Embodiments of the present invention prevent condensation from being generated in a rotor in an indoor fan when a multi-split air conditioning apparatus performs a low-capacity cooling operation.

<Solution to Problem>

A multi-split air conditioning apparatus according to an aspect of the present invention includes an outdoor unit including a compressor configured to compress refrigerant that circulates and executes a refrigeration cycle; and a plurality of indoor units including: a plurality of indoor heat exchangers through which refrigerant discharged from the compressor circulates; a plurality of pressure reducing mechanisms through which refrigerant discharged from the compressor circulates; and a plurality of indoor fans through which passes air that passes through the plurality of indoor heat exchangers, in which at least one indoor unit among the plurality of indoor units is configured to, when an indoor temperature is higher than a set temperature during a low-capacity cooling operation which increases an superheat region more than during a normal cooling operation, increase an opening degree of the pressure reducing mechanism, to thereby narrow the superheat region of the indoor heat exchanger so as to expand a wet region of the indoor heat exchanger and increase flow rate of the indoor fan, so as to restrict expansion of the wet region to an upper limit at which condensation in the apparatus is not generated at a downstream of the indoor heat exchanger, and wherein the at least one indoor unit is configured to perform cooling with mixed air that has passed through the wet region and the superheat region during the low-capacity cooling operation.

According to the above aspect of the multi-split air conditioning apparatus, although cooling capacity is increased by expanding the wet region of the indoor heat exchanger by increasing the opening degree of the pressure reducing mechanism, the temperature of mixed air, which is a mix of air that passes through the superheat region of the indoor heat exchanger and air that passes through the wet region, increases when the wet region expands. Therefore, in order that condensation in the apparatus is not generated due to the temperature of the mixed air falls too far below the dew point temperature of the mixed air, necessary cooling capacity can be guaranteed by controlling the opening degree of the pressure reducing mechanism such that the opening degree does not exceed an upper limit at which condensation occurs in the apparatus downstream of the indoor heat exchanger so as to reduce an increase in size of the wet region. Further improvement of cooling capacity can be ensured by increasing the flow rate of the indoor fan and necessary cooling capacity can

be guaranteed. As a result, when the multi-split air conditioning apparatus performs the low-capacity cooling operation, condensation in the apparatus downstream of the indoor heat exchanger can be reduced while ensuring necessary cooling capacity.

In an embodiment, at least one indoor unit is configured to, when the indoor temperature is lower than the set temperature during the low-capacity cooling operation, decrease cooling capacity decreased by reducing the opening degree of the pressure reducing mechanism and/or reducing the flow rate of the indoor fan.

According to the above embodiment, if the room temperature during the low-capacity cooling operation while cooling is lower than the set temperature, cooling capacity is reduced by reducing the opening degree of the pressure reducing mechanism is reduced and/or lowering the flow rate of the indoor fan. As a result, the wet region is narrowed from the state in which expansion of the wet region is restricted to the upper limit at which condensation in the apparatus downstream of the indoor heat exchanger is not generated and/or flow rate is reduced.

In another embodiment, at least one indoor unit is configured to determine that expansion of the wet region is restricted to an upper limit at which condensation in the apparatus is not generated at a downstream of the indoor heat exchanger using a temperature of the mixed air or a humidity of the mixed air.

According to the above embodiment, a temperature of the mixed air or a humidity of the mixed air can be used to easily determine whether or not expansion of the wet region is restricted to the upper limit at which condensation in the apparatus downstream of the indoor heat exchanger is not generated.

In another embodiment, at least one indoor unit further comprises an indoor heat exchanger temperature sensor provided to the indoor heat exchanger, and in which the at least one indoor unit is configured to determine that expansion of the wet region is restricted to the upper limit at which condensation in the apparatus downstream of the indoor heat exchanger is not generated using detection results of the indoor heat exchanger temperature sensor during the low-capacity cooling operation.

According to the above embodiment, detection results of the indoor heat exchanger temperature sensor can be used to easily determine whether or not expansion of the wet region is restricted to the upper limit at which condensation in the apparatus downstream of the indoor heat exchanger is not generated.

In another embodiment, at least one indoor unit switches from a low-capacity cooling operation mode to a normal cooling operation mode to obtain necessary cooling

capacity when expansion of the wet region cannot be restricted to the upper limit at which condensation in the apparatus is not generated at a downstream of the indoor heat exchanger by increasing the flow rate of the indoor fan.

