(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 1 391 664 A2

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
25.02.2004 Bulletin 2004/09

(51) Int Cl.[7]: **F25B 13/00**

(21) Application number: **03009017.9**

(22) Date of filing: **17.04.2003**

(84) Designated Contracting States:
AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HU IE IT LI LU MC NL PT RO SE SI SK TR
Designated Extension States:
AL LT LV MK

(30) Priority: **22.08.2002 KR 2002049750**

(71) Applicant: **LG ELECTRONICS INC.**
Seoul 150-010 (KR)

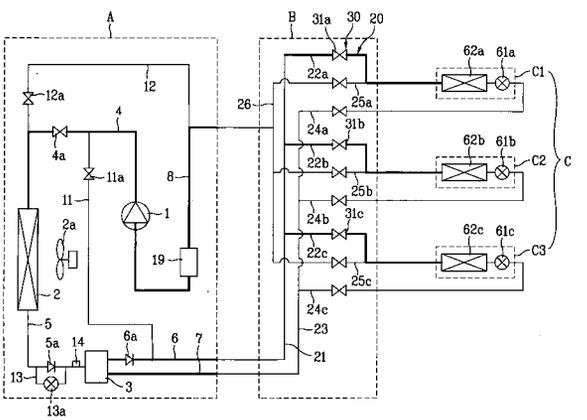
(72) Inventors:
- **Park, Jong Han**
  Kwangmyong-shi, Kyonggi-do (KR)
- **Park, Young Min**
  Namdong-gu, Inchon-kwangyok-shi (KR)
- **Lee, Chang Seon**
  Gumchon-gu, Seoul (KR)
- **Choi, Sung Oh**
  Kwangmyong-shi, Kyonggi-do (KR)

(74) Representative: **Schorr, Frank, Dr. et al**
Diehl Glaeser Hiltl & Partner,
Augustenstrasse 46
80333 München (DE)

(54) Multi-unit air conditioner and method for controlling operation of outdoor unit fan thereof

(57) The invention provides a multi-unit air conditioner for independent cooling/heating of rooms, including a system in which, depending on operation conditions, gas refrigerant discharged from a compressor 1 in an outdoor unit A is introduced into a distributor B through a first bypass pipe 11 directly, or via an outdoor unit heat exchanger 2 and a gas-liquid separator 3 with the refrigerant separated into gas and liquid refrigerant indirectly, wherefrom the liquid refrigerant is introduced into the compressor 1 after passed through an electric expansion valve 61a,61b,61c for an indoor unit C which cools the room, an indoor unit heat exchanger 62a,62b, 62c, and a distributor B, and the gas refrigerant is introduced into the compressor 1 through a second bypass pipe 12 after passed through an indoor unit heat exchanger 62a,62b,62c and an electric expansion valve 61a,61b,61c for the indoor unit C which heats the room, the distributor B, the gas-liquid separator 3, the outdoor unit electric expansion valve 13a, and the outdoor unit heat exchanger 2. Further, the invention provides a method for controlling operation of an outdoor unit fan 2a in a multi-unit air conditioner including the steps of measuring a temperature of gas-liquid mixture refrigerant discharged from an outdoor unit heat exchanger 2, comparing a measured refrigerant temperature to a preset refrigerant temperature, to detect a gas-liquid mixture ratio, and varying a rotational speed of the outdoor unit fan 2a so that a detected gas-liquid mixture ratio becomes identical to a preset mixture ratio required for an intended operation condition.

FIG. 1



EP 1 391 664 A2

Description

BACKGROUND OF THE INVENTION

Field of the Invention

[0001] The present invention relates to a multi-unit air conditioner.

Background of the Related Art

[0002] In general, the air conditioner is an appliance for cooling or heating spaces, such as living spaces, restaurants, and offices. At present, for effective cooling or heating of a space partitioned into many rooms, it is a trend that there has been ceaseless development of multi-unit air conditioner. The multi-unit air conditioner is in general provided with one outdoor unit and a plurality of indoor units each connected to the outdoor unit and installed in a room, for cooling or heating the room while operating in one of cooling or heating mode.

[0003] However, the multi-unit air conditioner is operative only one mode of cooling or heating uniformly even if one room requires heating, and the other room requires cooling among the many rooms within the partitioned space, the multi-unit air conditioner has a limit in that the requirement can not be dealt with, appropriately.

[0004] For an example, even in a building, there are rooms having a temperature difference depending on locations of the room or time, such as while a north side room requires heating, a south side room requires cooling owing to the sun light, which can not be dealt with a related art multi-unit air conditioner that is operative in a single mode.

[0005] Moreover, even though a building equipped with a computer room requires cooling not only in summer, but also in winter for resolving the problem of heat load of the computer related equipment, the related art multi-unit air conditioner can not deal with such a requirement, appropriately.

[0006] In conclusion, the requirement demands development of multi-unit air conditioner of concurrent cooling/heating type, for air conditioning rooms individually, i.e., the indoor unit installed in a room requiring heating is operative in a heating mode, and, at the same time, the indoor unit installed in a room requiring cooling is operative in a cooling mode.

SUMMARY OF THE INVENTION

[0007] Accordingly, the present invention is directed to multi-unit air conditioner that substantially obviates one or more of the problems due to limitations and disadvantages of the related art.

[0008] An object of the present invention is to provide multi-unit air conditioner which can carry out heating and cooling at the same time proper to each room.

[0009] Another object of the present invention is to provide multi-unit air conditioner, in which weight of a distributor is reduced for easy installation.

[0010] Further object of the present invention is to provide a method for controlling operation of multi-unit air conditioner which can improve an efficiency of air conditioning by optimizing a gas-liquid mixture ratio of refrigerant introduced into a gas-liquid separator in operations of cooling all rooms, or cooling a major number of the rooms while heating a minor number of rooms.

[0011] Additional features and advantages of the invention will be set forth in the description which follows, and in part will be apparent from the description, or may be learned by practice of the invention. The objectives and other advantages of the invention will be realized and attained by the structure particularly pointed out in the written description and claims hereof as well as the appended drawings.

