exchanger may not satisfactorily deliver the performance of an evaporator.

[0012] Embodiments of the present invention seek to provide a heat exchanger capable of securing the performance of an evaporator.

SOLUTION TO PROBLEM

[0013] A heat exchanger according to an aspect of the present invention has a plurality of heat transfer tubes for heat exchange between refrigerant flowing inside the plurality of heat transfer tubes and air flowing outside the plurality of heat transfer tubes. The heat exchanger includes an auxiliary heat exchange unit and a main heat exchange unit. The auxiliary heat exchange unit has a first auxiliary heat exchange region and a second auxiliary heat exchange region. The second auxiliary heat exchange region faces the first auxiliary heat exchange region in a flow direction in which the air flows. The main heat exchange unit has a first main heat exchange region, a second main heat exchange region, a third main heat exchange region, and a fourth main heat exchange region. The second main heat exchange region faces the first main heat exchange region in the flow direction. The third main heat exchange region is disposed opposite to the first auxiliary heat exchange region across the first main heat exchange region. The fourth main heat exchange region faces the third main heat exchange region in the flow direction and is disposed opposite to the second auxiliary heat exchange region across the second main heat exchange region. The plurality of heat transfer tubes of each of the first auxiliary heat exchange region and the second auxiliary heat exchange region are fewer than the plurality of heat transfer tubes of each of the first main heat exchange region, the second main heat exchange region, the third main heat exchange region, and the fourth main heat exchange region. The first auxiliary heat exchange region, the first main heat exchange region, and the third main heat exchange region are disposed windward of the second auxiliary heat exchange region, the second main heat exchange region, and the fourth main heat exchange region, respectively, in the flow direction. The auxiliary heat exchange unit and the main heat exchange unit are configured to cause the refrigerant to flow successively through the first auxiliary heat

exchange region, the second auxiliary heat exchange region, the first main heat exchange region, the second main heat exchange region, the fourth main heat exchange region, and the third main heat exchange region when the heat exchanger functions as an evaporator. The main heat exchange unit also has a fifth main heat exchange region and a sixth main heat exchange region. The fifth main heat exchange region is disposed between the first main heat exchange region and the third main heat exchange region. The sixth main heat exchange region is disposed between the second main heat exchange region and the fourth main heat exchange region. The main heat exchange unit is configured to cause the refrigerant to flow successively through the first main heat exchange region, the second main heat exchange region, the fifth main heat exchange region, the sixth main heat exchange region, the fourth main heat exchange region, and the third main heat exchange region when the heat exchanger functions as the evaporator.

[0013a] A heat exchanger according to another aspect of the present invention has a plurality of heat transfer tubes for heat exchange between refrigerant flowing inside the plurality of heat transfer tubes and air flowing outside the plurality of heat transfer tubes. The heat exchanger includes an auxiliary heat exchange unit and a main heat exchange unit. The auxiliary heat exchange unit has a first auxiliary heat exchange region and a second auxiliary heat exchange region. The second auxiliary heat exchange region faces the first auxiliary heat exchange region in a flow direction in which the air flows. The main heat exchange unit has a first main heat exchange region, a second main heat exchange region, a third main heat exchange region, and a fourth main heat exchange region. The second main heat exchange region faces the first main heat exchange region in the flow direction. The third main heat exchange region is disposed opposite to the first auxiliary heat exchange region across the first main heat exchange region. The fourth main heat exchange region faces the third main heat exchange region in the flow direction and disposed opposite to the second auxiliary heat exchange region across the second main heat exchange region. The plurality of heat transfer tubes of each of the first auxiliary heat exchange region and the second auxiliary heat exchange region are fewer than the plurality of heat transfer tubes of each of the first main heat exchange region, the second main heat exchange region, the third main heat exchange region, and the fourth main heat exchange region. The first auxiliary heat exchange region, the first main heat exchange region, and the third main heat exchange region are disposed windward of the second auxiliary heat exchange region, the second main heat exchange region, and the fourth main heat exchange region, respectively, in the flow direction. The auxiliary heat exchange unit and the main heat exchange unit are configured to cause the

