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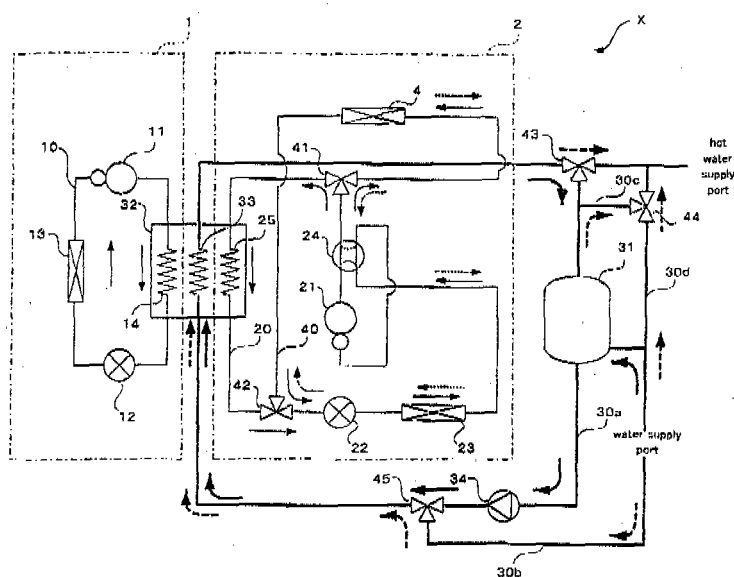
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(54) **HEAT PUMP HOT WATER SUPPLY DEVICE**

(57) The heat pump water heater comprises a CO₂ cycle 1 in which CO₂ refrigerant circulates, a R410A cycle 2 in which R410A refrigerant circulates, and a water heat exchanger 32 for conducting heat exchange between the CO₂ refrigerant and/or the R410A refrigerant and water, wherein the R410A cycle 2 includes a circulation path 20 passing through the water heat exchanger 32, a circulation path 40 passing through a indoor air heat exchanger 4 that conducts heat exchange between the R410A re-

frigerant and indoor air, and a four-way valve 24 for switching the circulating direction of the R410A refrigerant in the present R410A cycle 2 to provide heat pump water heater, capable of using a heat pump cycle for supplying hot water in cooling and heating (air-conditioning). And also, to obtain a sufficient temperature and an amount of the hot water supply when the heat pump water heater simultaneously conducts heating and supplying hot water.

[Fig.1]



Description

BACKGROUND OR THE INVENTION

Field of the Invention

[0001] The present invention relates to a heat pump water heater for supplying hot water by heating water by means of heat exchange with a refrigerant circulating within a heat pump cycle provided with a compressor and an expander, and more particularly, to a heat pump water heater comprising two heat pump cycles, each employing a refrigerant having different properties, such as the heat exchange efficiency and the energy consumption efficiency.

Description or the Related Art

[0002] Conventionally, a heat pump water heater for supplying hot water by heating water by means of heat exchange with a refrigerant circulating within a heat pump cycle provided with a compressor and an expander has been well-known. The refrigerant may be, such as carbon dioxide gas refrigerant and HFC refrigerant.

[0003] Here, the carbon dioxide gas refrigerant is able to heat water to high temperatures (for example, around 90 degrees centigrade) as its refrigerant property. On the other hand, the HFC refrigerant can heat water only to relatively low temperatures (for example, around 65 degrees centigrade) due to its refrigerant property. However, when used for an air-conditioning device, the energy consumption efficiency (COP) of the HFC refrigerant is better than that of the carbon dioxide gas refrigerant.

[0004] On the other hand, Patent Literature 1 (Japanese Unexamined Patent Application Publication No. 2005-83585) discloses a heat pump type hot-water supply system comprising two heat pump cycles: one using CO₂ refrigerant (one example of carbon dioxide gas refrigerants) (hereinafter, referred to as "CO₂ cycle"), and the other using R410A refrigerant (one example of HFC refrigerants) (hereinafter, referred to as "R410A cycle"). In the heat pump type hot-water supply system, the CO₂ cycle is used when hot water at high temperature is demanded, and the R410A cycle is used when hot water at low temperature meets the demand.