[0012] To achieve these and other advantages and in accordance with the purpose of the present invention, as embodied and broadly described, the multi-unit air conditioner includes an outdoor unit including an outdoor unit heat exchanger, and a gas-liquid separator connected to an outlet side of the outdoor unit heat exchanger for separating refrigerant from the outdoor unit heat exchanger into gas refrigerant and liquid refrigerant, and discharging separately, an indoor unit in each of a plurality of rooms having an indoor unit heat exchanger and an electric expansion valve, a distributor connected between the outdoor unit and the indoor unit, for leading gas refrigerant from the outdoor unit to the indoor unit heat exchanger in the indoor unit which heats the room, liquid refrigerant from the outdoor unit to the electric expansion valve on the indoor unit which cools the room, refrigerant passed through the indoor unit to the indoor unit again, wherein, when heating and cooling are carried out for the rooms individually, the refrigerant liquefied as the refrigerant passes through the indoor unit which heats the room is lead to the outdoor unit after being lead to the electric expansion valve of the indoor unit which cools the room again, and a refrigerant piping connected between above units inclusive of a plurality of check valves and solenoid valves provided thereto for controlling flow paths of the refrigerant.

[0013] The multi-unit air conditioner further includes control means for controlling a rotational speed of the outdoor unit fan such that a gas-liquid mixture ratio of the refrigerant introduced into the gas-liquid separator through the outdoor unit heat exchanger is regulated suitable to different operation conditions. The control means includes a temperature sensor on an outdoor unit pipe for measuring a temperature of refrigerant discharged from the outdoor unit heat exchanger, and a microcomputer for comparing the temperature of refrigerant measured at the temperature sensor and a present refrigerant temperature, to detect a refrigerant mixture ratio in the pipe, and controlling a rotational speed of the outdoor unit fan so that the detected mixture ratio is identical to a preset mixture ratio required

for different operation conditions.

[0014] The outdoor unit includes a compressor, an outdoor unit tan. the outdoor unit heat exchanger, an outdoor unit electric expansion valve, the gas-liquid separator, an accumulator, and an outdoor unit piping connected between above elements having a plurality of check valves. and solenoid valves provided thereto.

[0015] The outdoor unit piping includes a discharge pipe connected between the compressor and the outdoor unit heat exchanger, a support pipe connected between the outdoor unit heat exchanger and the gas-liquid separator, a parallel pipe branched from one side of the support pipe and joined to the support pipe again, a gas refrigerant pipe connected between an upper part of the gas-liquid separator and the distributor, a liquid refrigerant pipe connected between a lower part of the gas-liquid separator and the distributor, a suction pipe connected between the distributor and the compressor, a first bypass pipe connected between the discharge pipe and the gas refrigerant pipe, and a second bypass pipe connected between the discharge pipe between the first bypass pipe and the outdoor unit heat exchanger and the suction pipe.

[0016] The discharge pipe has a first solenoid valve provided on a position between the first bypass pipe and the second bypass pipe. The first solenoid valve is opened in operations all rooms are cooled, and a major number of rooms are cooled and a minor number of rooms are heated, and closed in operations all rooms are heated, and a major number of rooms are heated and a minor number of rooms are cooled.

[0017] The first bypass pipe has a second solenoid valve provided thereon. The second solenoid valve is closed in operations all rooms are cooled, and a major number of rooms are cooled and a minor number of rooms are heated, and opened in operations all rooms are heated, and a major number of rooms are heated and a minor number of rooms are cooled.

[0018] The second bypass pipe has a third solenoid valve provided thereon. The third solenoid valve is closed in operations all rooms are cooled, and a major number of rooms are cooled and a minor number of rooms are heated, and opened in operations all rooms are heated. and a major number of rooms are heated and a minor number of rooms are cooled.

[0019] The support pipe has a first check valve provided thereon at a position between one point the parallel pipe is branched therefrom and a point the parallel pipe is joined thereto. for prevention of refrigerant flow from the gas-liquid separator toward the outdoor unit heat exchanger.

[0020] The outdoor unit electric expansion valve is provided on the parallel pipe. The outdoor unit electric expansion valve is closed in operations all rooms are cooled, and a major number of rooms are cooled and a minor number of rooms are heated, and operative in operations all rooms are heated, and a major number of rooms are heated and a minor number of rooms are cooled.

[0021] There is a second check valve provided on the gas refrigerant pipe between the gas-liquid separator and the first bypass pipe, for prevention of refrigerant flow from a first bypass pipe side to a gas-liquid separator side.

[0022] The accumulator is provided on the suction pipe.

[0023] The distributor includes a distributor piping for guiding gas or liquid refrigerant received through a gas refrigerant pipe or a liquid refrigerant pipe toward the indoor unit, and guiding refrigerant passed through the indoor unit toward the outdoor unit again, and a valve part for controlling refrigerant flow in the distributor piping such that gas or liquid refrigerant is selectively introduced into indoor units in respective rooms and the refrigerant passed through the indoor unit is re-introduced into the outdoor unit according to different operation conditions.

[0024] The distributor piping includes a gas refrigerant connection pipe connected to the gas refrigerant pipe, gas refrigerant branch pipes each branched from the gas refrigerant connection pipe and connected to the indoor unit heat exchanger in each of the rooms, a liquid refrigerant connection pipe connected to the liquid refrigerant pipe, liquid refrigerant branch pipes each branched from the liquid refrigerant connection pipe and connected to the electric expansion valve in each of the rooms, a connection branch pipe branched from each of the gas refrigerant branch pipes, and a common branch pipe having the connection branch pipes joined thereto and connected to the suction pipe.

[0025] The valve part includes a plurality of solenoid valves provided to the gas refrigerant branch pipes, the liquid refrigerant branch pipes, the connection branch pipes and controlled. The valve part in the distributor is controlled such that the solenoid valve on the refrigerant connection pipe on an indoor unit side which heats the room, and the solenoid valve on the gas refrigerant branch pipe on an indoor unit side which cools the room are only closed.

