configured to heat water flowing through the water heat exchanger, a compressor control unit configured to control an operating frequency of the compressor a discharge temperature sensor configured to detect a discharge temperature of refrigerant discharged from the compressor, a suction state estimation unit configured to estimate, based on the discharge temperature detected by the discharge temperature sensor, a suction state of the refrigerant to be sucked into the compressor, a circulation rate calculation unit configured to calculate a refrigerant circulation rate of the refrigerant from the estimated suction state, and an operating frequency determination unit configured to determine, based on the calculated refrigerant circulation rate, the operating frequency of the compressor. The compressor control unit sets an operating frequency of the compressor to the operating frequency determined by the operating frequency determination unit upon start of a defrosting operation in which the pressure reducing device is opened, supply of the water to the water heat exchanger is stopped, and the refrigerant discharged from the compressor is caused to flow into the air heat exchanger, thereby reducing flow speed of the refrigerant flowing into the pressure reducing device to less than present flow speed.

A hot water supply apparatus according to another embodiment of the present disclosure includes a heat pump unit that includes a compressor, a water heat exchanger, a pressure reducing device, and an air heat exchanger and that is configured to heat water flowing through the water heat exchanger, a refrigerant density estimation unit configured to estimate, based on a discharge temperature of refrigerant discharged from the compressor and a high-pressure-side pressure, a refrigerant density at an inlet of the pressure reducing device, a refrigerant density determination unit configured to compare the estimated refrigerant density with a set threshold, and a pressure reducing device control unit configured to control an opening degree of the pressure reducing device. Upon start of a defrosting operation in which the pressure reducing device is opened, supply of the water to the water heat exchanger is stopped, and the refrigerant discharged from the compressor is caused to flow into the air heat exchanger, in a case where the estimated refrigerant density is less than the set threshold, the pressure reducing device control unit reduces the opening degree of the

pressure reducing device to less than a present opening degree, thereby reducing flow speed of the refrigerant flowing into the pressure reducing device to less than present flow speed.

A hot water supply apparatus according to still another embodiment of the present disclosure includes a heat pump unit that includes a compressor, a water heat exchanger, a pressure reducing device, and an air heat exchanger and that is configured to heat water flowing through the water heat exchanger, a tank unit that includes a hot water storage tank that has a heated water inlet through which heated water heated by the water heat exchanger flows into the tank, an unheated water outlet through which unheated water flows out of the tank, and a medium temperature water outlet through which medium temperature water that has a medium temperature between a temperature of the heated water and that of the unheated water flows out of the tank, and a flow switching valve that has a first inlet port connected to the unheated water outlet, a second inlet port connected to the medium temperature water outlet, and an outlet port connected to an inlet side of the water heat exchanger and that is configured to switch between passages such that either one of the first inlet port and the second inlet port is in communication with the outlet port; and a switching valve control unit configured to cause, upon start of a defrosting operation in which the pressure reducing device is opened and refrigerant discharged from the compressor is caused to flow into the air heat exchanger, the flow switching valve to switch between the passages such that the second inlet port is in communication with the outlet port, a compressor control unit configured to control an operating frequency of the compressor, and a pressure reducing device control unit configured to control an opening degree of the pressure reducing device. Upon start of the defrosting operation, at least one of the operating frequency of the compressor and the opening degree of the pressure reducing device is controlled by the compressor control unit or the pressure reducing device control unit, thereby reducing flow speed of the refrigerant flowing into the pressure reducing device to less than present flow speed.

Advantageous Effects of Invention

[0016]

According to the embodiment of the present disclosure, upon start of the defrosting operation, the operating frequency of the compressor or the opening degree of the pressure reducing device is controlled, thereby reducing the flow speed of the refrigerant flowing into the pressure reducing device. This can suppress an increase in refrigerant passing sound upon start of the defrosting operation.

Brief Description of Drawings

[0017]

[Fig. 1] Fig. 1 is a schematic diagram of an exemplary configuration of a hot water supply apparatus according to Embodiment 1.

[Fig. 2] Fig. 2 is a block diagram of an exemplary configuration of a controller in Fig. 1.

[Fig. 3] Fig. 3 is a graph showing an example of a refrigeration cycle upon start of a defrosting operation.

[Fig. 4] Fig. 4 is a schematic diagram of an exemplary configuration of a hot water supply apparatus according to Embodiment 2.

[Fig. 5] Fig. 5 is a block diagram of an exemplary configuration of a controller in Fig. 4.

