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TITLE OF THE INVENTION

MULTIPLE-TYPE AIR CONDITIONER ✓

FIELD OF THE INVENTION AND RELATED ART STATEMENT

5 The present invention relates to a multiple-type air conditioner in which a plurality of indoor units are connected to one refrigerant system.

FIG. 2 shows an example of a conventional multiple-type air conditioner.

10 In FIG. 2, reference numerals 1a and 1b denote outdoor units, and 2a, 2b, and 2c denote indoor units.

The outdoor unit 1a and the indoor unit 2a are connected to each other via a refrigerant liquid pipe 9a and a refrigerant gas pipe 6a.

15 The gas refrigerant discharged from a fixed-volume type compressor 3a, which is mounted in the outdoor unit 1a and rotates at a constant speed, is condensed and liquefied in an outdoor heat exchanger 5a by heat dissipation to the outside air supplied by an outdoor fan 15a.

20 This liquid refrigerant is adiabatically expanded by being contracted by a flow rate controlling capillary tube 10a, and then goes into the indoor unit 2a through the refrigerant liquid pipe 9a. In the indoor unit 2a, the liquid refrigerant is evaporated and gasified in an indoor
25 heat exchanger 12a by cooling the indoor air supplied by an

indoor fan 14a.

This gas refrigerant returns to the outdoor unit 1a through the refrigerant gas pipe 6a, and is sucked into the fixed-volume type compressor 3a through an accumulator 8a.

5 Part of the liquid refrigerant flowing out of the flow rate controlling capillary tube 10a is sprayed into the compressor 3a through a liquid injection capillary tube 4a to prevent the temperature of the compressor 3a from rising abnormally.

10 The two indoor units 2b and 2c are connected in parallel to the outdoor unit 1b via refrigerant liquid pipes 9b and 9c and refrigerant gas pipes 6b and 6c, respectively.

15 The gas refrigerant discharged from a fixed-volume type compressor 3b, which is mounted in the outdoor unit 1b and rotates at a constant speed, is condensed and liquefied in an outdoor heat exchanger 5b by heat dissipation to the outside air supplied by an outdoor fan 15b. Then, the liquefied refrigerant branches off and is adiabatically expanded by being contracted by a flow rate controlling capillary tubes
20 10b and 10c installed in the refrigerant liquid pipes 9b and 9c.

25 This refrigerant goes into the indoor units 2b and 2c through solenoid valves 13b and 13c, respectively. In the indoor unit 2b, 2c, the refrigerant is evaporated and gasified in an indoor heat exchanger 12b, 12c by cooling the

indoor air supplied by an indoor fan 14b, 14c.

The gas refrigerant returns to the outdoor unit 1b through the refrigerant gas pipe 6b, 6c, and is sucked into the compressor 3b through an accumulator 8b.

5 When either one of the indoor units 2b and 2c, for example, the indoor unit 2b is operated, and the other indoor unit 2c is stopped, the solenoid valve 13b is opened and the solenoid valve 13c is closed. Also, a volume controlling solenoid valve 7b is opened.

10 Thus, part of the gas refrigerant discharged from the compressor 3b flows to the suction side of the compressor 3b through a capillary tube 11b, solenoid valve 7b, and check valve 16b, and the remaining gas refrigerant is supplied to the indoor unit 2b through the outdoor heat exchanger 5b,
15 flow rate controlling capillary tube 1b, solenoid valve 13b, and refrigerant liquid pipe 9b.

 In such a conventional multiple-type air conditioner, since the capillary tubes 10a, 10b, and 10c are used to control the flow rate of refrigerant supplied to the indoor
20 units 2a, 2b, and 2c, the range of flow rate control is narrow. Therefore, the outdoor unit 1a has one-to-one correspondence to the indoor unit 2a, or the outdoor unit 1b corresponding to the two indoor units 2b and 2c is provided with the volume controlling solenoid valve 7b, capillary tube
25 11b, and check valve 16b in order to control the volume of

the compressor 3b, which poses a problem of complicated construction and increased cost.