[0026] The electric expansion valve for the indoor unit which heats the room is opened fully. The electric expansion valve for the indoor unit which cools the room is controlled to expand the refrigerant.

[0027] The check valves and the solenoid valves make different refrigerant flow control depending on operation conditions of cooling all rooms, heating all rooms, a major number of rooms are cooled and a minor number of rooms are heated, a major number of rooms are heated and a minor number of rooms are cooled.

[0028] The check valves and the solenoid valves are controlled in the operation of cooling all room such that entire refrigerant discharged from the compressor is introduced into the compressor after passed through the outdoor unit heat exchanger, the gas-liquid separator, the distributor, the electric expansion valve, the indoor unit heat exchanger, and the distributor in succession.

[0029] The check valves and the solenoid valves are controlled in the operation of heating all room such that entire refrigerant discharged from the compressor is introduced into the compressor the second bypass pipe after passed through the first bypass pipe, the distributor the indoor unit heat exchanger, the electric expansion valve, the distributor. the gas-liquid separator, the outdoor unit expansion valve, and the outdoor unit heat exchanger in succession.

[0030] The check valves and the solenoid valves are controlled in the operation of cooling a major number of rooms and heating a minor number of rooms such that entire refrigerant discharged from the compressor is introduced into the outdoor unit heat exchanger and the gas-liquid separator, wherefrom liquid refrigerant is introduced into the compressor after passed through the distributor, the cooling room electric expansion valves, the cooling room indoor unit heat exchangers, and the distributor in succession, and gas refrigerant is introduced into the compressor through the distributor, a heating room indoor unit heat exchanger and a heating room electric expansion valve, joined with the liquid refrigerant in the distributor, and passed through the cooling room electric expansion valves, cooling room indoor unit heat exchangers, and the distributor.

[0031] The check valves and the solenoid valves are controlled in the operation of heating a major number of rooms and cooling a minor number of rooms such that entire refrigerant discharged from the compressor is introduced into the distributor through the first bypass pipe, and, therefrom, reintroduced into the distributor via the heating room indoor unit heat exchangers and the heating room electric expansion valves, and a portion of which refrigerant is introduced into the compressor via the cooling room electric expansion valve and the cooling room indoor unit heat exchanger and the distributor, and the other portion of which refrigerant is introduced into the compressor via the gas-liquid separator, the outdoor unit electric expansion valve, and the outdoor unit heat exchanger and through the second bypass pipe.

[0032] In another aspect of the present invention, there is provided a method for controlling operation of an outdoor unit fan in a multi-unit air conditioner including the steps of measuring a temperature of gas-liquid mixture refrigerant discharged from an outdoor unit heat exchanger. comparing a measure refrigerant temperature to a preset refrigerant temperature, to detect a gas-liquid mixture ratio, and varying a rotational speed of the outdoor unit fan so that a detected gas-liquid mixture ratio becomes identical to a preset mixture ratio required for an intended operation condition.

[0033] It is to be understood that both the foregoing general description and the following detailed description are exemplary and explanatory and are intended to provide further explanation of the invention as claimed.

BRIEF DESCRIPTION OF THE DRAWINGS

[0034] The accompanying drawings, which are included to provide a further understanding of the invention and are incorporated in and constitute a part of this specification, illustrate embodiments of the invention and together with the description serve to explain the principles of the invention:

[0035] In the drawings:

FIG. 1 illustrates a circuit diagram showing multi-unit air conditioner in accordance with a preferred embodiment of the present invention;

FIG. 2A illustrates a circuit diagram showing an operation state of the multi-unit air conditioner in FIG. 1 when all rooms are cooled;

FIG. 2B illustrates a circuit diagram showing an operation state of the multi-unit air conditioner in FIG. 1 when all rooms are heated;

FIG. 3A illustrates a circuit diagram showing an operation state of the multi-unit air conditioner in FIG. 1 when a major number of rooms are cooled and a minor number of rooms are heated; and

FIG. 3B illustrates a circuit diagram showing an operation state of the multi-unit air conditioner in FIG. 1 when a major number of rooms are heated and a minor number of rooms are cooled.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

[0036] Reference will now be made in detail to the preferred embodiments of the present invention, examples of which are illustrated in the accompanying drawings. In describing the embodiments of the present invention, same parts will be given the same names and reference symbols, and iterative description of which will be omitted.

[0037] Referring to FIG. 1, the air conditioner in accordance with a preferred embodiment of the present invention includes an outdoor unit 'A', a distributor 'B', and a plurality of indoor units 'C'; 'C1', 'C2', and 'C3', wherein the air conditioner has a system in which rooms the indoor units 'C'; 'C1', 'C2', and 'C3' are installed therein respectively are cooled or heated independently depending on different operation conditions of cooling all rooms, heating all rooms, cooling a major number of the rooms and heating a minor number of rooms, and heating a major number of the rooms and cooling a minor number of rooms, detail of which will be described with reference to FIG. 1.

[0038] For convenience of description, the following drawing reference symbols 22 represents 22a, 22b, and 22c, 24 represents 24a, 24b, and 24c, 25 represents 25a, 25b, and 25c, 31 represents 31a, 31b, and 31c, 61 represents 61a, 61b, and 61c, 62 represents 62a, 62b, and 62c, and C represents C1, C2, and C3. Of course, a number of the indoor units 'C' and numbers of ele-

ments related to the indoor units are varied with a number of rooms, and for convenience of description, the specification describes assuming a case when there are three rooms.

[0039] The outdoor unit 'A' includes a compressor 1, an outdoor unit heat exchanger 2 and an outdoor unit fan 2a, a gas-liquid separator 3, an outdoor unit electric expansion valve 13a, an accumulator 19, and a refrigerant piping connecting respective units and provided with a plurality of check valve and solenoid valves, of which detailed system will be described.