[0005] Moreover, the invention disclosed in Patent Literature 1 (Japanese Unexamined Patent Application Publication No. 2005-83585) proposes to connect a close circuit for hot water-heating with the R410A cycle, so as to share the R410A cycle between supplying hot water and hot water heating.

[0006] However, in the heat pump type hot-water supply system disclosed in Patent Literature 1 (Japanese Unexamined Patent Application Publication No. 2005-83585), the circulating direction of the R410A refrigerant within the R410A cycle is constant. The R410A cycle may therefore be used for supplying hot water and hot water-heating, but not for cooling.

[0007] In addition, in the heat pump type hot-water supply system disclosed in Patent Literature 1 (Japanese Unexamined Patent Application Publication No. 2005-83585), the R410A cycle is selectively used either for supplying hot water or hot water-heating, but not simultaneously.

[0008] Furthermore, the heat pump type hot-water supply system is configured so as to selectively use either the CO₂ cycle or the R410A cycle. The water heating efficiency in the heat pump type hot-water supply system is therefore limited to those of each the CO₂ cycle and the R410A cycle. And thus, when supplying hot water and hot water-heating are simultaneously conducted with the R410A refrigerant distributed in the R410A cycle, the temperature as well as the amount of the hot water supply becomes insufficient due to decrease in the water heating efficiency. The R410A cycle may obviously be configured so as to obtain a sufficient temperature of the hot water supply, however, for the purpose of obtaining a sufficient temperature and an amount of hot water supply in the R410 cycle, increase in apparatus size and cost are required.

[0009] In view of the above problem residing in the prior art, it is the first object of the present invention to provide a heat pump water heater capable of using a heat pump cycle for supplying hot water in both cooling and heating (air-conditioning). And the second object of the present invention is to obtain a sufficient temperature and an amount of the hot water supply when the heat pump water heater simultaneously conducts heating and supplying hot water.

SUMMARY OF THE INVENTION

[0010] In order to achieve the above goal, a heat pump water heater according to the present invention comprises; a first heat pump cycle in which a first refrigerant circulates through at least a compressor and an expander, a second heat pump cycle in which a second refrigerant having properties different from those of the first refrigerant circulates through at least a compressor and an expander, and a water heat exchanger for conducting heat exchange between water and the first refrigerant and/or the second refrigerant, wherein the second heat pump cycle includes a first circulation path passing through the water heat exchanger, a second circulation path passing through an indoor air heat exchanger that conducts heat exchange between the second refrigerant and indoor air, and a circulating direction switching means for switching the circulating direction of the second refrigerant in the second heat pump cycle. More particularly, the first refrigerant may be carbon dioxide gas refrigerant, and the second refrigerant may be HFC refrigerant.

[0011] According to the present invention, switching of the circulating direction of the second refrigerant within the second heat pump cycle is possible, and cooling and heating (air-conditioning) can therefore be performed us-

ing the second heat pump cycle.

[0012] Moreover, the water heat exchanger is configured so as to enable heat exchange simultaneously between: water and the first refrigerant, and water and the second refrigerant, so that a sufficient temperature as well as an amount of the hot water supply can be obtained by distributing the second refrigerant for circulation in both the first and second circulation paths.

[0013] The present invention enables cooling and heating (air-conditioning) with the use of the second heat pump cycle. Also, when simultaneously performing heating and supplying hot water, a sufficient temperature and an amount of the hot water supply can be obtained.

BRIEF DESCRIPTION OF THE DRAWINGS

[0014]

Fig. 1 is a schematic configuration diagram showing a heat pump water heater according to an embodiment of the present invention;

Fig. 2 is a schematic configuration diagram showing a heat pump water heater according to another embodiment of the present invention.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

[0015] In what follows, an embodiment of the present invention is described as referring to the accompanied figures, in order to provide sufficient understanding. In addition, the following embodiment is a mere example of realizing the present invention, having no intention to limit the spirit and scope of the present invention.

[0016] Fig. 1 is a schematic configuration diagram of a heat pump water heater X1 according to an embodiment of the present invention.

[0017] As shown in fig. 1, the heat pump water heater X is generally configured by comprising: heat pump cycles 1 (one example of the first heat pump cycle) and 2 (one example of the second heat pump cycle) in which a refrigerant circulates, water flowing paths 30a to 30d, a storage tank 31, a water heat exchanger 32, a circulation pump 34 and switching valves 41 to 45. Additionally, the heat pump water heater X comprises a controller having such as CPU, RAM, and ROM (not shown).