OBJECT AND SUMMARY OF THE INVENTION

5 The present invention was made to solve the above problem, and accordingly an object thereof is to provide a multiple-type air conditioner which can easily control the flow rate of refrigerant supplied to an indoor unit by using capillary tubes even when only one indoor unit is operated.

10 Another object of the present invention is to provide a multiple-type air conditioner in which three or more indoor units can be connected in parallel to one outdoor unit having a fixed-volume type compressor, so that the configuration of air conditioner can be simplified and the cost can be
15 decreased.

 To achieve the above objects, the present invention provides a multiple-type air conditioner in which three or more indoor units having an indoor heat exchanger each are connected in parallel to one outdoor unit having a fixed-
20 volume type compressor and an outdoor heat exchanger via refrigerant liquid pipes provided with a flow rate controlling capillary tube and a solenoid valve each and refrigerant gas pipes, characterized in that the refrigerant liquid pipes are connected to each other via capillary tubes
25 at a position between the flow rate controlling capillary

tube and the solenoid valve.

Still another object of the present invention is to provide a multiple-type air conditioner which can more easily control the flow rate of refrigerant supplied to an indoor unit even when the number of operated indoor units is small.

To achieve the above object, in the present invention, an on-off type volume control mechanism is added to the fixed-volume type compressor.

10 BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a schematic diagram of a multiple-type air conditioner in accordance with one embodiment of the present invention; and

FIG. 2 is a schematic diagram of a conventional multiple-type air conditioner.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

FIG. 1 shows a multiple-type air conditioner in accordance with one embodiment of the present invention.

20 In FIG. 1, an outdoor unit 1 includes a fixed-volume type compressor 3 rotating at a constant speed, an outdoor heat exchanger 5, an outdoor fan 15, an accumulator 8, a liquid injection capillary tube 4, a liquid injection solenoid valve 14, a volume controlling solenoid valve 7, a capillary tube 11, a check valve 16, and the like.

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Three indoor units 2a, 2b, and 2c are connected in parallel to the outdoor unit 1 via refrigerant gas pipes 6a, 6b, and 6c and refrigerant liquid pipes 9a, 9b, and 9c, respectively.

5 The refrigerant liquid tubes 9a, 9b, and 9c each are provided with flow rate controlling capillary tubes 10a, 10b, and 10c and solenoid valves 13a, 13b, and 13c, respectively. At a position between the capillary tube 10a, 10b, 10c and the solenoid valve 13a, 13b, 13c, the refrigerant liquid
10 tubes 9a and 9b are connected to each other via a capillary tube 10ab, the refrigerant liquid tubes 9b and 9c are connected to each other via a capillary tube 10bc, and the refrigerant liquid tubes 9a and 9c are connected to each other via a capillary tube 10ac.

15 When all indoor units 2a, 2b, and 2c are operated, the gas refrigerant discharged from the compressor 3 is condensed and liquefied in an outdoor heat exchanger 5 by heat dissipation to the outside air supplied by an outdoor fan 15.

 This liquid refrigerant flows dividedly in the
20 refrigerant liquid pipes 9a, 9b, and 9c, and is adiabatically expanded by being contracted by the flow rate controlling capillary tubes 10a, 10b, and 10c and then goes into the indoor units 2a, 2b, and 2c through the solenoid valves 13a, 13b, and 13c, respectively. In the indoor unit 2a, 2b, 2c,
25 the liquid refrigerant is evaporated and gasified in an

indoor heat exchanger 12a, 12b, 12c by cooling the indoor air supplied by an indoor fan 14a, 14b, 14c.

This gas refrigerant returns to the outdoor unit 1 through a refrigerant gas pipe 6a, 6b, 6c and is sucked into the fixed-volume type compressor 3 through the accumulator 8.

When any one of the indoor units 2a, 2b, and 2c, for example, the indoor unit 2b is operated and other indoor units 2a and 2c are stopped, the solenoid valve 13b is opened, and the solenoid valves 13a and 13c are closed.