[0040] Referring to FIG. 1, the compressor 1 and the outdoor unit heat exchanger 2 are connected with a discharge pipe 4. The outdoor fan 2a blow air toward the outdoor unit heat exchanger 2. The compressor 1 has a suction pipe 8 connected to a suction side thereof, with an accumulator 19 on the suction pipe 8.

[0041] The outdoor unit heat exchanger 2 and the gas-liquid separator 3 are connected with a support pipe 5, with a parallel pipe 13 branched from one point of the support pipe 5 and connected to the other point of the support pipe 5 to form a bypass path. There is an outdoor unit electric expansion valve 13a on the parallel pipe 13, so that the outdoor unit electric expansion valve 13a is closed in operations all rooms are cooled, and a major number of the room are cooled and a minor number of rooms are heated, and operative in operations all rooms are heated, and a major number of the room are heated and a minor number of rooms are cooled.

[0042] There is a first check valve 5a on the support pipe 5 between one point and the other point the parallel pipe 13 is connected thereto. The check valve 5a permits a refrigerant flow from the outdoor unit heat exchanger 2 to the gas-liquid separator 3, and blocks a refrigerant flow from the gas-liquid separator 3 to the outdoor unit heat exchanger 2.

[0043] The gas-liquid separator 3 has a liquid refrigerant pipe 7 connected to a lower side thereof, and a gas refrigerant pipe 6 connected to an upper side thereof. The liquid refrigerant pipe 7 and the gas refrigerant pipe 6 are connected to a pipe on the distributor 'B' side respectively.

[0044] There is a first bypass pipe 11 connected between one point of the gas refrigerant pipe 6 and one point of the discharge pipe 4. There is a second solenoid valve 11a on the first bypass pipe 11 controlled such that the second solenoid valve 11a is closed in operations all the rooms are cooled and a major number of the rooms are cooled and a minor number of rooms are heated. and opened in operations all the rooms are heated and a major number of the rooms are heated and a minor number of rooms are cooled. There is a second check valve 6a on the gas refrigerant pipe 6 between the one point the first bypass pipe 11 is connected thereto and the gas-liquid separator 3. The second check valve 6a permits refrigerant flow from the gas-liquid separator 3 to the distributor 'B', and blocks refrigerant flow from the first bypass pipe 11 to the gas-liquid separator 3.

[0045] There is a second bypass pipe 12 connected between one point of the discharge pipe 4 between the first bypass pipe 11 and the outdoor unit heat exchanger 2 and one point of the suction pipe 8. The second bypass pipe 12 is connected such that the accumulator 19 is positioned between the compressor 1 and the second bypass pipe 12. There is a third solenoid valve 12a on the second bypass pipe 12, controlled so that the second bypass valve 12a is closed in operations all the rooms are cooled and a major number of the rooms are cooled and a minor number of rooms are heated, and opened in operations all the rooms are heated and a major number of the rooms are heated and a minor number of rooms are cooled.

[0046] There is a first solenoid valve 4a on the discharge pipe 4 between one point the first bypass pipe 11 is connected thereto and one point the second bypass pipe 12 is connected thereto.

[0047] Referring to FIG. 1, the distributor 'B' includes a distributor pipe 20 and a valve part 30.

[0048] The distributor pipe 20 guides gas or liquid refrigerant introduced thereto through the gas refrigerant pipe 6 or the liquid refrigerant pipe 7 toward the indoor units "C", and refrigerant discharged from the indoor units 'C' to the outdoor unit 'A' again. The distributor pipe 20 includes a gas refrigerant connection pipe 21, a gas refrigerant branch pipe 22, a liquid refrigerant connection pipe 23, a liquid refrigerant branch pipe 24, a connection branch pipe 25, and a common branch pipe 26, of which detail is as follows.

[0049] The gas refrigerant pipe 21 has one end connected to the gas refrigerant pipe 6 on the outdoor unit 'A', and the liquid refrigerant pipe 23 has one end connected to the liquid refrigerant pipe 7 on the outdoor unit 'A'.

[0050] Referring to FIG. 1, the gas refrigerant branch pipe 22 has a plurality of branches from the gas refrigerant connection pipe 21 connected to the indoor unit heat exchangers 62 in the indoor units 'C', and the liquid refrigerant branch pipe 24 has a plurality of branches from the liquid refrigerant connection pipe 23 connected to the electric expansion valve 61 in the indoor units 'C'.

[0051] Referring to FIG. 1, the connection branch pipe 25 is branched from each of the gas refrigerant branch pipes 22, and the common branch pipe 26 connects the connection branch pipes 25 branched from the gas refrigerant branch pipes 22 into one, and is connected to the suction pipe 8 in the outdoor unit 'A'.

[0052] The valve part 30 serves to control refrigerant flow in the distributor pipe 20, such that gas or liquid is introduced into the indoor units 'C' of the rooms selectively depending on respective operation conditions of cooling all rooms, heating all rooms, cooling a major number of the rooms and heating a minor number of rooms, and heating a major number of the rooms and cooling a minor number of rooms, and introducing the

gas or liquid refrigerant from the indoor units 'C' to the outdoor unit 'A' again.

[0053] Referring to FIG. 1, the valve part 30 includes a plurality of solenoid valves 31; 31a, 31b, and 31c on the gas refrigerant branch pipes 22, the gas refrigerant branch pipes 24, and the connection branch pipes 25. The plurality of solenoid valves 31 are controlled such that only the solenoid valves on refrigerant connection pipes on the indoor unit side for heating, and the solenoid valves on the gas refrigerant branch pipe on the indoor side for cooling are closed, of which detailed control depending on different operation conditions will be described, later.

[0054] Next, the indoor units 'C' are installed in the rooms, each inclusive of an indoor unit heat exchanger 62, an electric expansion valve 61, and a room fan (not shown).

[0055] The indoor unit heat exchanger 62 is connected to the gas refrigerant branch pipe 22 in the distributor 'B', and the electric expansion valve 61 is connected to the liquid refrigerant branch pipe 24 in the distributor. The indoor unit heat exchangers 62 and the electric expansion valves 61 are connected with refrigerant pipe to one another.