refrigerant to flow successively through the first auxiliary heat exchange region, the second auxiliary heat exchange region, the first main heat exchange region, the second main heat exchange region, the fourth main heat exchange region, and the third main heat exchange region when the heat exchanger functions as an evaporator. The auxiliary heat exchange unit has a third auxiliary heat exchange region and a fourth auxiliary heat exchange region. The third auxiliary heat exchange region is disposed between the first auxiliary heat exchange region and the first main heat exchange region. The fourth auxiliary heat exchange region is disposed between the second auxiliary heat exchange region and the second main heat exchange region. The auxiliary heat exchange unit is configured to cause the refrigerant to flow successively through the first auxiliary heat exchange region, the second auxiliary heat exchange region, the third auxiliary heat exchange region, and the fourth auxiliary heat exchange region when the heat exchanger functions as the evaporator.

ADVANTAGEOUS EFFECTS OF INVENTION

[0014] In the heat exchanger according to embodiments of the present invention, the auxiliary heat exchange unit and the main heat exchange unit are configured to cause refrigerant to flow successively through the first auxiliary heat exchange region, the second auxiliary heat exchange region, the first main heat exchange region, the second main heat exchange region, the fourth main heat exchange region, and the third main heat exchange region when the heat exchanger functions as an evaporator. This may allow refrigerant in the gas-liquid two-phase state and air to flow parallel to each other in the first main heat exchange region and the second main heat exchange region, allowing refrigerant in the gas single-phase state and air to flow opposite to each other in the fourth main heat exchange region and the third main heat exchange region. Consequently, a temperature difference between refrigerant and air can be secured in the first main heat exchange region and the second main heat exchange region and also in the fourth main heat exchange region and the third main heat exchange region, thus securing the performance of the evaporator of the heat exchanger.

BRIEF DESCRIPTION OF DRAWINGS

[0015] Fig. 1 shows an example refrigerant circuit of an air conditioning apparatus according to Embodiment 1.

Fig. 2 shows a flow of refrigerant in the refrigerant circuit for illustrating an operation of the air conditioning apparatus according to Embodiment 1.

Fig. 3 is a perspective view showing an outline of a heat exchanger according to Embodiment 1.

Fig. 4 is a schematic view showing an outline of the heat exchanger according to Embodiment 1.

Fig. 5 is a temperature distribution chart schematically showing changes in

CLAIMS

1. A heat exchanger having a plurality of heat transfer tubes for heat exchange between refrigerant flowing inside the plurality of heat transfer tubes and air flowing outside the plurality of heat transfer tubes, the heat exchanger comprising:

an auxiliary heat exchange unit having

a first auxiliary heat exchange region, and

a second auxiliary heat exchange region facing the first auxiliary heat exchange region in a flow direction in which the air flows; and

a main heat exchange unit having

a first main heat exchange region,

a second main heat exchange region facing the first main heat exchange region in the flow direction,

a third main heat exchange region disposed opposite to the first auxiliary heat exchange region across the first main heat exchange region, and

a fourth main heat exchange region facing the third main heat exchange region in the flow direction and disposed opposite to the second auxiliary heat exchange region across the second main heat exchange region, wherein

the plurality of heat transfer tubes of each of the first auxiliary heat exchange region and the second auxiliary heat exchange region are fewer than the plurality of heat transfer tubes of each of the first main heat exchange region, the second main heat exchange region, the third main heat exchange region, and the fourth main heat exchange region,

the first auxiliary heat exchange region, the first main heat exchange region, and the third main heat exchange region are disposed windward of the second auxiliary heat exchange region, the second main heat exchange region, and the fourth main heat exchange region, respectively, in the flow direction,

the auxiliary heat exchange unit and the main heat exchange unit are configured to cause the refrigerant to flow successively through the first auxiliary heat exchange

region, the second auxiliary heat exchange region, the first main heat exchange region, the second main heat exchange region, the fourth main heat exchange region, and the third main heat exchange region when the heat exchanger functions as an evaporator,

the main heat exchange unit has

a fifth main heat exchange region disposed between the first main heat exchange region and the third main heat exchange region, and

a sixth main heat exchange region disposed between the second main heat exchange region and the fourth main heat exchange region, and

the main heat exchange unit is configured to cause the refrigerant to flow successively through the first main heat exchange region, the second main heat exchange region, the fifth main heat exchange region, the sixth main heat exchange region, the fourth main heat exchange region, and the third main heat exchange region when the heat exchanger functions as the evaporator.

