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(54) CONTROL METHOD AND DEVICE FOR HEAT PUMP WATER HEATER

(57) A control method for a heat pump water heater, a controller and a water heater. The water heater includes a first condenser (21) and a second condenser (22) disposed one above the other along a water tank (1), a refrigerant outlet of the first condenser (21) is connected to a refrigerant inlet of the second condenser (22) through a first refrigerant branch pipe (31), the first refrigerant branch pipe (31) is provided with a regulating valve (311), the refrigerant inlet of the second condenser (22) is further connected to a refrigerant gross pipe (30) through a second refrigerant branch pipe (32), and the second refrigerant branch pipe (32) is provided with a switch valve (321). The controller is communicatively connected to the regulating valve (311) and the switch valve (321) respectively.

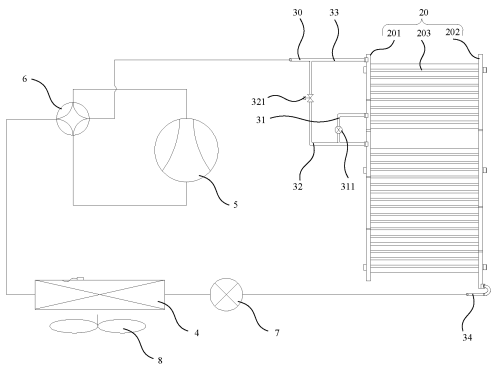

FIG. 1

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Description

[0001] This application claims priority to Chinese Patent Application No. 2020108612302, filed to the China National Intellectual Property Administration on August 25, 2020 and entitled "CONTROL METHOD FOR HEAT PUMP WATER HEATER", the contents of which are hereby incorporated by reference in their entireties.

TECHNICAL FIELD

[0002] The present invention relates to the field of household appliance technologies and specifically, to a control method and device for a heat pump water heater.

BACKGROUND

[0003] A heat pump water heater is an apparatus that uses refrigerant to absorb the low-temperature thermal energy in the air to transfer it to a water tank to produce hot water. It is increasingly popularized because of its advantages such as being energy-saving and environmental-friendly.

[0004] Since water density decreases when water temperature increases, the water temperature at the upper part of the water tank of the heat pump water heater is higher than that of the lower part of the water tank. When a user is using water, cold water enters the lower part of the water tank, letting hot water in the upper part of the water tank discharge from an outlet, and water temperature in the water tank is, therefore, stratified. Typically, a temperature detector is arranged at 1/2 or 1/3 of the height of the water tank. When a temperature detected by the temperature detector is lower than a preset value, the heat pump water heater starts to heat the water in the water tank.

[0005] However, a condenser has a relatively high temperature and a poor heat exchange efficiency due to an effect of the water of high temperature in the upper part of the water tank, therefore, performance and a life cycle of the condenser are affected.

SUMMARY

[0006] To address the above problem in the prior art, namely, to address the problem that a condenser of an existing heat pump water heater has a relatively high temperature and a poor heat exchange efficiency due to an effect of the water of high temperature in the upper part of the water tank, a first aspect of the present application provides a control method for a heat pump water heater.

[0007] The heat pump water heater includes: a water tank, an evaporator, a compressor, a first condenser, a second condenser and a controller; the water tank is divided into a first heating area and a second heating area along a height direction, the first condenser covers an outside of the first heating area, and the second condenser covers an outside of the second heating area; a refrigerant inlet of the first condenser is connected to a refrigerant outlet of the compressor, and a refrigerant outlet of the first condenser is connected to a refrigerant inlet of the second condenser through a first refrigerant branch pipe; the refrigerant inlet of the second condenser is further connected to a refrigerant outlet of the evaporator through a second refrigerant branch pipe, and a refrigerant outlet of the second condenser is connected to a refrigerant inlet of the evaporator; the first refrigerant branch pipe is provided with a regulating valve, the second refrigerant branch pipe is provided with a switch valve, and the controller is communicatively connected to the switch and the regulating valve respectively; the control method for the heat pump water heater includes: in response to a stratified heating instruction, starting, by the controller, a stratified heating mode, and controlling, according to the stratified heating mode, an opening degree of the regulating valve to be turn down to 20-30B, and the switch valve to open.

[0008] A second aspect of the present application provides a controller for a heat pump water heater, configured to implement the method according to the foregoing first aspect.

[0009] A third aspect of the present application provides a heat pump water heater, including: a water tank, an evaporator, a compressor, a first condenser, a second condenser and a controller according to the second aspect; the water tank is divided into a first heating area and a second heating area along a height direction, the first condenser covers an outside of the first heating area, and the second condenser covers an outside of the second heating area; a refrigerant inlet of the first condenser is connected to a refrigerant outlet of the compressor, and a refrigerant outlet of the first condenser is connected to a refrigerant inlet of the second condenser through a first refrigerant branch pipe; the refrigerant inlet of the second condenser is further connected to a refrigerant outlet of the evaporator through a second refrigerant branch pipe, and a refrigerant outlet of the second condenser is connected to a refrigerant inlet of the evaporator; the first refrigerant branch pipe is provided with a regulating valve, the second refrigerant branch pipe is provided with a switch valve, and the controller is communicatively connected to the switch and the regulating valve respectively.

[0010] Those skilled in the art can understand that, the heat pump water heater according to the present application includes a water tank, an evaporator, a compressor, a first condenser, a second condenser and a controller; the water

tank is divided into a first heating area and a second heating area along a height direction, the first condenser covers an outside of the first heating area, and the second condenser covers an outside of the second heating area; a refrigerant inlet of the first condenser is connected to a refrigerant outlet of the compressor, and a refrigerant outlet of the first condenser is connected to a refrigerant inlet of the second condenser through a first refrigerant branch pipe; the refrigerant inlet of the second condenser is further connected to a refrigerant outlet of the evaporator through a second refrigerant branch pipe, and a refrigerant outlet of the second condenser is connected to a refrigerant inlet of the evaporator; the first refrigerant branch pipe is provided with a regulating valve, the second refrigerant branch pipe is provided with a switch valve, and the controller is communicatively connected to the switch and the regulating valve respectively. A control method for the heat pump water heater according to the present application includes: in response to a stratified heating instruction, starting, by the controller, a stratified heating mode, and controlling, according to the stratified heating mode, an opening degree of the regulating valve to be turn down to 20-30B, and the switch valve to open. By means of the foregoing arrangement, under the stratified heating mode, only the second heating area of the water tank is heated, thereby improving heat exchange efficiency, and further improving performance and a life cycle of a condenser.

BRIEF DESCRIPTION OF DRAWINGS

[0011]

FIG. 1 is a schematic diagram of a principle of a heat pump water heater according to an embodiment of the application.
FIG. 2 is a schematic structural diagram of a water tank and a heat exchanging device of a heat pump water heater according to an embodiment of the application.
FIG. 3 is a schematic diagram of mounting positions of temperature detecting devices of a heat pump water heater according to an embodiment of the application.
FIG. 4 is a schematic structural diagram of a heat exchanging device of a heat pump water heater according to an embodiment of the application.
FIG. 5 is a flowchart of a control method for a heat pump water heater according to an embodiment of the application.

DESCRIPTION OF EMBODIMENTS

[0012] Firstly, those skilled in the art understand that the embodiments are only used to explain the technical principles of the present application and are not intended to limit the protection scope of the present application. Those skilled in the art can make modifications to them as needed to fit a specific application scenario.

[0013] Secondly, it should be noted that in the description of the present application, a term indicating a direction or position relationship such as "inside", "outside" or the like is based on a direction or position relationship as shown in the accompanying drawings, which is only for the convenience of description, rather than to indicate or imply that a referred device or component must have a specific orientation, be constructed and operated in a specific orientation, thus, so it should not be interpreted as a limitation to the present application.

[0014] In addition, it should be noted that in the description of the present application, unless otherwise specified and limited, the term "connected" or "connection" should be understood in a broad sense, for example, it can be a fixed connection, a detachable connection, or an integrated connection; it can be a direct connection, or an indirect connection through intermediate media, or it can be an internal connection of two components. For those skilled in the art, a specific meaning of the mentioned term in the present application can be interpreted according to a specific situation.

[0015] A heat pump water heater includes a water tank, an evaporator, a compressor, a main expansion valve and a condenser. The main expansion valve is arranged between the condenser and the evaporator. When the heat pump water heater works, the evaporator absorbs thermal energy from the surrounding environment, gasifying the liquid refrigerant at the evaporator as low temperature and low pressure gas; then, the low temperature and low pressure refrigerant flows to the compressor and is compressed as high temperature and high pressure gas; the high temperature and high pressure refrigerant enters the condenser of the water tank for condensation and thermal energy discharging to heat up the water in the water tank, meanwhile, the refrigerant after discharging thermal energy becomes medium temperature and high pressure liquid; subsequently, the medium temperature and high pressure refrigerant becomes a gas-liquid two-phase state of low temperature and low pressure under the process of the main expansion valve, and then flows back to the evaporator to absorb thermal energy and gasifies. Repeat as such to implement preparation of hot water.