[0056] The indoor unit fan is installed so as to blow air toward the indoor unit heat exchanger 62.

[0057] In the meantime, there may be control means further included to the multi-unit air conditioner of the present invention for controlling a rotational speed of the outdoor unit fan 2a.

[0058] The control means includes a temperature sensor 14 and a microcomputer (not shown), for controlling the rotational speed of the outdoor unit fan 2a so that a gas-liquid mixture ratio of the refrigerant introduced into the gas-liquid separator 3 through the outdoor unit heat exchanger 2 is controlled depending on the different operation conditions.

[0059] As shown in FIG. 1, the temperature sensor 14 is fitted to the support pipe 5, for measuring a refrigerant temperature flowing through the support pipe 5 after being discharged from the outdoor unit heat exchanger 2.

[0060] After comparing a refrigerant temperature measured at the temperature sensor 14 and a preset refrigerant temperature, to detect the gas-liquid mixture ratio of the refrigerant flowing in the support pipe 5, the microcomputer controls outdoor unit fan 2a to vary the rotational speed of the outdoor unit fan 2a so that the detected gas-liquid mixture ratio is identical to a preset gas-liquid mixture ratio required under the different operation conditions.

[0061] Depending on the different operation conditions, the multi-unit air conditioner of the present invention is operative such that, after the gas refrigerant from the compressor 1 is introduced into the distributor 'B' directly through the first bypass pipe 11, or after separated into gas and liquid via the outdoor heat exchanger 2 and the gas-liquid separator 3, the liquid refrigerant is introduced into the compressor 1 after passed through the electric expansion valve and the indoor unit heat exchanger of the indoor unit which cools the room, and the distributor 'B', and the gas refrigerant is introduced into the compressor 1 through the second bypass pipe 12 after passed through the indoor unit heat exchanger and the electric expansion valve of the indoor unit which heat the room via the distributor 'B', the gas-liquid separator 3, the outdoor unit electric expansion valve 13a and the outdoor unit heat exchanger 2, of which detailed operation process will be described for each of the different operation conditions, separately. For the convenience of description, it is assumed that two indoor units C1 and C2 carry out cooling, and the third indoor unit C3 carries out heating in the operation a major number of the rooms are cooled, and a small number of the rooms are heated. Two indoor units C1 and C2 carry out heating, and the third indoor unit C3 carries out cooling in the operation a major number of the rooms are heated, and a small number of the rooms are cooled.

[0062] FIG. 2A illustrates a circuit diagram showing an operation state of the multi-unit air conditioner in FIG. 1 when all rooms are cooled. wherein the operation condition of cooling all rooms has a circulation path in which entire refrigerant discharged from the compressor 1 is introduced into the compressor 1 after passing through the outdoor unit heat exchanger 2, the gas-liquid separator 3, the distributor 'B', the electric expansion valve 61, the indoor unit heat exchanger 62, and the distributor 'B' in succession, of which detail is as follows.

[0063] Referring to FIG. 2A, the gas refrigerant discharged from the compressor 1 is introduced into the outdoor unit heat exchanger 2 through the discharge pipe 4. In this instance, for guiding the gas refrigerant toward the outdoor unit heat exchanger 2, the first solenoid valve 4a is opened, and the second solenoid valve 11a on the first bypass pipe 11 and the third solenoid valve 12a on the second bypass pipe 12 are closed.

[0064] The refrigerant introduced into the outdoor unit heat exchanger 2 makes heat exchange with external air blown from the outdoor unit fan 2a controlled by the control means, until supercooled into a liquid state, passes through the first check valve 5a as it flows through the support pipe 5, and introduced into the gas-liquid separator 3. In this instance, the outdoor unit heat exchanger 2 serves as a condenser, and the outdoor unit electric expansion valve on the parallel pipe 13 is closed.

[0065] The high pressure liquid refrigerant introduced into the gas-liquid separator 3 passes through the liquid refrigerant pipe 7, and the liquid refrigerant connection pipe 23 in succession, and divided and introduced into the liquid refrigerant branch pipes 24. The liquid refrigerant introduced into the liquid refrigerant branch pipe 24 is introduced into the indoor units 'C' after passed through the solenoid valve on the liquid refrigerant branch pipe 24.

[0066] The liquid refrigerant introduced into the indoor unit 'C' is expanded at the expansion valve 61, cools

down the room as the refrigerant vaporizes at the indoor unit heat exchanger 62 and makes heat exchange with room air, and introduced into the gas refrigerant branch pipe 22. In this instance, the indoor unit heat exchanger 62 serves as a vaporizer.

[0067] The gas refrigerant introduced into the gas refrigerant branch pipe 22 is introduced into the common branch pipe 26 through the connection branch pipe 25. In this instance, for guiding the gas refrigerant toward the connection branch pipe 25, the solenoid valve on the gas refrigerant branch pipe 22 is closed. The gas refrigerant introduced into the common branch pipe 26 is introduced into the compressor 1 via the suction pipe 8 and the accumulator 19.

[0068] FIG. 2B illustrates a circuit diagram showing an operation state of the multi-unit air conditioner in FIG. 1 when all rooms are heated, wherein the operation condition of heating all rooms has a circulation path in which entire refrigerant discharged from the compressor 1 is introduced into the compressor 1 through the second bypass pipe 12 after passing through the first bypass pipe 11, the distributor 'B', the indoor unit heat exchanger 62, the electric expansion valve 61, the distributor 'B', the outdoor unit electric expansion valve 13a, and the outdoor unit heat exchanger 2 in succession, of which detail is as follows.

[0069] Referring to FIG. 2B, the gas refrigerant discharged from the compressor 1 moves through the discharge pipe 4 toward the gas refrigerant pipe 6 through the first bypass pipe 11 as the first solenoid valve 4a is closed.

[0070] The gas refrigerant introduced into the gas refrigerant pipe 6 moves toward the gas refrigerant connection pipe 21 in the distributor 'B' as flow toward the gas-liquid separator 3 is limited.