[0018] The water heat exchanger 32 performs heat exchange between the refrigerant that flows in a piping 14 connected with the heat pump cycle 1 and in a piping 25 connected with the heat pump cycle 2, and water that flows on a water flowing path 30b running from a water supply port to a hot water supply port or on a water flowing path 30a returning to the storage tank 31. Here, the water flowing path 30a is a water flow channel that sequentially connects from the water supply port, the storage tank 31, the circulation pump 34, the switching valve 45, the water heat exchanger 32, the switching valve 43, and back to the storage tank 31. And also, the water flowing path 30b

is a water flow channel that sequentially connects from the water supply port, the switching valve 45, the water heat exchanger 32, the switching valve 43, and to the hot water supply port. Additionally, the water flowing path 30c is a hot water flow channel connecting from the storage tank 31 to the hot water supply port via the switching valve 44, and the water flowing path 30d is also a water flow channel connecting from the water supply port to the hot water supply port via the switching valve 44.

[0019] In the upper layer of the storage tank 31, hot water heated in the water heat exchanger 32 by heat exchange with the refrigerant is stored, while in the lower layer of the storage tank 31, water supplied from the water supply port is stored.

[0020] With the above-mentioned each component controlled by the controller (not shown), the present heat pump water heater X performs such as an instantaneous hot water supply operation for directly supplying hot water from the hot water supply port by heating water supplied from the water supply port using the water heat exchanger 32 on the water flowing path 30b, and a hot water storage operation for heating water supplied from the water supply port using the water heat exchanger 32 on the water flowing path 30a to store the heated water in the storage tank 31.

[0021] Here, the instantaneous hot water supply operation distributes the water supplied from the water supply port in the direction of the dashed arrows along the water flowing path 30b, with the switching valves 43 and 45 controlled by the controller. However, for a certain time from the start of the instantaneous hot water supply operation, a sufficient heating amount cannot be achieved by the water heat exchanger 32. And thus, for a certain time after the start of the instantaneous hot water supply operation, the hot water stored in the storage tank 31 is mixed with the water, that is supplied from the water supply port via the water flowing path 30d, at the switching valve 44 via the water flowing path 30c, and then adjusted in its temperature before being supplied to the hot water supply port. This enables hot water to be supplied instantaneously from the hot water supply port. And then, at the moment when it's possible to sufficiently heat the water supplied from the water supply port with the water heat exchanger 32, water supply from the storage tank is stopped, so that the instantaneous hot water supply starts using the water flowing path 30b connecting from the water supply port to the hot water supply port via the water heat exchanger 32. In addition, the hot water at high temperature stored in the storage tank 31 may be supplied as it is, without being mixed with water supplied from the water supply port.

[0022] And also, the hot water storage operation stores hot water in the storage tank 31, with the circulation pump 34 driven so as to distribute water in the direction of the solid arrows along the water flowing path 30a.

[0023] The heat pump cycle 1 (hereinafter referred to as "CO₂ cycle") has a circulation path 10 sequentially connecting a compressor 11, the water heat exchanger

32, an expander 12, and an outdoor air heat exchanger 13.

[0024] In the circulation path 10, the controller (not shown) drives the compressor 11 to circulate the CO₂ refrigerant (one example of the first refrigerant) as one example of carbon dioxide gas refrigerant in the direction of the arrows illustrated in the figure. Here, the CO₂ refrigerant has properties different from those of the after-mentioned R410A refrigerant, and is capable of heating water to high temperatures (around 90 degrees C) as its refrigerant property, however, has relatively low energy consumption efficiency. The CO₂ cycle 1 is therefore used mainly for heating water in the hot water storage operation.

[0025] More specifically, the CO₂ refrigerant at high temperature and high pressure compressed by the compressor 11 and discharged therefrom is cooled in the water heat exchanger 32 by heat exchange with water flowing on the water flowing paths 30a or 30b, then expands in the expander 12. After that, the CO₂ refrigerant at low temperature and low pressure expanded by the expander 12 absorbs heat from the outdoor air in the outdoor air heat exchanger 13 to vaporization by means of heat exchange, and then flows into the compressor 11 again.