CLAIMS

[Claim 1]

A hot water supply apparatus comprising:

a heat pump unit including a compressor, a water heat exchanger, a pressure reducing device, and an air heat exchanger, the heat pump unit being configured to heat water flowing through the water heat exchanger;

a compressor control unit configured to control an operating frequency of the compressor;

a discharge temperature sensor configured to detect a discharge temperature of refrigerant discharged from the compressor;

a suction state estimation unit configured to estimate, based on the discharge temperature detected by the discharge temperature sensor, a suction state of the refrigerant to be sucked into the compressor;

a circulation rate calculation unit configured to calculate a refrigerant circulation rate of the refrigerant from the estimated suction state; and

an operating frequency determination unit configured to determine, based on the calculated refrigerant circulation rate, the operating frequency of the compressor,

wherein the compressor control unit sets an operating frequency of the compressor to the operating frequency determined by the operating frequency determination unit upon start of a defrosting operation in which the pressure reducing device is opened, supply of the water to the water heat exchanger is stopped, and the refrigerant discharged from the compressor is caused to flow into the air heat exchanger, thereby reducing flow speed of the refrigerant flowing into the pressure reducing device to less than present flow speed.

[Claim 2]

The hot water supply apparatus of claim 1, further comprising:

a high-pressure-side pressure sensor configured to detect a high-pressure-side pressure,

wherein the suction state estimation unit estimates the suction state based on the high-pressure-side pressure detected by the high-pressure-side pressure sensor and the discharge temperature detected by the discharge temperature sensor.

[Claim 3]

A hot water supply apparatus comprising:

a heat pump unit including a compressor, a water heat exchanger, a pressure reducing device, and an air heat exchanger, the heat pump unit being configured to heat water flowing through the water heat exchanger;

a refrigerant density estimation unit configured to estimate, based on a discharge temperature of refrigerant discharged from the compressor and a high-pressure-side pressure, a refrigerant density at an inlet of the pressure reducing device;

a refrigerant density determination unit configured to compare the estimated refrigerant density with a set threshold; and

a pressure reducing device control unit configured to control an opening degree of the pressure reducing device,

wherein, upon start of a defrosting operation in which the pressure reducing device is opened, supply of the water to the water heat exchanger is stopped, and the refrigerant discharged from the compressor is caused to flow into the air heat exchanger, in a case where the estimated refrigerant density is less than the set threshold, the pressure reducing device control unit reduces the opening degree of the pressure reducing device to less than a present opening degree, thereby reducing flow speed of the refrigerant flowing into the pressure reducing device to less than present flow speed.

[Claim 4]

A hot water supply apparatus comprising:

a heat pump unit including a compressor, a water heat exchanger, a pressure reducing device, and an air heat exchanger, the heat pump unit being configured to heat water flowing through the water heat exchanger;

a tank unit including

a hot water storage tank having a heated water inlet through which heated water heated by the water heat exchanger flows into the tank, an unheated water outlet through which unheated water flows out of the tank, and a medium temperature water outlet through which medium temperature water having a medium temperature between a temperature of the heated water and that of the unheated water flows out of the tank, and

a flow switching valve having a first inlet port connected to the unheated water outlet, a second inlet port connected to the medium temperature water outlet, and an outlet port connected to an inlet side of the water heat exchanger, the flow switching valve being configured to switch between passages such that either one of the first inlet port and the second inlet port is in communication with the outlet port; and

a switching valve control unit configured to cause, upon start of a defrosting operation in which the pressure reducing device is opened and refrigerant discharged from the compressor is caused to flow into the air heat exchanger, the flow switching valve to switch between the passages such that the second inlet port is in communication with the outlet port;

a compressor control unit configured to control an operating frequency of the compressor; and

a pressure reducing device control unit configured to control an opening degree of the pressure reducing device,

wherein, upon start of the defrosting operation, at least one of the operating frequency of the compressor and the opening degree of the pressure reducing device is controlled by the compressor control unit or the pressure reducing device control unit, thereby reducing flow speed of the refrigerant flowing into the pressure reducing device to less than present flow speed.

[Claim 5]

The hot water supply apparatus of claim 4, wherein

the heated water inlet is located in upper part of the hot water storage tank,

the unheated water outlet is located in lower part of the hot water storage tank, and

the medium temperature water outlet is located in middle part of the hot water storage tank.

[Claim 6]

The hot water supply apparatus of any one of claims 1 to 5, wherein the compressor, the water heat exchanger, the pressure reducing device, and the air heat exchanger are connected in circuit by refrigerant pipes to form a refrigerant circuit.