[0016] Since water density decreases when water temperature increases, the water temperature at the upper part of the water tank of the heat pump water heater is higher than that of the lower part of the water tank. When a user is using water, cold water enters the lower part of the water tank, letting hot water in the upper part of the water tank discharge from an outlet, and water temperature in the water tank is, therefore, stratified. Typically, a temperature detector is arranged at 1/2 or 1/3 of the height of the water tank. When a temperature detected by the temperature detector is lower

than a preset value, the heat pump water heater starts to heat the water in the water tank. However, a condenser has a relatively high temperature and a poor heat exchange efficiency due to an effect of the water of high temperature in the upper part of the water tank; and, even if a user needs a relatively small amount of water, the user has to wait for a relatively long time before the water is heated.

[0017] In view of this, the present application provides a control method for a heat pump water heater. The heat pump water heater includes an evaporator, a compressor, a water tank and a controller. Two condensers are arranged along a height direction of the water tank, and the controller, by controlling an amount of refrigerant that enters the upper and lower condensers, controls the implementation of stratified heating, whole tank heating and fast heating, thereby, improving the heat exchange efficiency of the heat pump water heater.

[0018] The following describes the preferred technical schemes of the control method of the heat pump water heater according to the present application in combination with the foregoing heat pump water heater.

[0019] To begin with, reference is made to FIG. 1 to FIG. 4, FIG. 1 is a schematic diagram of a principle of a heat pump water heater according to an embodiment of the application; FIG. 2 is a schematic structural diagram of a water tank and a heat exchanging device of a heat pump water heater according to an embodiment of the application; FIG. 3 is a schematic diagram of mounting positions of temperature detecting devices of a heat pump water heater according to an embodiment of the application; and FIG. 4 is a schematic structural diagram of a heat exchanging device of a heat pump water heater according to an embodiment of the application.

[0020] As shown in FIG. 1 to FIG. 4, the present application provides a heat pump water heater, including: a water tank 1, an evaporator 4, a compressor 5, a first condenser 21, a second condenser 22 and a controller, the water tank 1 is divided into a first heating area and a second heating area along a height direction, the first condenser 21 covers an outside of the first heating area, and the second condenser 22 covers an outside of the second heating area; a refrigerant inlet of the first condenser 21 is connected to a refrigerant outlet of the compressor 5, and a refrigerant outlet of the first condenser 21 is connected to a refrigerant inlet of the second condenser 22 through a first refrigerant branch pipe 31; and the refrigerant inlet of the second condenser 22 is further connected to a refrigerant outlet of the compressor 5 through a second refrigerant branch pipe 32, and a refrigerant outlet of the second condenser 22 is connected to a refrigerant inlet of the evaporator 4. The first refrigerant branch pipe 31 is provided with a regulating valve 311, the second refrigerant branch pipe 32 is provided with a switch valve 321, and the controller is communicatively connected to the switch valve 321 and the regulating valve 311 respectively. The control method for a heat pump water heater according to the present application includes: in response to a stratified heating instruction, starting, by the controller, a stratified heating mode, and controlling, mounting the stratified heating mode, an opening degree of the regulating valve 311 to be turn down to 20-30B, and the switch valve 321 to open.

[0021] With reference to FIG. 1, a refrigerant pipeline of the heat pump water heater according to the embodiment connects the evaporator 4, the compressor 5 and the condensers, so as to form a heat pump circuit for the circulation flow of refrigerant. The heat pump water heater according to the embodiment further includes a four-way valve 6, a fan 8, and a main expansion valve 7. The fan 8 is arranged near the evaporator 4. A refrigerant recycle pipe 34 between the refrigerant outlet of the condensers and the refrigerant inlet of the evaporator 4 is provided with the main expansion valve 7, which is configured to regulate a flow rate of refrigerant. The four ports of the four-way valve 6 are respectively connected to the inlet and outlet ports of the compressor 5, the outlet of the evaporator 4 and a refrigerant gross pipe 30.

[0022] The heat pump water heater according to the embodiment further includes a water supply device, which is connected to a water inlet at the bottom of the water tank 1 to supply water to the water tank 1 and prevent the water tank 1 from draining; the top of the water tank 1 is provided with an outlet connected to the outside, so as to conduct hot water from the top to the outside of the water tank 1 for a user to use.

[0023] It should be understood that the heating areas are divided according to the areas where the condensers are arranged on the water tank 1. For example, if two condensers are arranged successively along the height direction of the water tank 1, the water tank 1 is divided into two heating areas. Naturally, if three condensers are arranged successively along the height direction of the water tank 1, the water tank 1 is divided into three heating areas. Although description is made in the present application by taking an example where the water tank 1 is divided into two heating areas, it should not be limited to such. When the water tank 1 is divided into three or more heating areas, the principle of a heating mode thereof is the same as that of the embodiment of the present application.

[0024] In some examples, the first condenser 21 is connected to the refrigerant gross pipe 30 through a third refrigerant branch pipe 33. At this time, the third refrigerant branch pipe 33 is not provided with a control valve. In the stratified heating mode, controlling the opening degree of the regulating valve to be turn down to 0-5B can make the refrigerant in the refrigerant gross pipe 30 enter the first condenser 21 at a relatively small flow rate, and most of the refrigerant enter the second condenser 22 to heat the second heating area. In this way, it can avoid the refrigerant from accumulating constantly in the first condenser 21, transforming from the high temperature and high pressure gas to low temperature and high pressure liquid through heat exchanging, thereby increasing a pressure in the first condenser 21 and affecting a life cycle of the first condenser 21.

[0025] In some further examples, the first condenser 21 is connected to the refrigerant gross pipe 30 through the third

refrigerant branch pipe 33, and the third refrigerant branch pipe 33 is provided with an electromagnetic switching valve. In the stratified heating mode, the controller controls the electromagnetic switching valve to close, preventing the refrigerant from entering the first condenser 21, thereby making all of the refrigerant in the refrigerant gross pipe 30 pass through the second condenser 22 to heat the second heating area of the water tank 1.

[0026] It should be understood that in the embodiment of the present application, the switch valve 321 can be an electromagnetic cut-off valve, an electromagnetic cut-off valve or the like, to control the flow and cutoff of the refrigerant in the second refrigerant branch pipe 32. The regulating valve 311 is configured to regulate a refrigerant flow rate in the first refrigerant branch pipe 31. For example, the regulating valve 311 may be an expansion valve.

[0027] The heat pump water heater in the embodiment further includes a controller, which is connected to the switch valve 321 and the regulating valve 311 respectively, in the stratified heating mode, controls the regulating valve 311 to adjust the opening degree to 0-5B, and the switch valve 321 to open, so as to make most of the high temperature and high pressure refrigerant in the refrigerant gross pipe 30 enter the second condenser 22 through the second refrigerant branch pipe 32, and heat the water in the second heating area of the water tank 1 by exchanging heat with the water in the second heating area of the water tank 1, thereby heating the water fully in the lower part of water tank 1, improving the heat exchange efficiency, and further improving the performance and life cycle of the condensers.

[0028] After the heat pump water heater is turned on, the controller starts stratified heating mode in response to the stratified heating instruction, which can be interpreted as starting the stratified heating mode according to a preset control strategy while the heat pump water heater is turned on; or, starting the stratified heating mode according to the stratified heating instruction input by a user.

[0029] With reference to FIG. 5, which is a flowchart of a control method for a heat pump water heater according to an embodiment of the application. Optionally, the stratified heating mode includes: acquiring a water temperature at the first heating area and a water temperature at the second heating area, controlling, by the controller according to a temperature difference between the water temperature at the first heating area and the water temperature at the second heating area, the opening degree of the regulating valve 311, and opening and closing of the switch valve 321.

[0030] By means of the foregoing arrangements, the controller controls, according to the water temperatures of the first heating area and the second heating area, the opening degree of the regulating valve 311, and opening and closing of the switch valve 321. Therefore, it is possible to adjust in real time according to the temperatures, and further improve the operating efficiency of the heat pump water heater.

[0031] In a specific implementation, the controller adjusts a working state of the switch valve 321 and the regulating valve 311 according to a water temperature feedback from a temperature detecting device. Specifically, with reference to FIG. 2 and FIG. 3, the first heating area is provided with a first temperature detecting device 11 for measuring a water temperature T1 at the first heating area, the second heating area is provided with a second temperature detecting device 12 for measuring a water temperature T2 at the second heating area, and both of the first temperature detecting device 11 and the second temperature detecting device 12 are communicatively connected to the controller; the controller, in response to a first difference value between a difference value of temperatures measured by the first temperature detecting device 11 and the second temperature detecting device 12, and a preset temperature t0, controls opening and closing of the switch valve 321, and the opening degree of the regulating valve 311.

[0032] That is to say, the controller, according to a size relationship between a difference value between the water temperature T1 at the first heating area and the water temperature T2 at the second heating area, and the preset temperature t0, controls opening and closing of the switch valve 321, and the opening degree of the regulating valve 311.