[0026] In the CO₂ cycle 1, the circulation of the CO₂ refrigerant in the circulation path 10 as mentioned above allows water flowing on the water flowing paths 30a or 30b in the arrow direction to be heated up around 90 degrees C by heat exchange with the CO₂ refrigerant in the water heat exchanger 32. And also, since the flow direction of the CO₂ refrigerant in the water heat exchanger 32 is opposite to the water flow direction, the heat exchange between the CO₂ refrigerant and water can be conducted efficiently.

[0027] Here, in the instantaneous hot water supply operation, the controller (not shown) controls the switching valve 45 so that water passes through the water flowing path 30b, and also, controls the switching valve 43 so that the hot water heated in the water heat exchanger 32 is supplied to the hot water supply port. In addition, in the hot water storage operation, the controller (not shown) controls the switching valve 45 so that water passes through the water flowing path 30a, and also, controls the switching valve 43 to be switched so that the hot water heated in the water heat exchanger 32 is stored in the storage tank 31.

[0028] Meanwhile, the heat pump cycle 2 (hereinafter referred to as "R410A cycle") has a circulation path 20 (one example of the first circulation path) and a circulation path 40 (one example of the second circulation path) in which the R410A refrigerant (one example of the second refrigerant) as one example of HFC refrigerant circulates. Here, the R410A refrigerant has properties different from those of the CO₂ refrigerant, and heats water to only low temperatures (around 65 degrees C) as compared with the CO₂ refrigerant. However, due to its high energy consumption efficiency (COP; Coefficient Of Performance),

the R410A refrigerant is suitable for a relatively low heating-up temperature. Thus, the R410A cycle 2 is used mainly for heating water in the instantaneous hot water supply operation. In addition, as other examples of R410A refrigerants, there are, for example, R407C/E, R404A, R507A, and R134a refrigerants. The two different refrigerants used for the heat pump water heater X are not limited to carbon dioxide gas refrigerant and HFC refrigerant, and other two refrigerants having properties, such as heat exchange efficiency and energy consumption efficiency, different from each other may be employed.

[0029] The circulation path 20 is configured by sequentially connecting from a compressor 21, a four-way valve 24, the switching valve 41, the water heat exchanger 32, the switching valve 42, an expander 22 (for example, an expanding valve), an outdoor air heat exchanger 23, and back to the four-way valve 24.

[0030] In the circulation path 20, the controller (not shown) drives the compressor 21 to circulate the R410A refrigerant in the direction of the solid arrows illustrated in the figure. More specifically, the R410A refrigerant at high temperature and high pressure compressed by the compressor 21 and discharged therefrom reaches the water heat exchanger 32 via the four-way valve 24 and the switching valve 41. And the R410A refrigerant is then cooled in the water heat exchanger 32 by heat exchange with water flowing on the water flowing paths 30a or 30b. The R410A refrigerant is then expanded in the expander 22 through the switching valve 42. After that, the R410A refrigerant at low temperature and low pressure expanded by the expander 22 absorbs heat from the outdoor air in the outdoor air heat exchanger 23 to vaporization by means of heat exchange, and then flows again into the compressor 21 via the four-way valve 24.

[0031] In the R410A cycle 2, the circulation of the R410A refrigerant in the circulation path 20 in the direction of the solid arrows as mentioned above allows water flowing on the water flowing path 30a or 30b in the direction of arrows to be heated to around 65 degrees C by heat exchange with the R410A refrigerant in the water heat exchanger 32. And also, since the flow direction of the R410A refrigerant in the water heat exchanger 32 are opposite to that of water therein, the heat exchange between the R410A refrigerant and water can be conducted efficiently.

[0032] Additionally, the water heat exchanger 32 is shared by both the CO₂ cycle 1 and the R410A cycle 2, and capable of performing heat exchange simultaneously between the CO₂ and R410A refrigerants circulating thereof and the water flowing on the water flowing paths 30a or 30b. More specifically, in the water heat exchanger 32, a piping 14 of the CO₂ refrigerant and a piping 25 of the R410A refrigerant both provided inside of the water heat exchanger 32 are positioned so as to commonly make contacts with a piping 33 provided on the water flowing paths 30a and 30b.