According to the above embodiment, by switching from the low-capacity cooling operation mode to the normal cooling operation mode, all of the indoor heat exchanger can be made a wet region. As a result, air that passes through the superheat region of the indoor heat exchanger can be eliminated.

<Advantageous Effects of Invention>

With the multi-split air conditioning apparatus according to embodiments of the present invention, condensation in the apparatus downstream of the internal heat exchanger can be reduced when the multi-split air conditioning apparatus performs a low-capacity cooling operation.

With the multi-split air conditioning apparatus according to embodiments of the present invention, cooling capacity can be reduced while maintaining a state in which condensation in the apparatus downstream of the internal heat exchanger is not generated.

With the multi-split air conditioning apparatus according to embodiments of the present invention, condensation within the apparatus can be more reliably reduced downstream of the internal heat exchanger.

With the multi-split air conditioning apparatus according to embodiments of the present invention, condensation in the apparatus downstream of the internal heat exchanger can be reduced while ensuring required cooling capacity.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a circuit diagram for illustrating a schematic configuration of a multi-split air conditioning apparatus according to an embodiment of the present invention.

FIG. 2 is a cross-sectional diagram for illustrating an exemplary configuration of an indoor unit in the multi-split air conditioning apparatus in FIG. 1.

FIG. 3 is a perspective diagram for illustrating the configuration around an indoor heat exchanger when a front panel or another component of the indoor unit in FIG. 2 has been removed.

FIG. 4 is a conceptual diagram of the indoor heat exchanger for explaining a normal

CLAIMS

1. A multi-split air conditioning apparatus comprising:

an outdoor unit (20) including a compressor (21) configured to compress refrigerant that circulates and executes a refrigeration cycle; and

a plurality of indoor units (40, 50, 60) including:

a plurality of indoor heat exchangers (42, 52, 62) through which refrigerant discharged from the compressor circulates;

a plurality of pressure reducing mechanisms (41, 51, 61, 41a, 51a, 61a) through which refrigerant discharged from the compressor circulates; and

a plurality of indoor fans (43, 53, 63) through which passes air that passes through the plurality of indoor heat exchangers,

wherein at least one indoor unit among the plurality of indoor units is configured to, when an indoor temperature is higher than a set temperature during a low-capacity cooling operation which increases an superheat region more than during a normal cooling operation, increase an opening degree of the pressure reducing mechanism, to thereby narrow the superheat region of the indoor heat exchanger so as to expand a wet region of the indoor heat exchanger and is configured to increase flow rate of the indoor fan so as to restrict expansion of the wet region to an upper limit at which condensation in the apparatus is not generated at a downstream of the indoor heat exchanger, and

wherein the at least one indoor unit is configured to perform cooling with mixed air that has passed through the wet region and the superheat region during the low-capacity cooling operation.

2. The multi-split air conditioning apparatus according to claim 1, wherein

the at least one indoor unit is configured to, when the indoor temperature is lower than the set temperature during the low-capacity cooling operation, decrease cooling capacity by reducing the opening degree of the pressure reducing mechanism and/or reducing the flow rate of the indoor fan.

3. The multi-split air conditioning apparatus according to claim 1 or 2, wherein

the at least one indoor unit is configured to determine that expansion of the wet region is restricted to an upper limit at which condensation in the apparatus is not generated at a downstream of the indoor heat exchanger using a temperature of the mixed air or a humidity of the mixed air.

4. The multi-split air conditioning apparatus according to any one of claims 1 to 3, wherein

the at least one indoor unit further includes an indoor heat exchanger temperature sensor (455) provided to the indoor heat exchanger,

and wherein the at least one indoor unit is configured to determine that expansion of the wet region is restricted to the upper limit at which condensation in the apparatus downstream of the indoor heat exchanger is not generated using detection results of the indoor heat exchanger temperature sensor during the low-capacity cooling operation.

5. The multi-split air conditioning apparatus according to any one of claims 1 to 4, wherein

the at least one indoor unit switches from a low-capacity cooling operation mode to a normal cooling operation mode to obtain necessary cooling capacity when expansion of the wet region cannot be restricted to the upper limit at which condensation in the apparatus is not generated at the downstream of the indoor heat exchanger by increasing the flow rate of the indoor fan.