[0033] By means of the foregoing arrangements, using the first difference value, the water temperature difference between the first heating area and the second heating area of the water tank 1 can be determined, and further, opening and closing of the switch valve 321 and the opening degree of the regulating valve 311 can be adjusted, so that an operation state of a whole system of the heat pump water heater is optimized to improve system efficiency.

[0034] Specifically, when the difference value between the water temperature T1 at the first heating area and the water temperature T2 at the second heating area is greater than the first preset temperature t0, the controller controls the opening degree of the regulating valve 311 to be turn down to 0~5B, and controls the switch valve 321 to open, so as to make most of the refrigerant in the refrigerant gross pipe 30 enter the second condenser 22 to heat the water in the second heating area. That is to say, when T1-T2>t0, the controller controls the opening degree of the regulating valve 311 to be turn down to 0~5B, and controls the switch valve 321 to open. In other words, the water temperature difference that the first heating area is higher than the second heating area exceeds the first preset temperature t0, the heat pump water heater is, therefore, controlled to heat the second heating area, thereby achieving stratified heating, and improving the heat exchange efficiency.

[0035] After the heat pump water heater is turned on, the controller starts a whole tank heating mode in response to a whole tank heating instruction, and controls, according to the whole tank heating mode, the opening degree of the regulating valve 311 to be turned up, and adjusts the switch valve 321 from an open state to a closed state. In the whole tank heating mode, the opening degree of the regulating valve 311 can be adjusted to a maximum value. It can be interpreted as starting the whole tank heating mode according to a preset control strategy while the heat pump water

heater is turned on; or, starting the whole tank heating mode according to the whole tank heating instruction input by a user.

[0036] Optionally, the whole tank heating mode includes: acquiring a water temperature at the first heating area and a water temperature at the second heating area; and controlling, by the controller, according to a temperature difference between the water temperature at the first heating area and the water temperature at the second heating area, the opening degree of the regulating valve 311, and opening and closing of the switch valve 312.

[0037] By means of the foregoing arrangements, the controller controls, according to the water temperatures of the first heating area and the second heating area, the opening degree of the regulating valve 311, and opening and closing of the switch valve 321. Therefore, it is possible to adjust in real time according to the temperatures, and further improve the operating efficiency of the heat pump water heater.

[0038] In a specific implementation, the controller adjusts a working state of the switch valve 321 and the regulating valve 311 according to a water temperature fedback from a temperature detecting device. Specifically, with reference to FIG. 2 and FIG. 3, the first heating area is provided with a first temperature detecting device 11 for measuring a water temperature T1 at the first heating area, the second heating area is provided with a second temperature detecting device 12 for measuring a water temperature T2 at the second heating area, and both of the first temperature detecting device 11 and the second temperature detecting device 12 are communicatively connected to the controller; the controller, in response to a first difference value between a difference value of temperatures measured by the first temperature detecting device 11 and the second temperature detecting device 12, and a preset temperature t0, controls opening and closing of the switch valve 321, and the opening degree of the regulating valve 311.

[0039] That is to say, the controller, according to a size relationship between a difference value between the water temperature T1 at the first heating area and the water temperature T2 at the second heating area, and the preset temperature t0, controls opening and closing of the switch valve 321, and the opening degree of the regulating valve 311.

[0040] By means of the foregoing arrangements, using the first difference value, the water temperature difference between the first heating area and the second heating area of the water tank 1 can be determined, and further, opening and closing of the switch valve 321 and the opening degree of the regulating valve 311 can be adjusted, so that an operation state of a whole system of the heat pump water heater is optimized to improve system efficiency.

[0041] Specifically, when the difference value between the water temperature T1 at the first heating area and the water temperature T2 at the second heating area is less than or equal to the first preset temperature t0, the controller controls the opening degree of the regulating valve 311 to be turned up, and controls the switch valve 321 to adjust from an open state to a closed state, so as to make the refrigerant in the refrigerant gross pipe 30 enter the first condenser 21 first, and further enter the second condenser 22 through the first refrigerant branch pipe 31, to heat, respectively, the water in the first heating area and the second heating area, namely, to perform whole tank heating on the water tank 1. That is to say, when $T1-T2 \leq t0$, the controller controls the opening degree of the regulating valve 311 to be turned up, and controls the switch valve 321 to adjust from the open state to the closed state. In other words, when the difference value between the water temperature T1 at the first heating area and the water temperature T2 at the second heating area is less than or equal to the first preset temperature t0, the heat pump water heater is controlled to perform whole tank heating, thereby achieving whole tank heating, and improving the heat exchange efficiency.

[0042] It should be understood that the first preset temperature t0 can be set in a control program according to a practical situation. For example, the first preset temperature t0 is 10°C. That is to say, when the difference between the water temperature at the first heating area and the water temperature at the second heating area exceeds 10°C, the heat pump water heater is controlled to perform stratified heating, and when the difference between the water temperature at the first heating area and the water temperature at the second heating area is less than or equal to 10°C, the heat pump water heater is controlled to perform whole tank heating, which thereby improves the heat exchange efficiency of the condensers, and improves the operating efficiency of the heat pump water heater.

[0043] It should be noted here that, when the heat pump water heater is turned on, there is no specific order between the controller starting the stratified heating mode in response to the stratified heating instruction and starting the whole tank heating mode in response to the whole tank instruction. That is to say, the controller may execute the whole tank heating mode first, and the controller may also execute the stratified heating mode first. When the controller executes the whole tank heating mode first, it controls the opening degree of the regulating valve 311 to be turned up, and controls the switch valve 321 to be maintained in the closed state. On this basis, when executing the stratified heating mod, the controller controls the opening degree of the regulating valve 311 to be turn down to 20-30B, and controls the switch valve 321 to adjust from the closed state to the open state.

[0044] In a specific implementation, a height range that the first condenser 21 and the second condenser 22 cover the water tank 1 is 2/3 to 4/5 of the height of the middle barrel 10 of the water tank 1.

[0045] Firstly, the water tank 1 of the heat pump water heater includes the middle barrel 10 and two end sockets 13 arranged at both ends of the middle barrel 10. The middle barrel 10 is a barrel-shaped structure with openings at both ends. The two end sockets 13 are respectively welded at the two ends of the middle barrel 10, thereby, forming a closed water storage space. With reference to FIG. 2, the height of the middle barrel 10 is H.

[0046] Secondly, in the implementation, the height range that the first condenser 21 and the second condenser 22

cover the water tank 1 is 2/3 to 4/5 of the height of the middle barrel 10 of the water tank 1,which avoids that the heat exchange efficiency is affected due to a too small heat exchange area of the first condenser 21 and the second condenser 22, and avoids the problems of high cost and inconvenience for installation resulting from a too big heat exchange area of the first condenser 21 and the second condenser 22.

[0047] In some examples, a height H2 of the second condenser 22 is 1/2 of the height H of the middle barrel 10 of the water tank 1. That is to say, the second condenser 22 covers half the height of the middle barrel 10, to heat the water in the second heating area fully to provide sufficient reserved hot water. It should be understood that a welding area between the middle barrel 10 and the end sockets 13 are not suitable to install the second condenser 22. Optionally, the second condenser 22 has a preset distance from the bottom of the middle barrel 10 to avoid the welding area, the preset distance can be 20mm.

[0048] In some examples, a height H1 of the first condenser 21 is 1/3 to 1/2 of the height H2 of the second condenser 22, and there is a preset interval H0 between the first condenser 21 and the second condenser 22.

[0049] In a practical application process, the height H1 of the first condenser 21 can be calculated according to a water consumption amount needed for at least one person. For example, a height the first heating area can be calculated based on that a volume of hot water of 40°C needed for one person is 60L, such that the height H1 of the first condenser 21 can be obtained.

[0050] It should be understood that a sum of the height H1 of the first condenser 21, the height H2 of the second condenser 22 and the preset interval H0 is the height that the first condenser 21 and the second condenser 22 cover the water tank 1.

[0051] By means of the foregoing arrangements, the first condenser 21 and the second condenser 22 different height ranges, and the height H1 of the first condenser 21 is less than the height H2 of the second condenser 22. That is to say, a water volume in the first heating area is less than a water volume in the second heating area, which not only reduces a water amount for fast heating to achieve fast heating, but also preheat a large amount of water at the bottom of the water tank 1 to provide sufficient reserved hot water. In addition, a preset interval H0 is provided between the first condenser 21 and the second condenser 22 to avoid an interaction between the first condenser 21 and the second condenser 22 from affecting the heat exchange efficiency.

[0052] In a possible implementation, with reference to FIG. 3, the first temperature detecting device 11 is arranged at a first position of the water tank 1, where the first position is within a range of 1/3-2/5 of the height H1 of the first condenser 21. That is to say, the first temperature detecting device 11 is arranged on the outside of the water tank 1, and the first temperature detecting device 11 is positioned between 1/3-2/5 of the height H1 of the first condenser 21. In other words, the first temperature detecting device 11 is arranged in a range of 1/3 to 2/5 height H1 of the first condenser 21 from its lower end to the top.

[0053] As the refrigerant flows from the upper end of the first condenser 21 to its lower end, the water temperature in the first heating area has a gradual declining tendency from its upper end to its lower end. By means of such arrangements, the first temperature detecting device 11 is positioned at the lower part of the first condenser 21 to characterize the water temperature at the first heating area and improve accuracy of water temperature measurement in the first heating area.