[0033] Consequently, the heat pump water heater X

uses the CO₂ cycle 1 and the R410A cycle 2 simultaneously, so as to heat water at heat exchange efficiency higher than those of each cycle. This enables the amount of the hot water supply to increase in the instantaneous hot water supply operation.

[0034] On the other hand, the circulation path 40 is configured by sequentially connecting from the compressor 21, the four-way valve 24, the switching valve 41, an indoor air heat exchanger 4, the switching valve 42, the expander 22, the outdoor air heat exchanger 23, and back to the four-way valve 24.

[0035] Here, the indoor air heat exchanger 4 is provided in an air conditioner (not shown) for cooling and heating the indoor, and heats or cools the indoor air by performing heat exchange between the R410A refrigerant circulating within the circulation path 40 and the indoor air.

[0036] In the heat pump water heater X configured as mentioned above, when the circulating direction of the R410A refrigerant in the R410A cycle 2 is constant, the R410A cycle 2 cannot be used for cooling and heating (air-conditioning) performed by the air conditioner (not shown). More specifically, when the circulating direction of the R410A refrigerant is only the same direction as the circulation path 20 (the direction shown with the solid arrows in Fig. 1), only heating can be performed, not cooling.

[0037] However, the heat pump water heater in accordance with one embodiment of the present invention allows the four-way valve 24 to be controlled by the controller (not shown), so that the circulating direction of the R410A refrigerant in the circulation path 40 is switched between the solid arrow direction and the dashed arrow direction shown in the figure. Here, the controller and the four-way valve 24 at the time of switching the circulating direction of the R410A refrigerant corresponds to a circulating direction switching means.

[0038] In what follows, the heating and the cooling operation achieved in the R410A cycle 2 in the heat pump water heater X is described.

(1) Heating operation

[0039] When a request for starting its heating operation is made by an user from an operating member not shown to the heat pump water heater X, the controller (not shown) controls the compressor 21 and the four-way valve 24 in the heat pump water heater X, so that the circulation of the R410A refrigerant starts in the direction shown with the solid arrows in the circulation path 40 in the R410A cycle 2. In this moment, the solid path shown in the figure is established inside of the four-way valve 24.

[0040] This enables the R410A refrigerant in the circulation path 40 to circulate in the direction of the solid arrows shown in the figure. More specifically, the R410A refrigerant at high temperature and high pressure compressed by the compressor 21 and discharged therefrom reaches the indoor air heat exchanger 4 via the four-way

valve 24 and the switching valve 41. The R410A refrigerant is then cooled in the indoor air heat exchanger 4 by heat exchange with the indoor air. After that, the R410A refrigerant is expanded in the expander 22 via the switching valve 42. And then, the R410A refrigerant at low temperature and low pressure expanded by the expander 22 absorbs heat from the outdoor air in the outdoor air heat exchanger 23 to vaporization by means of heat exchange, and flows again into the compressor 21 via the four-way valve 24.

[0041] In the R410A cycle 2, the circulation of the R410A refrigerant in the circulation path 40 in the direction of the solid arrows as mentioned above allows the indoor air to be heated by heat exchange with the R410A refrigerant in the indoor air heat exchanger 4. In short, heating is achieved by the heat pump water heater X.

[0042] On the other hand, as mentioned above, the conventional devices (for example, see Patent literature 1: Japanese Unexamined Patent Application Publication No. 2005-83585) cannot perform instantaneous hot water supply and heating simultaneously by using the R410A cycle 2. In addition, the R410A refrigerant may be distributed so as to perform instantaneous hot water supply and heating simultaneously, however, in such case, there still remains a problem that a sufficient temperature and an amount of hot water supply cannot be obtained.

[0043] However, when performing instantaneous hot water supply and heating simultaneously, the heat pump water heater X allows the CO₂ refrigerant circulating in the CO₂ cycle 1 and the R410A refrigerant circulating in the R410A cycle 2 to heat water simultaneously in the water heat exchanger 32. This enables a sufficient temperature and an amount of the hot water supply to be obtained, when simultaneously performing the instantaneous hot water supply and the heating. In the following, this regard is explained in details.