[0071] The gas refrigerant introduced into the gas refrigerant connection pipe 21 is introduced into the gas refrigerant branch pipes 22, and, therefrom to the indoor unit heat exchangers 62 in the indoor unit 'C' as the solenoid valves on the connection branch pipes 25 are closed.

[0072] The gas refrigerant introduced into the indoor unit heat exchanger 62 makes heat exchange with the air blown from the indoor unit fan, to discharge condensing heat and heat the room. when the indoor unit heat exchanger 62 serves as a condenser.

[0073] The liquid refrigerant supercooled and condensed at the indoor unit heat exchanger 62 passes through the electric expansion valve 61 opened fully. and is introduced into the gas-liquid separator 3 in the outdoor unit 'A' through the liquid refrigerant branch pipe 24, the liquid refrigerant connection pipe 23, and the liquid refrigerant pipe 7.

[0074] The liquid refrigerant introduced into the gas-liquid separator 3 is introduced into the parallel pipe 13 as the first check valve 5a blocks the flow path, expanded at the outdoor unit electric expansion valve 13a, and makes heat exchange and vaporizes at the outdoor unit heat exchanger 2, when the outdoor unit heat exchanger 2 serves as an evaporator.

[0075] The liquid refrigerant supercooled and condensed at the outdoor unit heat exchanger 2 is guided to the second bypass pipe 12 through the discharge pipe 4 as the first solenoid valve 4a is closed, and introduced into the compressor 1 via the second bypass pipe 12, the suction pipe 8 and the accumulator 19.

[0076] FIG. 3A illustrates a circuit diagram showing an operation state of the multi-unit air conditioner in FIG. 1 when a major number of the rooms are cooled and a minor number of rooms are heated, wherein the operation condition of cooling a major number of rooms and heating a minor number of rooms has a circulation path in which entire refrigerant discharged from the compressor 1 is introduced into the outdoor unit heat exchanger 2 and the gas-liquid separator 3, wherefrom the liquid refrigerant is introduced into the compressor 1 after passing through the distributor 3, cooling room electric expansion valves 61a and 61b, cooling room indoor unit heat exchangers 62a and 62b, and the distributor 'B' in succession, and gas refrigerant is introduced into the compressor 1 through the distributor 'B', a heating room indoor unit heat exchanger 62c and a heating room electric expansion valve 61c, joined with the liquid refrigerant in the distributor 'B', and passed through the cooling room electric expansion valves 61a and 61b, cooling room indoor unit heat exchangers 62a and 62b, and the distributor B', of which detail is as follows.

[0077] Referring to FIG. 3A, the gas refrigerant discharged from the compressor 1 is introduced into the outdoor unit heat exchanger 2 through the discharge pipe 4, when. for guidance of the gas refrigerant, the first solenoid valve 4a is opened, and the second solenoid valve 11a on the first bypass pipe 11 and the third solenoid valve 12a on the second bypass pipe 12 are closed.

[0078] In the meantime, the gas refrigerant introduced into the outdoor unit heat exchanger 2 makes heat exchange with external air blown from the outdoor unit fan 2a, to have a gas-liquid mixture ratio suitable for operation for cooling a major number of the rooms and heating a minor number of rooms. That is, if a large amount of external air is blown to the outdoor unit heat exchanger 2 owing to a high rotational speed of the outdoor unit fan 2a, a liquid ratio in the refrigerant becomes high, and if a small amount of external air is blown to the outdoor unit heat exchanger 2 owing to a low rotational speed of the outdoor unit fan 2a, a gas ratio in the refrigerant becomes high. The present invention suggests to control the rotational speed of the outdoor unit fan 2a by means of control means, for obtaining an optimal gas-liquid mixture ratio required for an operation for cooling a major number of the rooms and heating a minor number of rooms.

[0079] A method for controlling operation of an outdoor unit fan in an air conditioner of the present invention for obtaining the optimal gas-liquid mixture ratio is as follows.

[0080] A temperature of the gas-liquid mixture refrigerant discharged from the outdoor unit heat exchanger 2 is measured at the temperature sensor 14 on the support pipe 5.

[0081] Then, a refrigerant temperature measured at the temperature sensor 14 and a preset refrigerant temperature are compared, to detect the gas-liquid mixture ratio of the refrigerant.

[0082] Next, the rotational speed of the outdoor unit fan 2a is changed such that the detected gas-liquid mixture ratio of the refrigerant is identical to the preset mixture ratio required for an operation condition for cooling a major number of rooms and heating a minor number of rooms.

[0083] Once the control means changes the rotational speed of the outdoor unit fan 2a by above method, the multi-unit air conditioner of the present invention can optimize the gas-liquid mixture ratio of the refrigerant under all conditions, thereby improving a cooling/heating efficiency.

[0084] When the control means controls the outdoor unit fan 2a by above method, the refrigerant mixture ratios set at the microcomputer are experimental values fixed from tests under different load conditions, such as suitable to the two cooling side indoor units C 1 and C2 which require liquid refrigerant and the one heating indoor unit C3 which requires gas refrigerant, or suitable to a flow rate of the liquid refrigerant introduced into the two cooling side indoor units C1 and C2 through the one heating indoor unit C3, or the like.

[0085] The control of the outdoor unit fan 2a carried out thus is applicable to operation conditions for cooling all rooms, and heating a major number of rooms and cooling a minor number of rooms.

[0086] In the meantime, the two phased refrigerant mixed at an optimal gas-liquid mixture ratio at the outdoor unit heat exchanger 2 is introduced into the gas-liquid separator 3 through the support pipe 5. For guiding the refrigerant thus, the outdoor unit electric expansion valve 13a on the parallel pipe 13 is closed.

[0087] The high pressure two phased refrigerant introduced into the gas-liquid separator 3 is separated into liquid phase refrigerant and gas phase refrigerant, wherein the liquid phase refrigerant is introduced into the liquid refrigerant pipe 7 and the gas refrigerant is introduced into the gas refrigerant pipe 6.