[0054] In a possible implementation, the second temperature detecting device 12 is arranged in a second position of the water tank 1, where the second position is within a range of 1/2-2/3 of the height H2 of the second condenser 22. That is to say, the second temperature detecting device 12 is arranged on the outside the water tank 1, and the second temperature detecting device 12 is positioned between 1/2-2/3 of the height H2 of the second condenser 22. In other words, the second temperature detecting device 12 is arranged in a range of 1/2 to 2/3 height H2 of the second condenser 22 from its low end to the top.

[0055] By means of such arrangements, the second temperature detecting device 12 is positioned at the upper part of the second condenser 22 to characterize the water temperature at the second heating area and improve accuracy of water temperature measurement in the second heating area.

[0056] In a possible implementation, the controller is further configured to control, under a fast heating mode, the switch valve 321 to adjust from the open state to the closed state, and the regulating valve 311 to turn up the opening degree.

[0057] Specifically, the controller starts the fast heating mode in response to a fast heating instruction, and controls, according to the fast heating mode, the opening degree of the regulating valve 311 to be turned up, and adjusts the switch valve 321 from the open state to the closed state.

[0058] The controller starts the fast heating mode in response to the fast heating instruction, which can be interpreted as starting the fast heating mode according to a preset control strategy while the heat pump water heater is turned on; or, starting the fast heating mode according to the fast heating instruction input by a user when the user needs to use hot water urgently.

[0059] For example, with reference to FIG. 5, the heat pump water heater is in the whole tank heating mode, the switch valve 321 is closed, and the opening degree of the regulating valve 311 is adjusted to a maximum opening degree. Upon receiving the fast heating instruction, the heat pump water heater starts the fast heating mode. The controller controls

the switch valve 321 to maintain the closed state, and controls the opening degree of the regulating valve 311 to be adjusted to a preset opening degree, or controls the opening degree of the regulating valve 311 according to temperatures fed back from the temperature detection devices.

[0060] For another example, with reference to FIG. 5, the current heat pump water heater is in the stratified heating mode, the switch valve 321 is in the opened state, and the opening degree of the regulating valve 311 is adjusted to a 20-30B state. Upon receiving the fast heating instruction, the heat pump water heater starts the fast heating mode. The controller controls the switch valve 321 to adjust from the open state to the closed state, and controls the opening degree of the regulating valve 311 to be adjusted to a preset opening degree, or controls the opening degree of the regulating valve 311 according to temperatures fed back from the temperature detection devices.

[0061] For yet another example, upon the fast heating instruction is received when the heat pump water heater is turned up, and the heat pump water heater starts the fast heating mode. The controller controls the switch valve 321 to adjust from the closed state to the closed state, and controls the opening degree of the regulating valve 311 to be adjusted to a preset opening degree, or controls the opening degree of the regulating valve 311 according to temperatures fed back from the temperature detection devices.

[0062] That is to say, under any working state of the heat pump water heater, the fast heating mode may be started when the fast heating instruction is received, to quickly heat up the water in the first heating area, so as to meet an instant need for water of a user, thereby improving user experience.

[0063] In an example, the fast heating mode includes: acquiring a water temperature T1 at the first heating area and a condensing temperature Tc at the refrigerant outlet of the first condenser 21; and controlling, by the controller according to a difference value between the water temperature T1 at the first heating area and the condensing temperature Tc at the refrigerant outlet of the first condenser 21, the opening degree of the regulating valve 311 and opening and closing of the switch valve 321.

[0064] That is to say, the controller, according to a size relationship between a second difference value between the water temperature T1 at the first heating area and the condensing temperature Tc at the refrigerant outlet of the first condenser 21, and a target heat exchange temperature difference Te, controls the opening degree of the regulating valve 311 and opening and closing of the switch valve 321.

[0065] By means of the foregoing arrangements, using the second difference value, the difference between the water temperature at the first heating area of the water tank 1 and the condensing temperature Tc of the first condenser 21 can be determined, and thus the opening degree of the regulating valve 311 and opening and closing of the switch valve 321 can be controlled, so as to quickly heat up the water in the first heating area, thereby improving the heat exchange efficiency of the heat pump water heater.

[0066] Specifically, when the difference value between the water temperature T1 at the first heating area and the condensing temperature Tc at the refrigerant outlet of the first condenser is greater than a target heat exchange temperature difference Te, the controller controls the regulating valve 311 to turn up the opening degree, and controls the switch valve 321 to adjust from the open state to the closed state; and when the difference value between the water temperature T1 at the first heating area and the condensing temperature Tc at the refrigerant outlet of the first condenser is less than or equal to the target heat exchange temperature difference Te, the controller controls the regulating valve 311 to turn down the opening degree, and controls the switch valve 321 to adjust from the open state to the closed state.

[0067] That is to say, when Tc-T1>Te, the controller controls the regulating valve 311 to turn up the opening degree, and controls the switch valve 321 to adjust from the open state to the closed state; when Tc-T1 $\leq$ Te, the controller controls the regulating valve 311 to turn down the opening degree, and controls the switch valve 321 to adjust from the open state to the closed state, such that a heating speed of the first heating area is fast, thereby achieving fast heating. Moreover, when a hot water amount needed by a user is small, an energy waste is not caused by too much hot water resulting from heating the water in the whole tank 1.

[0068] The opening degree of regulating valve 311 is controlled according to the following PID. Specifically, Pi+1=Pi+ΔP, where Pi+1 is a step count of the regulating valve 311 for a next time, whose unit is B; Pi is a current step count where the regulating valve 311 is, whose unit is B; Δ P is a target adjustment step count of the regulating valve 311, whose unit is B. In addition, Δ P=(Tc-T1)- Δ_t, where Tc is the condensing temperature at the refrigerant outlet of the first condenser 21, whose unit is °C; T1 is the water temperature at the first heating area, whose unit is °C; Δt is the target heat exchange temperature difference, see Table 1, whose unit is °C; and Te is the ambient temperature, whose unit is °C.

Table 1 Target heat exchange temperature difference Δt

Water Temperature T1 at the First Heating Area	Target Heat Exchange Temperature Difference Δt when Te>30°C	Target Heat Exchange Temperature Difference Δt when 30°C $\geq$Te> 12°C	Target Heat Exchange Temperature Difference Δt when 12°C $\geq$ Te
T1 >55°C	7	8	9

(continued)

Water Temperature T1 at the First Heating Area	Target Heat Exchange Temperature Difference Δt when Te>30°C	Target Heat Exchange Temperature Difference Δt when 30°C ≥Te> 12°C	Target Heat Exchange Temperature Difference Δt when 12°C ≥ Te
55°C ≥T1 >50°C	9	10	11
50°C ≥T1 >40°C	11	12	13
40°C ≥T1 >30°C	13	14	15
30°C ≥T1	15	16	18

[0069] Naturally, the above Table 1 only shows an example of the target heat exchange temperature difference Δ t, which is not limiting. Those skilled in the art can set the target heat exchange temperature difference Δ t according to a practical situation. Optionally, the opening degree of the regulating valve 311 may be adjusted according to a temperature every 60-90 seconds according to a program by those skilled in the art.

[0070] Before the fast heating mode is started, namely, before controlling, according to the fast heating mode, the opening degree of the regulating valve to be turned up, and adjusting the switch valve from the open state to the closed state, further includes: controlling, by the controller, the regulating valve 311 to adjust the opening degree to 200-400B, and maintaining for a preset period.

[0071] By means of the foregoing arrangements, the opening degree of the regulating valve 311 is approximately within a middle range, which is convenient for the adjustment of the opening degree of the regulating valve 311. The purpose of maintaining the opening degree for the preset time is such that the refrigerant of the heat pump water heater can circulate in its circuit for about one cycle, which permits a changing time for the water temperature at the first heating area and the condensing temperature at the refrigerant outlet of the first condenser 21, and improves accuracy of temperature measurement, thereby improving the heat exchange efficiency of the heat pump water heater.

[0072] In order to measure the condensing temperature at the refrigerant outlet of the first condenser 21, reference is further made to FIG. 3. A temperature sensing device 35 for measuring a refrigerant temperature is arranged at the outlet of the first condenser 21. The temperature sensing device 35 is communicatively connected to the controller, such that the controller, in response to a second difference value between a difference value between temperatures obtained by the temperature sensing device 35 and the first temperature detecting device 11, and the target heat exchange temperature difference, controls the switching valves 321 to close, and the regulating valve 311 to adjust the opening degree thereof, thereby achieving fast heating of the first heating area. The temperature sensing device 35 may be a temperature sensor. The temperature sensing device 35 may also be other temperature detecting devices in the art.