[0044] Firstly, when a request is made by an user to an operating member not shown for starting instantaneous hot water supply during the process of heating operation of the R410A cycle 2 in the heat pump water heater X, the controller (not shown) controls the switching valves 41 and 42 in the heat pump water heater X, so that the circulation of the R410A refrigerant starts in the direction shown with the solid arrows in the circulation path 20 in the R410A cycle 2. Here, the R410A refrigerant is distributed for circulation to both the circulation paths 20 and 40 in the R410A cycle 2. The R410A refrigerant circulating in the circulation path 20 in the water heat exchanger 32 may therefore be unable to heat water sufficiently.

[0045] In response, when a request is made by an user to an operating member not shown for starting the instantaneous hot water supply during the heating operation of the R410A cycle 2 in the heat pump water heater X, the controller (not shown) controls the drive of the compressor 11 in the CO₂ cycle 1, so that The circulation of the CO₂ refrigerant starts in the CO₂ cycle 1.

[0046] This enables water to be heated by both the R410A refrigerant and the CO₂ refrigerant in the water heat exchanger 32. In short, the decrease in the water heating efficiency at the time of simultaneous operation of instantaneous hot water supply and heating in the R410A cycle 1 can be compensated by heat exchange between the CO₂ refrigerant circulating in the CO₂ cycle 1 and water. Consequently, a sufficient temperature and an amount of the hot water supply can be obtained, when simultaneously performing instantaneous hot water supply and heating in the R410A cycle 2.

(2) Cooling operation

[0047] On the other hand, when a request is made by an user from an operating member not shown to the heat pump water heater X for starting the cooling operation, the controller (not shown) controls the compressor 21 and the four-way valve 24 in the heat pump water heater X, so that the circulation of the R410A refrigerant starts in the direction shown with the dashed arrows in the circulation path 40 in the R410A cycle 2. In this moment, the dashed line path shown in the figure is established inside of the four-way valve 24.

[0048] This enables the R410A refrigerant in the circulation path 40 to circulate in the direction of the dashed arrows shown in the figure. More specifically, the R410A refrigerant at high temperature and high pressure compressed by the compressor 21 and discharged therefrom reaches the outdoor air heat exchanger 23 via the four-way valve 24. And then, the R410A refrigerant is cooled in the outdoor air heat exchanger 23 by mean of heat exchange with the outdoor air. The R410A refrigerant is then expanded in the expander 22. After that, the R410A refrigerant at low temperature and low pressure expanded by the expander 22 passes through the switching valve 42 and then absorbs heat from the indoor air in the indoor air heat exchanger 4 to vaporization by means of heat exchange, and then flows again into the compressor 21 via the switching valve 41 and the four-way valve 24.

[0049] In the R410A cycle 2, the circulation of the R410A refrigerant in the circulation path 40 in the direction of the dashed arrows as mentioned above allows indoor air to be cooled by heat exchange with the R410A refrigerant in the indoor air heat exchanger 4. In short, the heat pump water heater X achieves the cooling operation.

[0050] Additionally, the heat pump water heater X enables the switching valves 41 and 42 to be controlled by the controller (not shown), so that the circulation of the R410A refrigerant in the circulation path 20 is blocked. And thus, there is no obstacle for the CO₂ cycle 1 to perform the hot water storage operation, even when the R410A cycle 2 is performing the cooling operation.

[0051] And also, in the R410A cycle 2 in the heat pump water heater X, the four-way valve 24 switches the circulating direction of the R410A refrigerant in both the circulation paths 20 and 40. The heat pump water heater

cannot, therefore, perform the cooling and the instantaneous hot water supply simultaneously. However, when the R410A cycle 2 is configured as the after-mentioned another embodiment, the cooling and the instantaneous hot water supply operations can be performed simultaneously.

Example

[0052] Here, Fig. 2 is a schematic configuration diagram showing a heat pump water heater X1 according to another embodiment of the present invention. In addition, the components same as those in the heat pump water heater X described in the above embodiment are allocated with the same symbols, thereby omitting the description thereof.

[0053] As shown in Fig. 2, the heat pump water heater X1 has a R410A cycle 5 instead of R410A cycle 2 in the heat pump water heater X. Provided in the R410A cycle 5 are arc switching valves 51 to 56 and two expanders 22a and 22b that are controlled by the controller (not shown).

