher (161) und der Hochtemperatur-Wärmetauscher (162) vorgesehen sind und der Kühler (160) in selektiver Verbindung mit der Kältemittelleitung (130) steht.

12. Gaswärmepumpensystem nach einem der Ansprüche 1 bis 11, wobei der Kühler (160) in selektiver Verbindung mit der Kühlwasserleitung (140) steht.

Revendications

1. Système de pompe à chaleur à gaz, comprenant :

une conduite de réfrigérant (130) ;
un compresseur (121) comprimant un réfrigérant,
un moteur à gaz (122) entraînant le compresseur ;
une conduite d'eau de refroidissement (140) prévue pour refroidir le moteur à gaz (122), un refroidisseur (160) comprenant un échangeur de chaleur (161) de réfrigérant échangeant de la chaleur entre le réfrigérant provenant du compresseur (121) et un fluide, et un échangeur de chaleur à haute température (162) échangeant de la chaleur entre le fluide ayant été soumis à échange thermique dans l'échangeur de chaleur (161) de réfrigérant et l'eau de refroidissement, et
un évaporateur supplémentaire (143) échangeant de la chaleur entre le réfrigérant introduit dans le compresseur (121) et la conduite d'eau de refroidissement (141),
caractérisé en ce que
la conduite d'eau de refroidissement (140) est pourvue d'une vanne trois voies (142) en aval de l'échangeur de chaleur à haute température (162) et d'une unité de dissipation de chaleur (144) pour refroidir l'eau de refroidissement ; et où la vanne trois voies (142) est prévue pour diriger sélectivement l'eau de refroidissement soit vers l'unité de dissipation de chaleur (144), soit vers l'évaporateur supplémentaire (143).

2. Système de pompe à chaleur à gaz selon la revendication 1, où le fluide est de l'eau.

3. Système de pompe à chaleur à gaz selon la revendication 1 ou la revendication 2, où l'échangeur de chaleur à haute température (162) est prévu dans le refroidisseur (160).

4. Système de pompe à chaleur à gaz selon la revendication 3, où le refroidisseur (160) présente une entrée de fluide de chauffage (163) pour l'introduction d'un fluide à basse température, et une sortie de fluide de chauffage (164) pour le refoulement d'un fluide à haute température, et où le fluide introduit par l'entrée de fluide de chauffage (163) est refoulé par la sortie de fluide de chauffage (164) en étant passé successivement par l'échangeur de chaleur (161) de réfrigérant et l'échangeur de chaleur à haute température (162).

5. Système de pompe à chaleur à gaz selon la revendication 3 ou la revendication 4, où le refroidisseur (160) présente une entrée d'eau de refroidissement (167) pour l'introduction de l'eau de refroidissement et une sortie d'eau de refroidissement (168) pour le refoulement de l'eau de refroidissement, et où l'eau de refroidissement introduite par l'entrée d'eau de refroidissement (167) est refoulée par la sortie d'eau de refroidissement (168) en étant passée par l'échangeur de chaleur à haute température (162).

6. Système de pompe à chaleur à gaz selon l'une des revendications 1 à 5, où le refroidisseur (160) présente une entrée de réfrigérant (165) pour l'introduction du réfrigérant, et une sortie de réfrigérant (166) pour le refoulement du réfrigérant, et où le réfrigérant introduit par l'entrée de réfrigérant (165) est refoulé par la sortie de réfrigérant (166) en étant passé par l'échangeur de chaleur (161) de réfrigérant.

7. Système de pompe à chaleur à gaz selon l'une des revendications 1 à 6, où l'échangeur de chaleur à haute température (162) est un échangeur de chaleur à plaques.

8. Système de pompe à chaleur à gaz selon l'une des revendications 1 à 7, comprenant en outre une unité extérieure pour l'échange de chaleur avec l'air extérieur, et une unité intérieure pour l'échange de chaleur avec l'air ambiant.

9. Système de pompe à chaleur à gaz selon la revendication 8, où l'unité extérieure comprend le compresseur (121) et le moteur à gaz (122), et où l'unité intérieure est en communication sélective avec l'échangeur de chaleur (161) de réfrigérant.

10. Système de pompe à chaleur à gaz selon l'une des revendications 1 à 9, où la conduite d'eau de refroidissement (140) est en communication sélective avec l'échangeur de chaleur à haute température (162).