[0073] With reference to FIG. 1 to FIG. 4, in some examples, the heat pump water heater further includes a heat exchanging device 20 including a first collecting pipe 201, a second collecting pipe 202 and a plurality of microchannel flat pipes 203. The first collecting pipe 201 and the second collecting pipe 202 are spaced and oppositely arranged, two ends of a microchannel flat pipes 203 are respectively connected to the first collecting pipe 201 and the second collecting pipe 202, and the plurality of microchannel flat pipes 203 are all arranged along a length direction of the first collecting pipe 201. The first collecting pipe 201 and the second collecting pipe 202 are respectively provided with a partition plate 204, and the two partition plates 204 are opposite. The portions of first collecting pipe 201, the second collecting pipe 202 and the microchannel flat pipe 203 above the partition plates 204 form the first condenser 21, and the portions of first collecting pipe 201, the second collecting pipe 202 and the microchannel flat pipe 203 below the partition plates 204 form the second condenser 22.

[0074] With reference to FIG. 2 and FIG. 4 for details, both of the first collecting pipe 201 and the second collecting pipe 202 of the heat exchanging device 20 extend along the height direction of the water tank 1, and are spaced along a circumference of the water tank 1. Both ends of the plurality of the microchannel flat pipes 203 are respectively connected to the first collecting pipe 201 and the second collecting pipe 202, and the plurality of microchannel flat pipes 203 are all arranged along a length direction of the first collecting pipe 201. The heat exchanging device 20 as shown in FIG. 1 and FIG. 4 is in an unfolded state, and an actual state of the heat exchanging device 20 is shown in FIG 2 and FIG. 3. That is to say, a microchannel flat pipe 203 is an arc extending along the circumference of the water tank 1.

[0075] A partition plate 204 is arranged in the first collecting pipe 201 to divide the first collecting pipe 201 into an upper and a lower part which are disconnected. A further partition plate 204 is arranged in the second collecting pipe 202, and the partition plate 204 is opposite to the partition plate 204 in the first collecting pipe 201. That is to say, the partition plates 204 in the first collecting pipe 201 and the second collecting pipe 202 are at a same height. The partition plate 204 in the second collecting pipe 202 divides the second collecting pipe 202 into an upper and a lower part which are disconnected.

[0076] Therefore, the portions of the first collecting pipe 201, the second collecting pipe 202 and the microchannel flat

pipe 203 above the two partition plates 204 form the first condenser 21, and the portions of first collecting pipe 201, the second collecting pipe 202 and the microchannel flat pipe 203 below the two partition plates 204 form the second condenser 22. Such that the structures of the first condenser 21 and the second condenser 22 are consistent, which simplifies the structures of the first condenser 21 and the second condenser 22, and facilitates the processing and installation of the first condenser 21 and the second condenser 22, and is conducive to reducing a cost. Moreover, the height of the first condenser 21 and the second condenser 22 can be set directly through setting a count of microchannel flat pipes 203 above and below the partition plates 204, which facilitates a setting of the heights of the first condenser 21 and the second condenser 22, and further simplifies the structures of the first condenser 21 and the second condenser 22, and is conducive to reducing a cost.

[0077] Further reference is made to FIG. 2 and FIG. 4. An opening at the upper end of the first collecting pipe 201 is the refrigerant inlet of the first condenser 21, which is connected to the refrigerant gross pipe 30 through the third refrigerant branch pipe 33. An opening of the upper portion of the first collecting pipe 201, which is near the partition plate 204, is the refrigerant outlet of the first condenser 21, which is connected to the refrigerant inlet of the second condenser 22 through the first refrigerant branch pipe 31. An opening of the lower portion of first collecting pipe 201, which is near the partition plate 204, is the refrigerant inlet of the second condenser 22, which is connected to the refrigerant gross pipe 30 through the second refrigerant branch pipe 32. An opening at the lower end opening of the second collecting pipe 202 is the refrigerant outlet of the second condenser 22, which is connected to the evaporator 4 through the refrigerant recycle pipe 34.

[0078] The refrigerant inlet and outlet of the first condenser 21 and the refrigerant inlet of the second condenser 22 are all arranged on the first collecting pipe 201, which is thus convenient for pipe connection and arrangement.

[0079] Further reference is made to FIG. 2, to ensure that the heat exchanging device 20 covers the outside of the middle barrel 10 of the water tank 1, there is a space between the first collecting pipe 201 and the second collecting pipe 202, and at least one fixing pipe 207 is arranged in the space, where both ends of the fixing pipe 207 are connected to the first collecting pipe 201 and the second collecting pipe 202 respectively. Optionally, there are a plurality of fixing pipes 207, such as two, three or the like, and the plurality of fixing pipes 207 are spaced along the height direction of the water tank 1, to improve stability and reliability of the heat exchanging device 20 installed on the outside the water tank 1.

[0080] On the basis of the foregoing embodiment, at least one first segmenting plate 205 is arranged in the portions of the first collecting pipe 201 and the second collecting pipe 202 above the partition plates 204 to segment the microchannel flat pipes 203 above the partition plates 204 into at least two segments of a refrigerant circulation circuit; and at least one second segmenting plate 206 is arranged in the portions of the first collecting pipe 201 and the second collecting pipe 202 below the partition plates 204 to segment the microchannel flat pipes 203 below the partition plate 204 into at least two segments of the refrigerant circulation circuit.

[0081] For example, one first segmenting plate 205 is arranged in the portion of the first collecting pipe 201 above the partition plates 204, such that the microchannel flat pipes 203 above the partition plates 204 are segmented into at least two interconnected segments of the refrigerant circulation circuit, to increase a length of the refrigerant circulation circuit. At this time, the temperature sensing device 35 may be arranged on the first collecting pipe 201 and positioned at the refrigerant outlet of the first condenser 21. The collecting pipe has a larger diameter than the microchannel flat pipe 203, which is convenient for the installation of the temperature sensing device 35. At the refrigerant outlet of the first condenser 21, the refrigerant is in a gas-liquid mixed state, which is suitable to characterize the condensing temperature at the refrigerant outlet of the first condenser 21.

[0082] For another example, two second segmenting plates 206 are spaced in the portion of the first collecting pipe 201 below the partition plates 204, two second segmenting plates 206 are spaced in the portion of the second collecting pipe 202 below the partition plates 204, and the second segmenting plates 206 in the first collecting pipe 201 and the second segmenting plates 206 in the second collecting pipe 202 are staggered in height, such that the microchannel flat pipes 203 below the partition plates 204 are segmented into five interconnected segments of the refrigerant circulation circuit, in which case, the refrigerant circulates along an S-shape, which can increase a length of contact path between the refrigerant and the water tank 1, thereby, improving the heat exchange efficiency.

[0083] Naturally, the quantity of the first segmenting plate 205 and the second segmenting plate 206 is not limited to such, and it can be set by those skilled in the art according to a practical situation.

[0084] Further reference is made to FIG. 5, the control method for a heat pump water heater according to the present application is specified in the following example.

[0085] When the heat pump water heater is turned up, at this time, the switch valve 321 is in the closed state.

[0086] The controller, in response to the stratified heating instruction, starts the stratified heating mode, controls, according to the stratified heating mode, the opening degree of the regulating valve 311 to be turn down to 20-30B, and controls the switch valve 321 to open, to thereby achieving stratified heating of the water in the water tank 1.

[0087] In an optional implementation, the controller acquires the water temperature at the first heating area and the water temperature at the second heating area; and the controller controls, according to the temperature difference

between the water temperature at the first heating area and the water temperature at the second heating area, the opening degree of the regulating valve 311, and opening and closing of the switch valve 321.

[0088] Specifically, when the temperature difference between the water temperature T1 at the first heating area and the water temperature T2 at the second heating area is greater than the first preset temperature T0, the controller controls the opening degree of the regulating valve 311 to be turn down to 20-30B, and controls the switch valve 321 to open, so as to make most of the refrigerant in the refrigerant gross pipe 30 enter the second condenser 22 to heat the water in the second heating area.

[0089] When the difference value between the water temperature T1 at the first heating area and the water temperature T2 at the second heating area is less than or equal to the first preset temperature t0, the controller controls the opening degree of the regulating valve 311 to be turned up, and controls the switch valve 321 to adjust from an open state to a closed state, so as to make the refrigerant in the refrigerant gross pipe 30 enter the first condenser 21 first, and then enter the second condenser 22 through the first refrigerant branch pipe 31, to heat, respectively, the water in the first heating area and the second heating area, namely, to perform whole tank heating on the water tank 1. At this time, the heat pump water heater is in the whole tank heating mode.

[0090] Regardless whether the heat pump water heater is in the stratified heating mode or the whole tank heating mode, the controller, further in response to the fast heating instruction, starts the fast heating mode, controls, according to the fast heating mode, the opening degree of the regulating valve 311 to be turned up, and adjusts the state of the switch valve 321 to the closed state, to quickly heat up the water in the upper part of the water tank 1, so as to meet a need for quickly using of hot water of a user.