[0088] The liquid refrigerant introduced into the liquid refrigerant pipe 7 is divided into the liquid refrigerant connection pipe 23, the first liquid refrigerant branch pipe 24a and the second liquid refrigerant branch pipe 24b, expanded as the liquid refrigerant passes through the first electric expansion valve 61a and the second electric expansion valve 61b, and makes heat exchange as the refrigerant passes through the first indoor unit heat exchanger 62a and the second indoor unit heat exchanger 62b, to cool down the rooms.

[0089] The gas refrigerant, vaporized at the first indoor unit heat exchanger 62a and the second indoor unit heat exchanger 62b while cooling down the rooms, is introduced into a common branch pipe 26 through the first gas refrigerant branch pipe 22a and the second gas refrigerant branch pipe 22b, and the first connection branch pipe 25a and the second connection branch pipe 25b. In this instance, for guiding the gas refrigerant, the solenoid valves 31a and 31b on the first gas refrigerant branch pipe 22a and the second gas refrigerant branch pipe 22b and the solenoid valve on the third connection branch pipe 25c on the third indoor unit C3 are closed. The gas refrigerant introduced into the common branch pipe 26 is introduced into the compressor 1 through the suction pipe 8 and the accumulator 19.

[0090] In the meantime, entire gas refrigerant, separated at the gas-liquid separator 3 and introduced into the gas refrigerant pipes 6, is introduced into the gas refrigerant connection pipe 21, and, therefrom, to the third gas refrigerant branch pipe 22c on the indoor unit C3 side as the solenoid valves 31a and 31b on the first gas refrigerant branch pipe 22a and the second gas refrigerant branch pipe 22b on the sides of the indoor units C and C2 are closed.

[0091] The gas refrigerant introduced into the third gas refrigerant branch pipe 22c is introduced into the third indoor unit heat exchanger 62c, and makes heat exchange to discharge heat, and heat the room as the solenoid valve on the third connection branch pipe 25c is closed, then introduced into the third liquid refrigerant branch pipe 24c through the third electric expansion valve 61c, and joined with the liquid refrigerant flowing in the liquid refrigerant connection pipe 23. After the joining, the refrigerant introduced into the indoor units C1 and C2 cool respective rooms. and introduced into the compressor 1.

[0092] In this instance, the liquid refrigerant introduced into the liquid refrigerant connection pipe 23 through the liquid refrigerant pipe 7 is introduced, not to the third indoor unit C3 side. but only to the sides of the first indoor unit C1 and the second indoor unit C2 owing to a pressure difference. That is, it is because a pressure of the refrigerant from the third liquid refrigerant branch pipe 24c is higher than a pressure of the refrigerant flowing toward the first liquid refrigerant branch pipe 24a and the second refrigerant branch pipe 24b.

[0093] FIG. 3B illustrates a circuit diagram showing an operation state of the multi-unit air conditioner in FIG. 1 when a major number of rooms are heated and a minor number of rooms are cooled, wherein the operation condition of heating a major number of rooms and cooling a minor number of rooms has a circulation path in which entire refrigerant discharged from the compressor 1 is introduced into the distributor 'B' through the first bypass pipe 11, and, therefrom, reintroduced into the distributor 'B' via the heating room indoor unit heat exchangers 62a and 62b and the heating room electric expansion valves 61a and 61b, and a portion of which refrigerant is introduced into the compressor 1 via the cooling room electric expansion valve 61c and the cooling room indoor

unit heat exchanger 62c and the distributor 'B', and the other portion of which refrigerant is introduced into the compressor 1 via the gas-liquid separator 3, the outdoor unit electric expansion valve 13a, and the outdoor unit heat exchanger 2 and through the second bypass pipe 12, of which detail is as follows.

[0094] Referring to FIG. 3B, the gas refrigerant discharged from the compressor 1 is guided to the first bypass pipe 11 by the closed first solenoid valve through the discharge pipe 4, and introduced into the gas refrigerant pipe 6.

[0095] The gas refrigerant introduced into the gas refrigerant pipe 6 is introduced into the gas refrigerant connection pipe 21 on a side of the distributor 'B' by blocking of the second check valve 6a. introduced into and condensed at the first indoor heat exchanger 62a and the second indoor heat exchanger 62b through the first gas refrigerant branch pipe 22a and the second gas refrigerant branch pipe 22b, and introduced into the first liquid refrigerant branch pipe 24a and the second refrigerant branch pipe 24b via the first electric expansion valve 61a and the second electric expansion valve 61b. In this instance, the first electric expansion valve 61a and the second electric expansion valve 61b are fully opened.

[0096] The liquid refrigerant introduced into the first liquid refrigerant branch pipe 24a and the second refrigerant branch pipe 24b is introduced into the liquid refrigerant connection pipe 23, and a portion of the liquid refrigerant is branched toward the liquid refrigerant pipe 7, and the other portion thereof is branched toward the third liquid refrigerant branch pipe 24c.

[0097] In this instance, the portion of liquid refrigerant branched to, and flowing in the liquid refrigerant pipe 7 is introduced into the gas-liquid separator 3, passes through the outdoor unit electric expansion valve 13a on the parallel pipe 13 guided by the first check valve 5a, and introduced into the compressor 1 through the indoor unit heat exchanger 2, the second bypass pipe 12 and the suction pipe 8.

[0098] The other portion of the liquid refrigerant branch to, and flowing in the third liquid refrigerant branch pipe 24c passes and expands through the third electric expansion valve 61c, makes heat exchange at the third indoor unit heat exchanger 62c and cools down the room. The gas refrigerant vaporized as the refrigerant cools the room passes the third gas refrigerant branch pipe 22c and the third connection branch pipe 25c, joins with the common branch pipe 26 through the third gas refrigerant branch pipe 22c and the third connection branch pipe 25c, and introduced into the compressor 1 through the suction pipe 8.

[0099] The present invention having the foregoing system and operative thus has the following advantages.