11. Système de pompe à chaleur à gaz selon l'une des revendications 1 à 10, où le refroidisseur (160) contient l'échangeur de chaleur (161) de réfrigérant et l'échangeur de chaleur à haute température (162), et où le refroidisseur (160) est en communication sélective avec la conduite de réfrigérant (130).

12. Système de pompe à chaleur à gaz selon l'une des revendications 1 à 11, où le refroidisseur (160) est en communication sélective avec la conduite d'eau de refroidissement (140).

FIG. 1

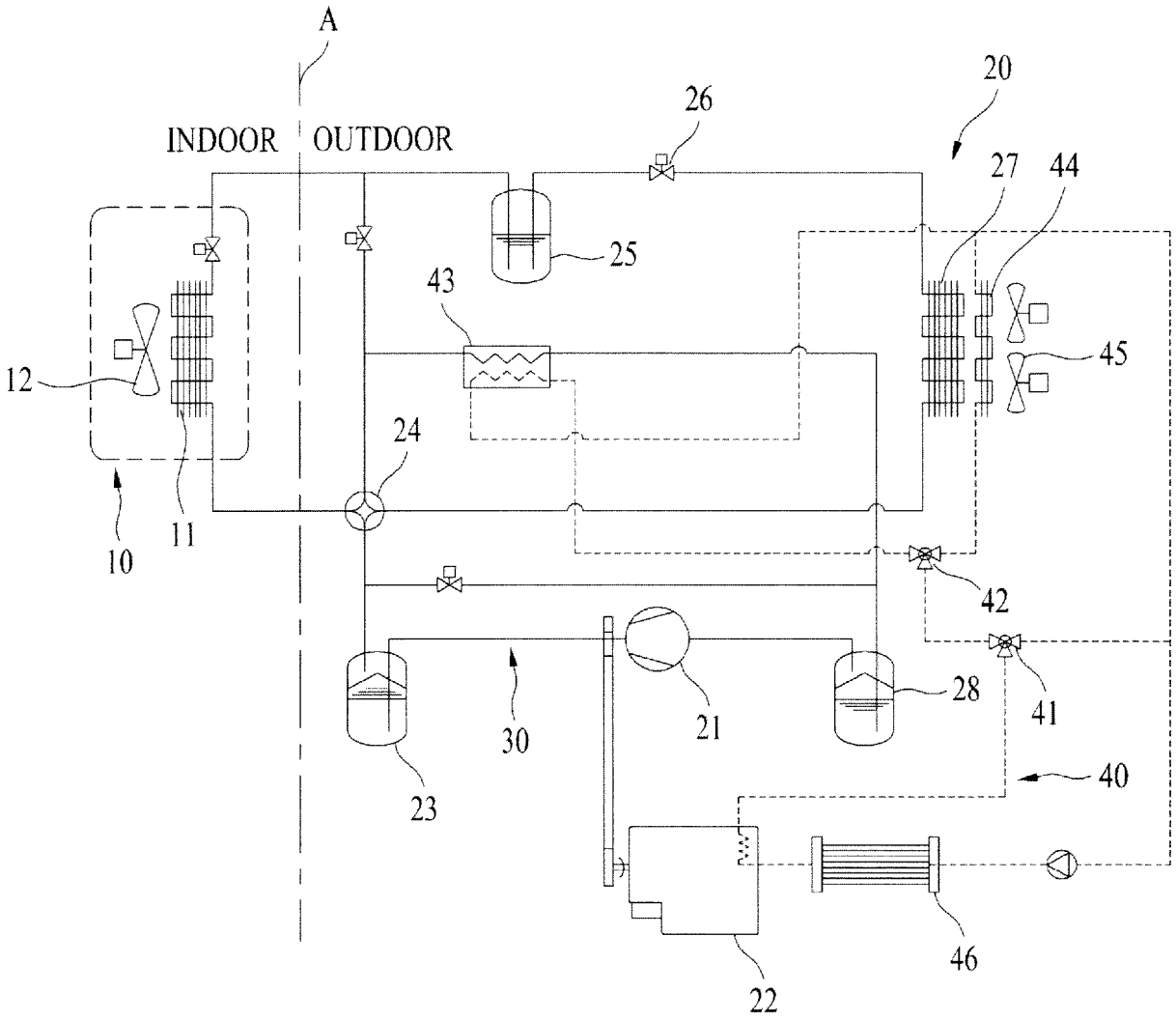

A
INDOOR
OUTDOOR
20
26
27
44
25
43
45
12
24
10
11
42
41
28
21
30
40
23
46
22

FIG. 2

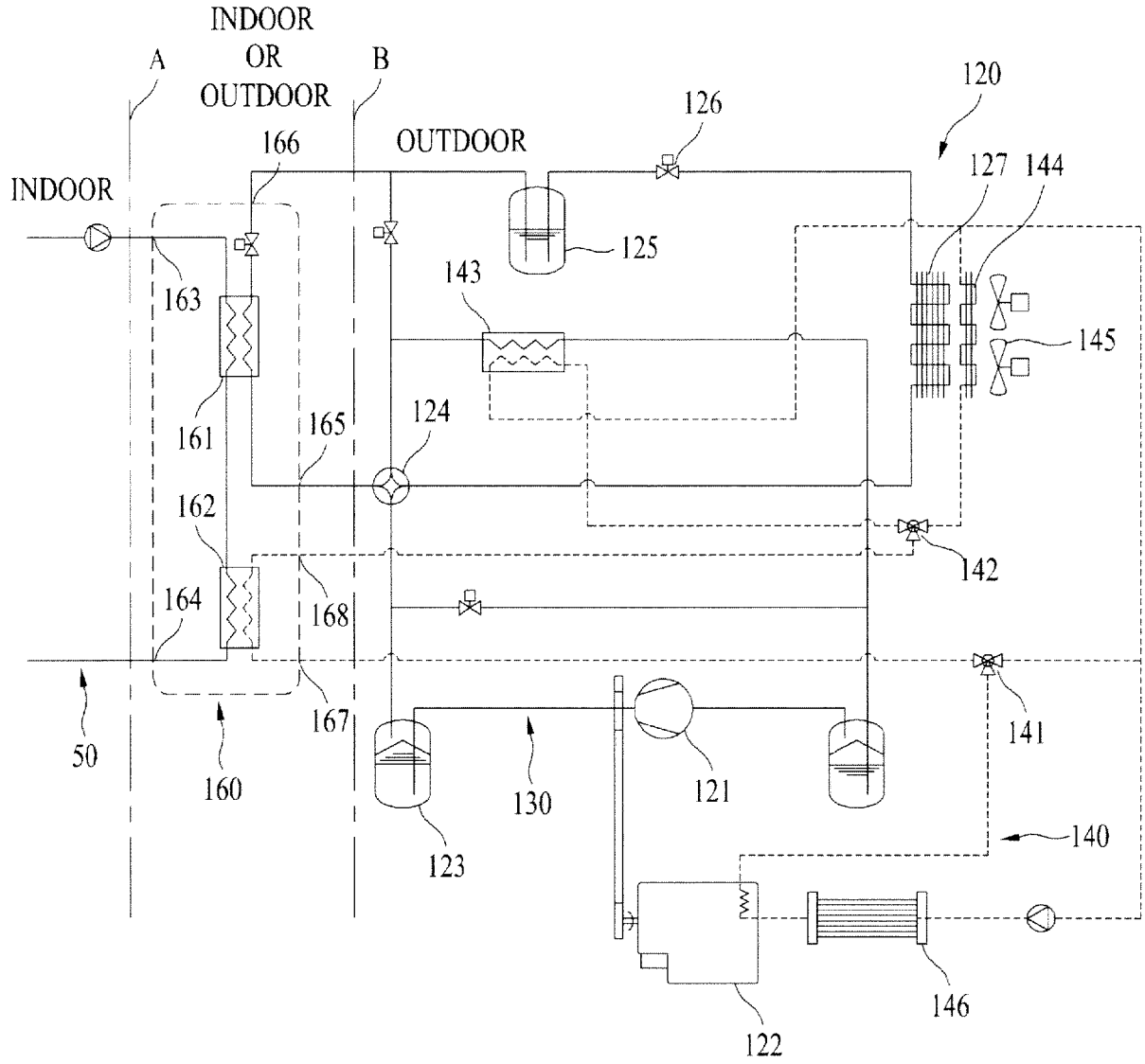
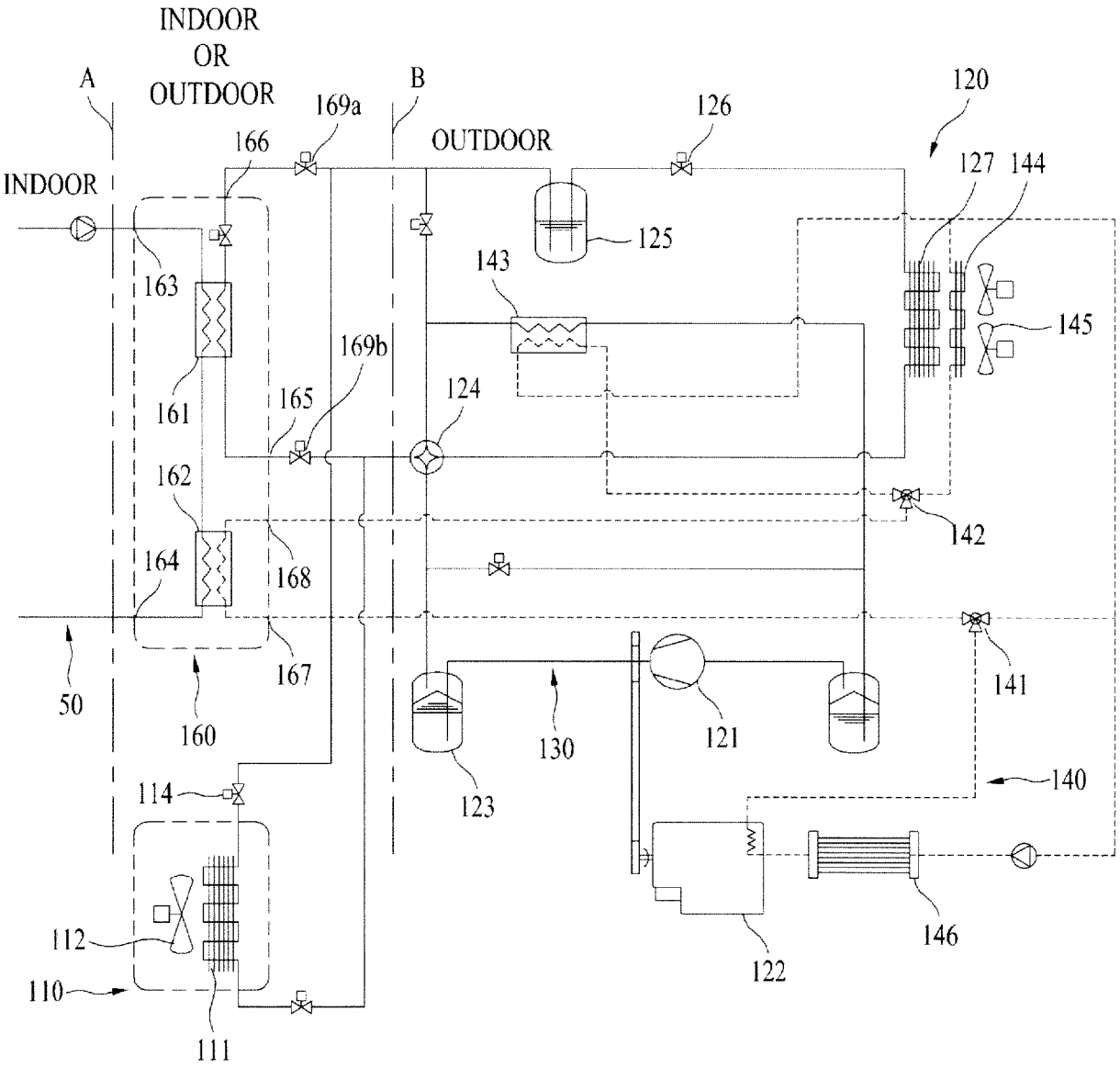

INDOOR
OR
OUTDOOR
A
B
INDOOR
OUTDOOR
166
126
120
127
144
125
143
145
163
161
165
124
162
142
164
168
167
141
50
160
130
121
140
123
146
122

FIG. 3


INDOOR
OR
OUTDOOR
A
B
INDOOR
OUTDOOR
120
126
169a
166
127
144
125
143
145
163
161
169b
165
124
162
142
164
168
167
50
160
141
130
121
123
140
114
112
110
111
122
146

REFERENCES CITED IN THE DESCRIPTION

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