[0091] In view of the foregoing, the heat pump water heater according to the present application includes: a water tank 1, an evaporator 4, a compressor 5, a first condenser 21, a second condenser 22 and a controller, the water tank 1 is divided into a first heating area and a second heating area along a height direction, the first condenser 21 covers an outside of the first heating area, and the second condenser 22 covers an outside of the second heating area; a refrigerant inlet of the first condenser 21 is connected to a refrigerant outlet of the compressor 5, and a refrigerant outlet of the first condenser 21 is connected to a refrigerant inlet of the second condenser 22 through a first refrigerant branch pipe 31; and the refrigerant inlet of the second condenser 22 is further connected to a refrigerant outlet of the compressor 5 through a second refrigerant branch pipe 32, and a refrigerant outlet of the second condenser 22 is connected to a refrigerant inlet of the evaporator 4. The first refrigerant branch pipe 31 is provided with a regulating valve 311, the second refrigerant branch pipe 32 is provided with a switch valve 321, and the controller is communicatively connected to the switch valve 321 and the regulating valve 311 respectively, and is configured to control, under a stratified heating mode, the switch valve 321 to open, and control the opening degree of the regulating valve 311 to be turn down to 20-30B. By means of the foregoing arrangements, under the stratified heating mode, only the second heating area is heated, thereby improving heat exchange efficiency, and further improving performance and a life cycle of a condenser.

[0092] So far, the technical solution of the present application has been described in conjunction with the preferred embodiments as shown in the accompanying drawings. However, it is readily understood by those skilled in the art that the protection scope of the present application is apparently not limited to these specific embodiments. Without departing from the principle of the present application, those skilled in the art can make equivalent changes or replacements to the relevant technical features, and the technical solutions after these changes or replacements shall fall within the protection scope of the present application.

Claims

1. A control method for a heat pump water heater, wherein the heat pump water heater comprises: a water tank, an evaporator, a compressor, a first condenser, a second condenser and a controller; the water tank is divided into a first heating area and a second heating area along a height direction, the first condenser covers an outside of the first heating area, and the second condenser covers an outside of the second heating area; a refrigerant inlet of the first condenser is connected to a refrigerant outlet of the compressor, and a refrigerant outlet of the first condenser is connected to a refrigerant inlet of the second condenser through a first refrigerant branch pipe; the refrigerant inlet of the second condenser is further connected to a refrigerant outlet of the evaporator through a second refrigerant branch pipe, and a refrigerant outlet of the second condenser is connected to a refrigerant inlet of the evaporator; the first refrigerant branch pipe is provided with a regulating valve, the second refrigerant branch pipe is provided with a switch valve, and the controller is communicatively connected to the switch and the regulating valve respectively;

   the control method comprises:

   in response to a stratified heating instruction, starting, by the controller, a stratified heating mode, and controlling, according to the stratified heating mode, an opening degree of the regulating valve to be turn down to 20-30B, and the switch valve to open.

2. The control method according to claim 1, wherein the stratified heating mode comprises:

acquiring a water temperature at the first heating area and a water temperature at the second heating area; and controlling, by the controller according to a temperature difference between the water temperature at the first heating area and the water temperature at the second heating area, the opening degree of the regulating valve, and opening and closing of the switch valve.

3. The control method according to claim 2, wherein,
controlling, by the controller, when the temperature difference between the water temperature at the first heating area and the water temperature at the second heating area is greater than a first preset temperature, the opening degree of the regulating valve to be turn down to 20-30B, and the switch valve to open.

4. The control method according to any one of claims 1-3, wherein,

further in response to a fast heating instruction, starting, by the controller, a fast heating mode; and
controlling, according to the fast heating mode, the opening degree of the regulating valve to be turned up, and adjusting the switch valve from an open state to a closed state.

5. The control method according to claim 4, wherein the fast heating mode comprises:

acquiring a water temperature at the first heating area and a condensing temperature at the refrigerant outlet of the first condenser; and
controlling, by the controller according to a difference value between the water temperature at the first heating area and the condensing temperature at the refrigerant outlet of the first condenser, the opening degree of the regulating valve and opening and closing of the switch valve.

6. The control method according to claim 5, wherein,

when the difference value between the water temperature at the first heating area and the condensing temperature at the refrigerant outlet of the first condenser is greater than a target heat exchange temperature difference, controlling, by the controller, the regulating valve to turn up the opening degree, and controlling the switch valve to adjust from the open state to the closed state; and
when the difference value between the water temperature at the first heating area and the condensing temperature at the refrigerant outlet of the first condenser is less than or equal to the target heat exchange temperature difference, controlling, by the controller, the regulating valve to turn down the opening degree, and controlling the switch valve to adjust from the open state to the closed state.

7. The control method according to any one of claims 4-6, before controlling, according to the fast heating mode, the opening degree of the regulating valve to be turned up, and adjusting the switch valve from the open state to the closed state, further comprising:
controlling, by the controller, the regulating valve to adjust the opening degree to 200-400B, and maintaining for a preset period.

8. The control method according to any one of claims 1-7, wherein,
further in response to a whole tank heating instruction, starting, by the controller, a whole tank heating mode; and
controlling, according to the whole tank heating mode, the opening degree of the regulating valve to be turned up, and adjusting the switch valve from an open state to a closed state.

9. The control method according to claim 8, wherein the whole tank heating mode comprises:

acquiring a water temperature at the first heating area and a water temperature at the second heating area; and by the controller according to a temperature difference between the water temperature at the first heating area and the water temperature at the second heating area, the opening degree of the regulating valve, and opening and closing of the switch valve.

10. The control method according to claim 9, wherein,
when the temperature difference between the water temperature at the first heating area and the water temperature at the second heating area is less than or equal to a first preset temperature, controlling, by the controller, the

opening degree of the regulating valve to be turned up, and controlling the switch valve to adjust from an open state to a closed state.

11. A controller of a heat pump water heater, configured to implement the method according to any one of claims 1-10.

12. A heat pump water heater, comprising: a water tank, an evaporator, a compressor, a first condenser, a second condenser and a controller according to claim 11; the water tank is divided into a first heating area and a second heating area along a height direction, the first condenser covers an outside of the first heating area, and the second condenser covers an outside of the second heating area; a refrigerant inlet of the first condenser is connected to a refrigerant outlet of the compressor, and a refrigerant outlet of the first condenser is connected to a refrigerant inlet of the second condenser through a first refrigerant branch pipe; the refrigerant inlet of the second condenser is further connected to a refrigerant outlet of the evaporator through a second refrigerant branch pipe, and a refrigerant outlet of the second condenser is connected to a refrigerant inlet of the evaporator; the first refrigerant branch pipe is provided with a regulating valve, the second refrigerant branch pipe is provided with a switch valve, and the controller is communicatively connected to the switch and the regulating valve respectively.