In this case, although the liquid refrigerant flowing out of the outdoor heat exchanger 5 flows dividedly in the refrigerant liquid pipes 9a, 9b, and 9c and passes through the flow rate controlling capillary tubes 10a, 10b, and 10c, the liquid refrigerant passing through the capillary tube 10a flows into the refrigerant liquid pipe 9b through the capillary tube 10ab, and the liquid refrigerant passing through the capillary tube 10c flows into the refrigerant liquid tube 9b through the capillary tube 10bc. In the refrigerant liquid tube 9b, these liquid refrigerants join the liquid refrigerant passing through the capillary tube 10b and flows into the indoor heat exchanger 12b in the indoor unit 2b.

On the other hand, when only the indoor unit 2a is operated, the refrigerant passing successively through the capillary tubes 10b and 10ab and the refrigerant passing

successively through the capillary tubes 10c and 10ac flow into the refrigerant liquid pipe 9a, where they join the refrigerant passing through the capillary tube 10a.

When only the indoor unit 2c is operated, or when two
5 of the indoor units 2a, 2b, and 2c are operated, the refrigerant passes through the capillary pipes in the same manner.

In the case where some of the indoor units 2a, 2b, and 2c are operated, if the flow rate controlling solenoid valve
10 7 is opened, part of the gas refrigerant discharged from the compressor 3 flows to the suction side of the compressor 3 by passing successively through the capillary tube 11, flow rate controlling solenoid valve 7, and check valve 16, so that the volume of the compressor 3 is decreased.

15 Also, if the liquid injection solenoid valve 14 is opened when the temperature of the compressor 3 rises, part of the liquid refrigerant flowing out of the outdoor heat exchanger 5 is sprayed to the compressor 3 by passing successively through the liquid injection capillary tube 4
20 and solenoid valve 14, thereby preventing the temperature of the compressor 3 from rising abnormally.

One embodiment of the present invention described above is summarized as follows:

In the multiple-type air conditioner in which three or
25 more indoor units 2a, 2b, and 2c having the indoor heat

exchanger 12a, 12b, 12c each is connected in parallel to one outdoor unit having the fixed-volume type compressor 3 and outdoor heat exchanger 5 via the refrigerant liquid pipes 9a, 9b, and 9c provided with the flow rate controlling capillary tube 10a, 10b, 10c and the solenoid valve 13a, 13b, 13c each and the refrigerant gas pipes 6a, 6b, and 6c, respectively, the refrigerant liquid pipes 9a, 9b, and 9c are connected to each other via the capillary tubes 10ab, 10ac, and 10bc at a position between the flow rate controlling capillary tube 10a, 10b, 10c and the solenoid valve 13a, 13b, 13c, by which the flow rate of refrigerant supplied to the indoor unit is easily controlled by the capillary tubes 10ab, 10ac, and 10bc even when the number of operated units of the indoor units 2a, 2b, and 2c is small.

In the present invention, since the refrigerant liquid tubes are connected to each other via the capillary tube at a position between the flow rate controlling capillary tube and the solenoid valve, the flow rate of refrigerant supplied to the indoor unit can be controlled easily by the capillary tube even when only one indoor unit is operated.

Therefore, since three or more indoor units can be connected in parallel to one outdoor unit having the fixed-volume type compressor, the configuration of air conditioner can be simplified and the cost can be decreased.

Also, by adding an on-off type volume control mechanism

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to the compressor, the flow rate of refrigerant supplied to the indoor unit can be controlled more easily even when the number of operated indoor units is small.



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CLAIMS

(1) A multiple-type air conditioner in which three or more indoor units having an indoor heat exchanger each are connected in parallel to one outdoor unit having a fixed-
5 volume type compressor and an outdoor heat exchanger via refrigerant liquid pipes provided with a flow rate controlling capillary tube and a solenoid valve each and refrigerant gas pipes, characterized in that said refrigerant liquid pipes are connected to each other via capillary tubes
10 at a position between said flow rate controlling capillary tube and said solenoid valve.

(2) A multiple-type air conditioner according to claim (1), wherein an on-off type volume control mechanism is added to said fixed-volume type compressor.

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