2. A heat exchanger having a plurality of heat transfer tubes for heat exchange between refrigerant flowing inside the plurality of heat transfer tubes and air flowing outside the plurality of heat transfer tubes, the heat exchanger comprising:

an auxiliary heat exchange unit having

a first auxiliary heat exchange region, and

a second auxiliary heat exchange region facing the first auxiliary heat exchange region in a flow direction in which the air flows; and

a main heat exchange unit having

a first main heat exchange region,

a second main heat exchange region facing the first main heat exchange region in the flow direction,

a third main heat exchange region disposed opposite to the first auxiliary heat exchange region across the first main heat exchange region, and

a fourth main heat exchange region facing the third main heat exchange region in the flow direction and disposed opposite to the second auxiliary heat

exchange region across the second main heat exchange region, wherein

the plurality of heat transfer tubes of each of the first auxiliary heat exchange region and the second auxiliary heat exchange region are fewer than the plurality of heat transfer tubes of each of the first main heat exchange region, the second main heat exchange region, the third main heat exchange region, and the fourth main heat exchange region,

the first auxiliary heat exchange region, the first main heat exchange region, and the third main heat exchange region are disposed windward of the second auxiliary heat exchange region, the second main heat exchange region, and the fourth main heat exchange region, respectively, in the flow direction,

the auxiliary heat exchange unit and the main heat exchange unit are configured to cause the refrigerant to flow successively through the first auxiliary heat exchange region, the second auxiliary heat exchange region, the first main heat exchange region, the second main heat exchange region, the fourth main heat exchange region, and the third main heat exchange region when the heat exchanger functions as an evaporator,

the auxiliary heat exchange unit has

a third auxiliary heat exchange region disposed between the first auxiliary heat exchange region and the first main heat exchange region, and

a fourth auxiliary heat exchange region disposed between the second auxiliary heat exchange region and the second main heat exchange region, and

the auxiliary heat exchange unit is configured to cause the refrigerant to flow successively through the first auxiliary heat exchange region, the second auxiliary heat exchange region, the third auxiliary heat exchange region, and the fourth auxiliary heat exchange region when the heat exchanger functions as the evaporator.

3. The heat exchanger according to claim 2, wherein

the auxiliary heat exchange unit has

a fifth auxiliary heat exchange region disposed between the third auxiliary heat exchange region and the first auxiliary heat exchange region, and

a sixth auxiliary heat exchange region disposed between the fourth auxiliary heat exchange region and the second auxiliary heat exchange region, and

the auxiliary heat exchange unit is configured to cause the refrigerant to flow successively through the first auxiliary heat exchange region, the second auxiliary heat exchange region, the fifth auxiliary heat exchange region, the sixth auxiliary heat exchange region, the third auxiliary heat exchange region, and the fourth auxiliary heat exchange region when the heat exchanger functions as the evaporator.

4. The heat exchanger according to any one of claims 1 to 3, wherein the plurality of heat transfer tubes are disposed to extend horizontally.

5. The heat exchanger according to any one of claims 1 to 3, wherein the plurality of heat transfer tubes are disposed to extend vertically.

6. The heat exchanger according to any one of claims 1 to 5, wherein in the main heat exchange unit and the auxiliary heat exchange unit, the first auxiliary heat exchange region serves as an inlet of the refrigerant, and the third main heat exchange region serves as an outlet of the refrigerant.

7. A refrigeration cycle apparatus comprising:

a heat exchanger according to any one of claims 1 to 6;

a compressor for compressing the refrigerant that flows into the heat exchanger; and

a blower for causing the air to flow to the heat exchanger.