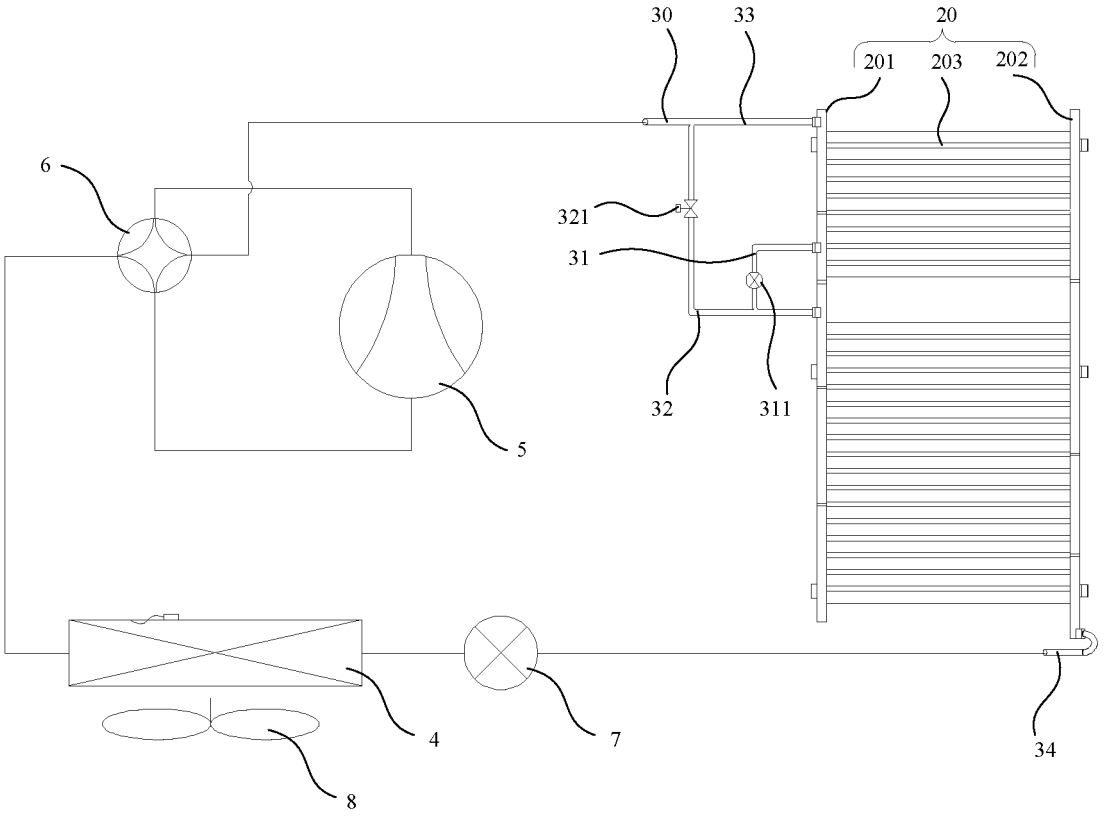

FIG. 1

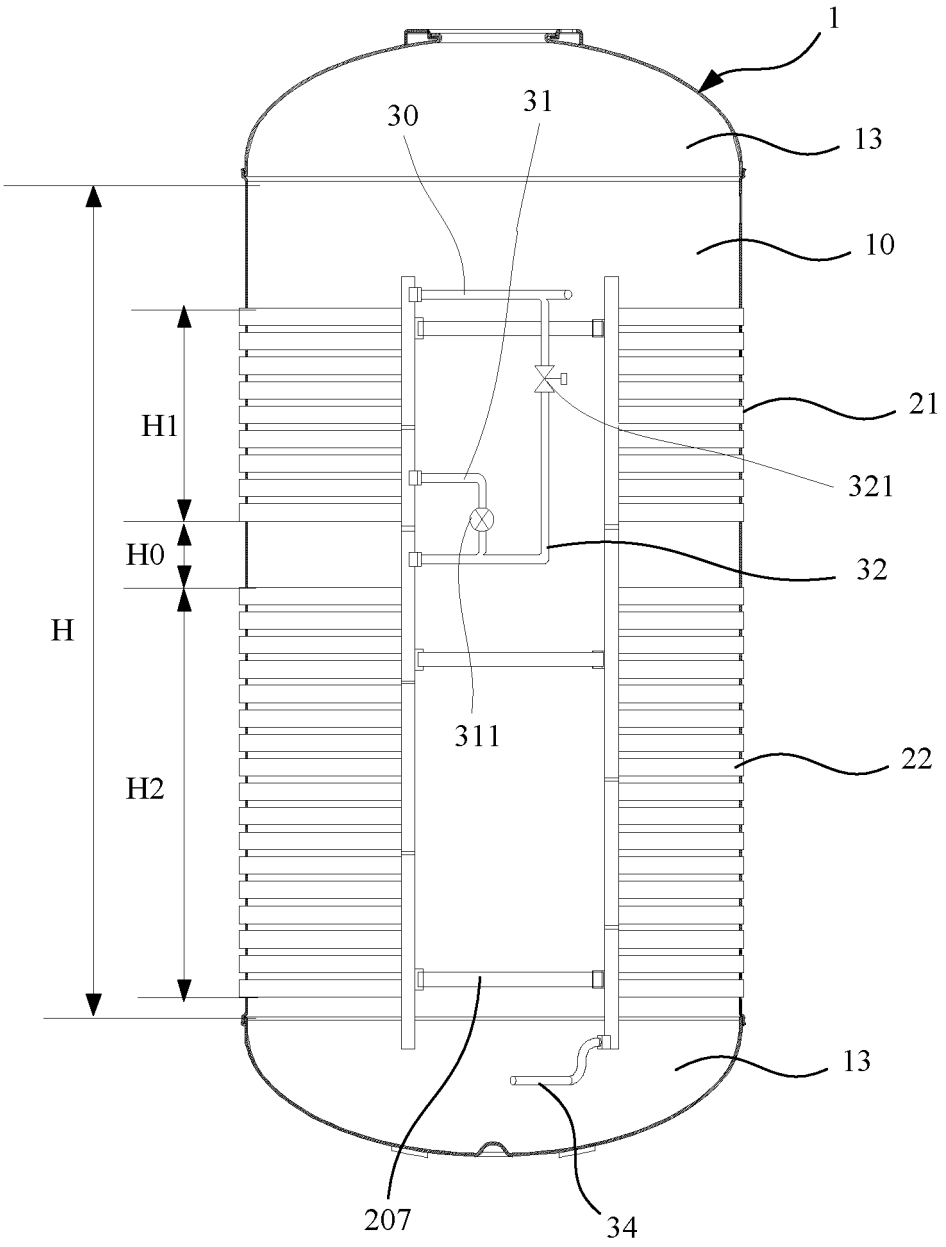

FIG. 2

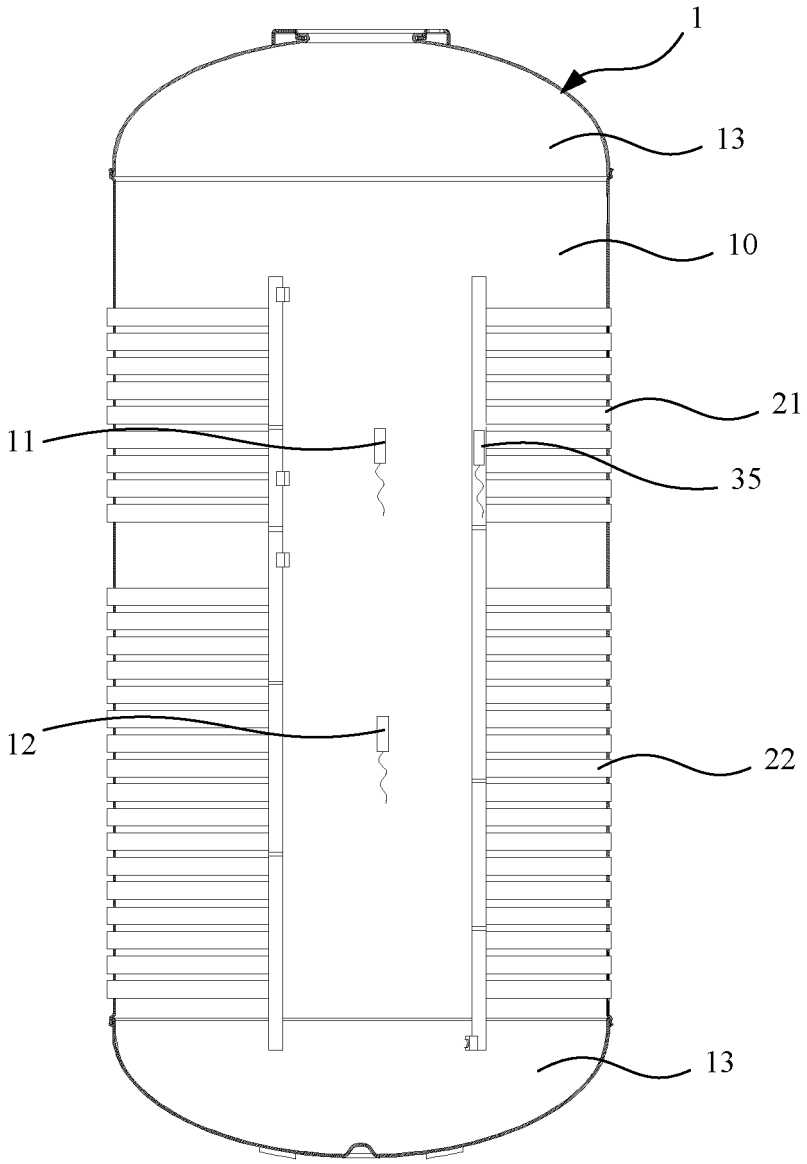

FIG. 3

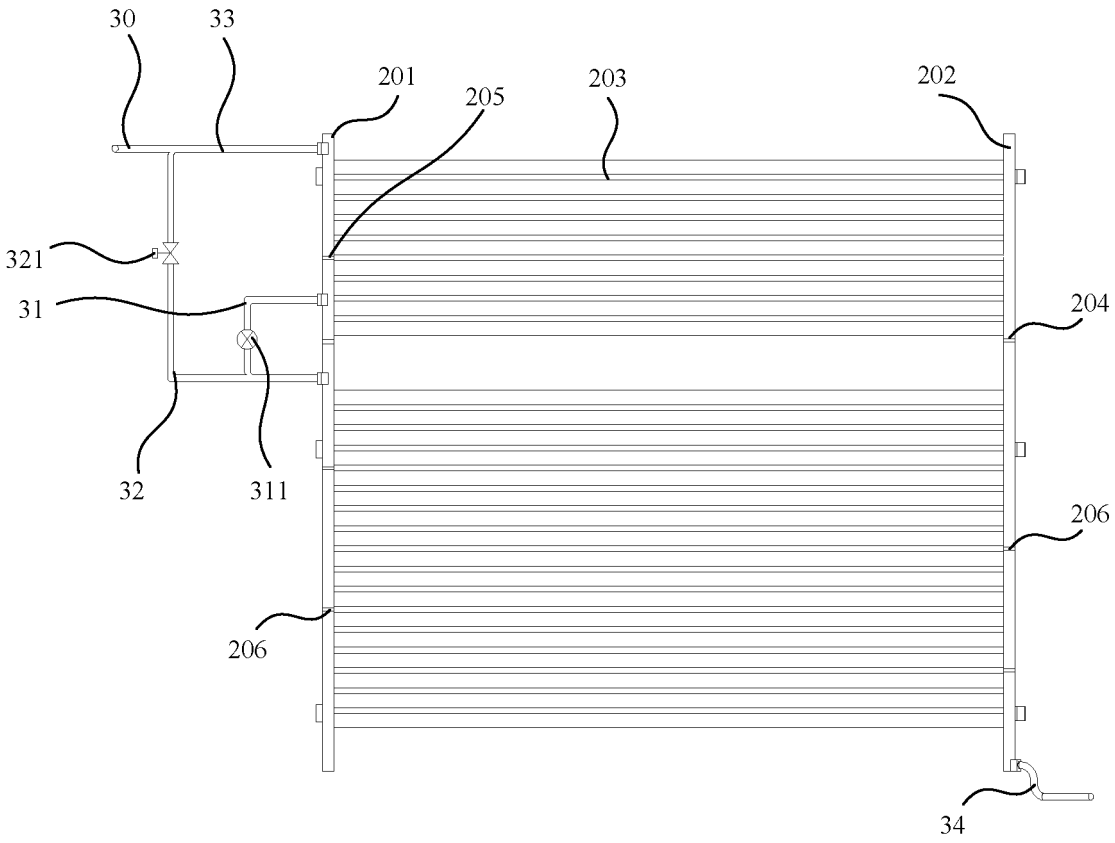

FIG. 4

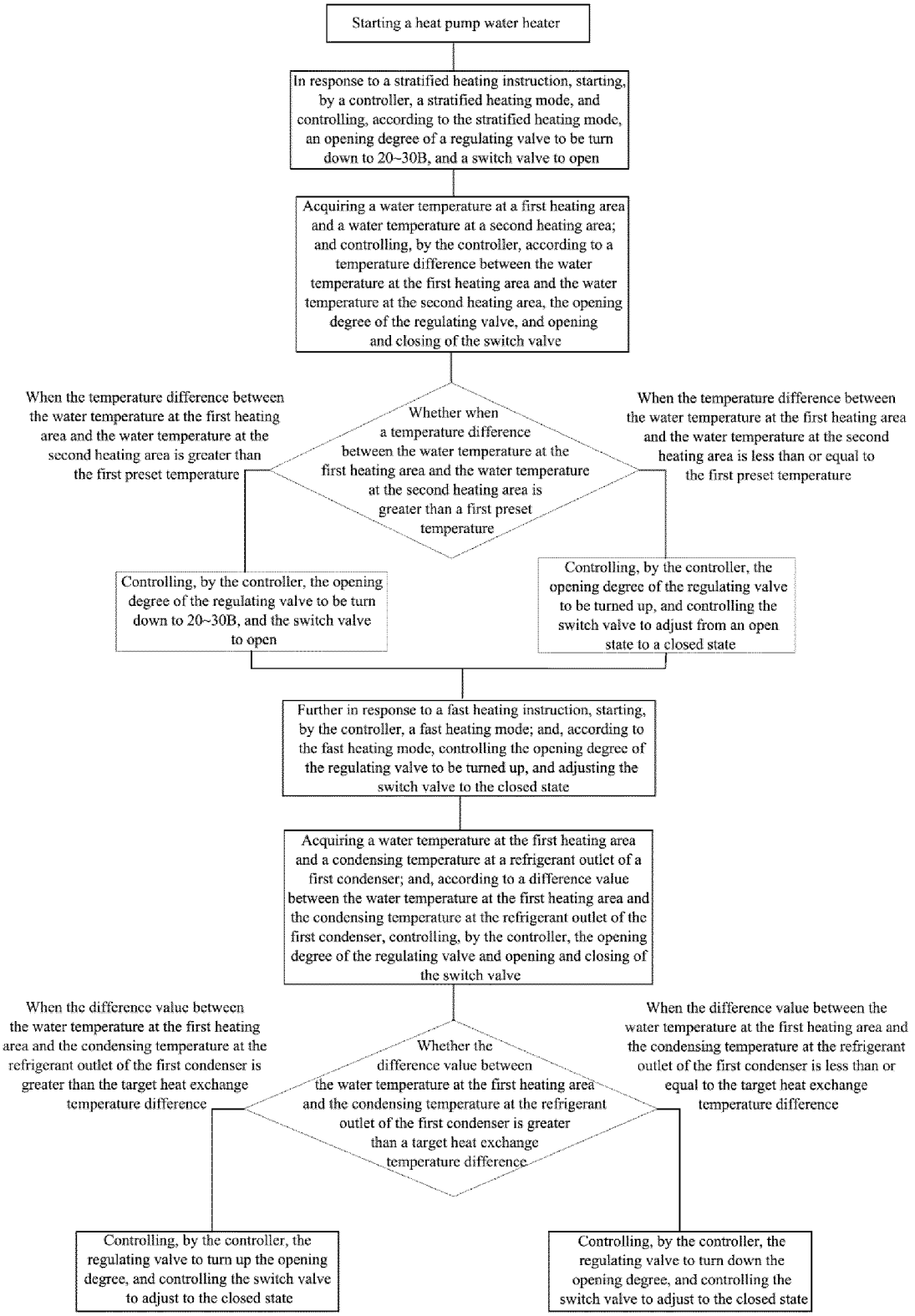
Starting a heat pump water heater
In response to a stratified heating instruction, starting, by a controller, a stratified heating mode, and controlling, according to the stratified heating mode, an opening degree of a regulating valve to be turn down to 20~30B, and a switch valve to open
Acquiring a water temperature at a first heating area and a water temperature at a second heating area; and controlling, by the controller, according to a temperature difference between the water temperature at the first heating area and the water temperature at the second heating area, the opening degree of the regulating valve, and opening and closing of the switch valve
Whether when a temperature difference between the water temperature at the first heating area and the water temperature at the second heating area is greater than a first preset temperature
When the temperature difference between the water temperature at the first heating area and the water temperature at the second heating area is greater than the first preset temperature
When the temperature difference between the water temperature at the first heating area and the water temperature at the second heating area is less than or equal to the first preset temperature
Controlling, by the controller, the opening degree of the regulating valve to be turn down to 20~30B, and the switch valve to open
Controlling, by the controller, the opening degree of the regulating valve to be turned up, and controlling the switch valve to adjust from an open state to a closed state
Further in response to a fast heating instruction, starting, by the controller, a fast heating mode; and, according to the fast heating mode, controlling the opening degree of the regulating valve to be turned up, and adjusting the switch valve to the closed state
Acquiring a water temperature at the first heating area and a condensing temperature at a refrigerant outlet of a first condenser; and, according to a difference value between the water temperature at the first heating area and the condensing temperature at the refrigerant outlet of the first condenser, controlling, by the controller, the opening degree of the regulating valve and opening and closing of the switch valve
Whether the difference value between the water temperature at the first heating area and the condensing temperature at the refrigerant outlet of the first condenser is greater than a target heat exchange temperature difference