[0054] In the thus configured R410A cycle 5, the circulating direction of the R410A refrigerant in the circulation path 20 as well as that in the circulation path 40 can be controlled independently. The R410A cycle 5 can therefore perform the cooling or heating and the instantaneous hot water supply simultaneously. Hereinafter, the details are explained.

(1) Simultaneous operation of heating and instantaneous hot water supply

[0055] When operating heating and instantaneous hot water supply simultaneously, the compressor 21, the four-way valve 24, and the switching valves 51 to 56 are controlled by the controller (not shown) in the R410A cycle 5, so that the R410A refrigerant circulates in the direction of solid arrows in Fig. 2.

[0056] More specifically, in the circulation path 20, the R410A refrigerant circulates sequentially from the compressor 21, the four-way valve 24, the switching valve 51, the switching valve 52, the water heat exchanger 32, the expander 22a, the switching valve 53, the switching valve 54, the outdoor air heat exchanger 23, the switching valve 56, the four-way valve 24, and back to the compressor 21. This allows the water heat exchanger 32 to heat water that flows on the water flowing paths 30a or 30b.

[0057] On the other hand, in the circulation path 40, the R410A refrigerant circulates sequentially from the compressor 21, the four-way valve 24, the switching valve 51, the indoor air heat exchanger 4, the switching valve 55, the expander 22b, the switching valve 54, the outdoor air heat exchanger 23, the switching valve 56, the four-way valve 24, and back to the compressor 21. This allows the indoor air heat exchanger 4 to heat indoor air for the heating operation.

[0058] As mentioned above, in the R410A cycle 5, the

R410A refrigerant may be distributed by the switching valve 51, thereby performing instantaneous hot water supply and heating simultaneously. Additionally, the decrease in the water heating efficiency in the water heat exchanger 32 due to flow of the R410A refrigerant can be compensated by the CO₂ cycle 1.

(2) Simultaneous operation of cooling and instantaneous hot water supply

[0059] When operating cooling and instantaneous hot water supply simultaneously, the compressor 21, the four-way valve 24, and the switching valves 51 to 56 are controlled by the controller (not shown) in the R410A cycle 5, so that the R410A refrigerant circulates in the direction of dashed arrows in Fig 2.

[0060] More specifically, in the circulation path 20, the R410A refrigerant circulates sequentially from the compressor 21, the four-way valve 24, the switching valve 56, the switching valve 52, the water heat exchanger 32, the expander 22a, the switching valve 53, the switching valve 55, the indoor air heat exchanger 4, the switching valve 51, the four-way valve 24, and back to the compressor 21. This allows the water heat exchanger 32 to heat water that flows on the water flowing paths 30a or 30b.

[0061] On the other hand, in the circulation path 40, the R410A refrigerant circulates sequentially from the compressor 21, the four-way valve 24, the switching valve 56, the outdoor air heat exchanger 23, the switching valve 54, the expander 22b, the switching valve 55, the indoor air heat exchanger 4, the switching valve 51, the four-way valve 24, and back to the compressor 21. This allows the indoor air heat exchanger 4 to cool indoor air for the cooling operation.

[0062] As mentioned above, in the R410A cycle 5, the R410A refrigerant may be distributed by the switching valve 56, thereby performing cooling and instantaneous hot water supply simultaneously. Additionally, the decrease in the water heating efficiency in the water heat exchanger 32 due to flow of the R410A refrigerant can be compensated by the CO₂ cycle 1.

[0063] In addition, the present embodiment as well as the above-mentioned embodiment include switching valves, however, the similar effect may be obtained by diminishing the function, without switching valves.