When the difference value between the water temperature at the first heating area and the condensing temperature at the refrigerant outlet of the first condenser is greater than the target heat exchange temperature difference
When the difference value between the water temperature at the first heating area and the condensing temperature at the refrigerant outlet of the first condenser is less than or equal to the target heat exchange temperature difference
Controlling, by the controller, the regulating valve to turn up the opening degree, and controlling the switch valve to adjust to the closed state
Controlling, by the controller, the regulating valve to turn down the opening degree, and controlling the switch valve to adjust to the closed state

FIG. 5

INTERNATIONAL SEARCH REPORT

International application No.
PCT/CN2021/107990

A. CLASSIFICATION OF SUBJECT MATTER

F24H 4/02(2006.01)i; F24H 9/20(2006.01)i; F25B 30/02(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)

F24F F25B

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

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

CNABS; CNKI; CNTXT; VEN: 节流, 膨胀, 毛细, 冷凝, 第一, 第二, 两, 子, 热水, 压缩, 热泵, 速热, 即热, 冷凝器, 放热, 制热, 水温, 调节, 阀门开度; heat pump, bypass, line, pipe, branch pipe, throttle, solenoid valve, expansion, valve, heat exchanger, condenser, water temperature, regulat???, adjust???, switch, first, second, heating, valve opening

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	CN 110986436 A (QINGDAO HAIER NEW ENERGY ELECTRIC APPLIANCE CO., LTD. et al.) 10 April 2020 (2020-04-10) description, pages 3-5 and figures 1-6	1-12
Y	CN 105588331 A (HISENSE (SHANDONG) AIR-CONDITIONING CO., LTD.) 18 May 2016 (2016-05-18) description, pages 4-6 and figures 3-7	1-12
PX	CN 112033003 A (QINGDAO HAIER NEW ENERGY ELECTRIC APPLIANCE CO., LTD. et al.) 04 December 2020 (2020-12-04) claims	1-12
Y	CN 106996644 A (GREE ELECTRIC APPLIANCES, INC. OF ZHUHAI) 01 August 2017 (2017-08-01) specific embodiments	1-12
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Date of the actual completion of the international search	Date of mailing of the international search report
15 September 2021	**28 September 2021**
Name and mailing address of the ISA/CN **China National Intellectual Property Administration (ISA/CN)** **No. 6, Xitucheng Road, Jimenqiao, Haidian District, Beijing 100088** **China**	Authorized officer
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Information on patent family members

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