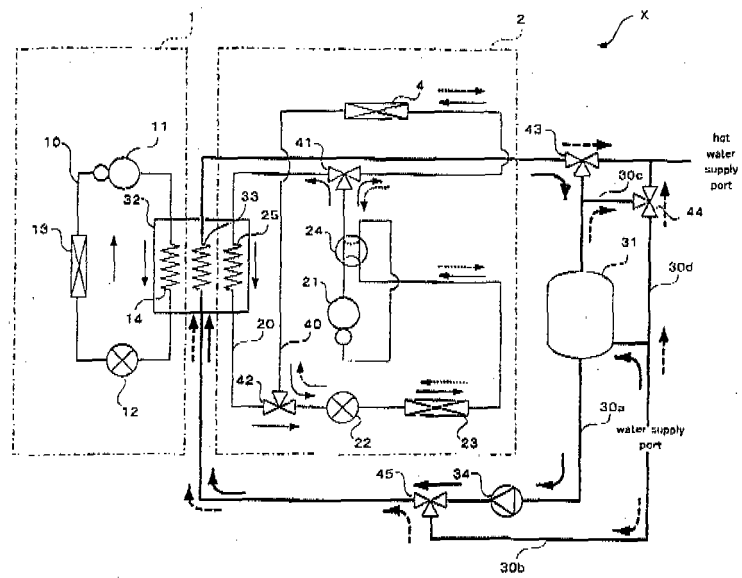
first refrigerant and/or the second refrigerant, wherein the second heat pump cycle includes a first circulation path passing through the water heat exchanger, a second circulation path passing through an indoor air heat exchanger that conducts heat exchange between the second refrigerant and indoor air, and a circulating direction switching means for switching the circulating direction of the second refrigerant in the second heat pump cycle.

2. A heat pump water heater according to Claim 1 wherein the first refrigerant is carbon dioxide gas refrigerant and the second refrigerant is HFC refrigerant.

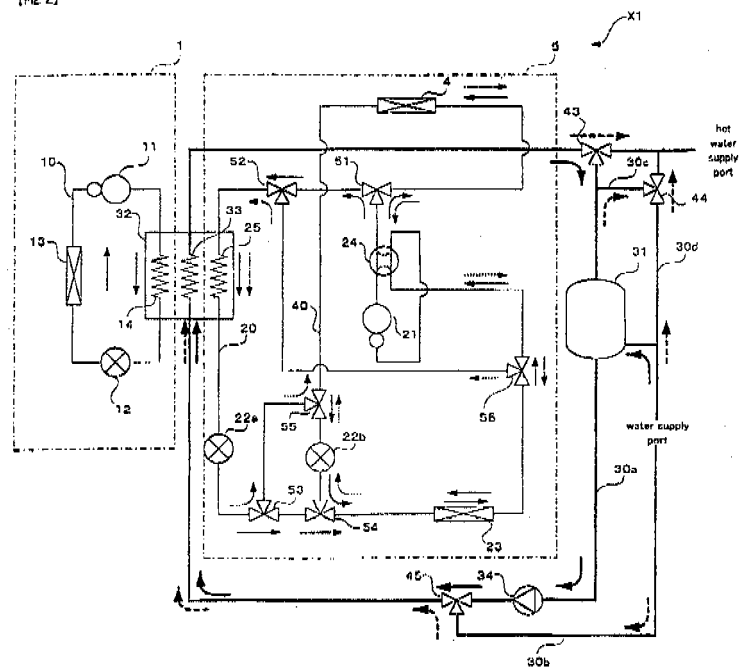
Claims

1. A heat pump water heater comprising; a first heat pump cycle in which a first refrigerant circulates through at least a compressor and an expander, a second heat pump cycle in which a second refrigerant having properties different from those of the first refrigerant circulates through at least a compressor and an expander, and a water heat exchanger for conducting heat exchange between water and the

[Fig.1]



【Fig. 2】



INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2006/323099

A. CLASSIFICATION OF SUBJECT MATTER

F24H1/00(2006.01) i, F24H9/00(2006.01) i, F25B1/00(2006.01) i

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

F24H1/00, F24H9/00, F25B1/00

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Jitsuyo Shinan Koho 1922-1996 Jitsuyo Shinan Toroku Koho 1996-2007

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.
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Y	JP 2005-147409 A (The Tokyo Electric Power Co., Inc., Sanyo Electric Co., Ltd., Sanyo Ea Kondishonazu Kabushiki Kaisha), 09 June, 2005 (09.06.05), Full text; Figs. 1, 2 (Family: none)	1, 2
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Date of the actual completion of the international search

30 January, 2007 (30.01.07)

Date of mailing of the international search report

06 February, 2007 (06.02.07)

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[0042]