[0100] First, optimal dealing with individual room environments are made available by the multi-unit air conditioner of the present invention. That is, not only the all room heating operation and the all room cooling operation, but also an operation a major number of rooms are heated and a minor number of rooms are cooled, and an operation a major number of rooms are cooled and a minor number of rooms are heated, when the rooms are selectively heated or cooled, are made available, thereby permitting to deal with individual room environments.

[0101] Second, the product cost is reduced because the piping is provided with inexpensive and simple on/off valves, instead of expensive three way, and four way valves.

[0102] Third, the mounting of the gas-liquid separator, not on the distributor, but on the outdoor unit, permits reduction of weight of the distributor, not only making mounting of the distributor simple, but also assuring safety after the mounting more. This is because in general while the outdoor unit 'A' is mounted on a sidewall surface or on a floor of a roof top outside of the room, the distributor 'B' is mounted on a ceiling inside of the room, making mounting of the distributor 'B' is more difficult than the outdoor unit 'A', particularly, if the distributor 'B' is heavy, when the mounting, not only is difficult, but also requires reinforcing for supporting the distributor 'B', or otherwise, the distributor 'B' can fall down from the ceiling due to the heavy weight, the gas-liquid separator 3 is fitted in the outdoor unit 'A'.

[0103] Fourth, the optimization of the gas-liquid mixture ratio of the two phased refrigerant introduced into the gas-liquid separator in the operations of cooling all rooms and cooling a major number of rooms and heating a minor number of rooms permits improvement of an air conditioning efficiency.

[0104] It will be apparent to those skilled in the art that various modifications and variations can be made in the present invention without departing from the spirit or scope of the invention. Thus, it is intended that the present invention cover the modifications and variations of this invention provided they come within the scope of the appended claims and their equivalents.

[0105] Summarized, the invention provides a multi-unit air conditioner for independent cooling/heating of rooms, including a system in which, depending on operation conditions, gas refrigerant discharged from a compressor in an outdoor unit is introduced into a distributor through a first bypass pipe directly, or via an outdoor unit heat exchanger and a gas-liquid separator with the refrigerant separated into gas and liquid refrigerant indirectly, wherefrom the liquid refrigerant is introduced into the compressor after passed through an electric expansion valve for an indoor unit which cools the room, an indoor unit heat exchanger, and a distributor, and the gas refrigerant is introduced into the compressor through a second bypass pipe after passed through an indoor unit heat exchanger and an electric expansion valve for the indoor unit which heats the room, the distributor, the gas-liquid separator, the outdoor unit electric expansion valve, and the outdoor unit heat exchanger. Further, the invention provides a method for control-

ling operation of an outdoor unit fan in a multi-unit air conditioner including the steps of measuring a temperature of gas-liquid mixture refrigerant discharged from an outdoor unit heat exchanger, comparing a measured refrigerant temperature to a preset refrigerant temperature, to detect a gas-liquid mixture ratio, and varying a rotational speed of the outdoor unit fan so that a detected gas-liquid mixture ratio becomes identical to a preset mixture ratio required for an intended operation condition.

Claims

1. A multi-unit air conditioner comprising:

an outdoor unit (A) including an outdoor unit heat exchanger (2), and a gas-liquid separator (3) connected to an outlet side of the outdoor unit heat exchanger (2) for separating refrigerant from the outdoor unit heat exchanger (2) into gas refrigerant and liquid refrigerant, and discharging separately;

an indoor unit (C) in each of a plurality of rooms having an indoor unit heat exchanger (62a,62b, 62c) and an electric expansion valve (61a,61b, 61c);

a distributor (B) connected between the outdoor unit (A) and the indoor unit (C), for leading gas refrigerant from the outdoor unit (A) to the indoor unit heat exchanger (62a,62b,62c) in the indoor unit (C) which heats the room, liquid refrigerant from the outdoor unit (A) to the electric expansion valve (61a,61b,61c) on the indoor unit (C) which cools the room, refrigerant passed through the indoor unit (C) to the indoor unit (C) again, wherein, when heating and cooling are carried out for the rooms individually, the refrigerant liquefied as the refrigerant passes through the indoor unit (C) which heats the room is lead to the outdoor unit (A) after being lead to the electric expansion valve (61a,61b, 61c) of the indoor unit (C) which cools the room again; and

a refrigerant piping connected between above units (A,B,C) inclusive of a plurality of check valves (5a,6a) and solenoid valves (4a,11a, 12a) provided thereto for controlling flow paths of the refrigerant.

2. The multi-unit air conditioner as claimed in claim 1, further comprising control means for controlling a rotational speed of an outdoor unit fan (2a) such that a gas-liquid mixture ratio of the refrigerant introduced into the gas-liquid separator (3) through the outdoor unit heat exchanger (2) is regulated suitable to different operation conditions.

3. The multi-unit air conditioner as claimed in claim 2, wherein the control means includes;
a temperature sensor (14) on an outdoor unit pipe for measuring a temperature of refrigerant discharged from the outdoor unit heat exchanger (2); and
a microcomputer for comparing the temperature of refrigerant measured at the temperature sensor (14) and a present refrigerant temperature, to detect a refrigerant mixture ratio in the pipe (5), and controlling a rotational speed of the outdoor unit fan (2a) so that the detected mixture ratio is identical to a preset mixture ratio required for different operation conditions.

4. The multi-unit air conditioner as claimed in claim 1, wherein the outdoor unit (A) includes a compressor (1), an outdoor unit fan (2a), the outdoor unit heat exchanger (2), an outdoor unit electric expansion valve (13a), the gas-liquid separator (3), an accumulator (19), and an outdoor unit piping connected between above elements having a plurality of check valves (5a,6a), and solenoid valves (4a,11a,12a) provided thereto.

5. The multi-unit air conditioner as claimed in claim 4, wherein the outdoor unit piping includes;
a discharge pipe (4) connected between the compressor (1) and the outdoor unit heat exchanger (2),
a support pipe (5) connected between the outdoor unit heat exchanger (2) and the gas-liquid separator (3),
a parallel pipe (13) branched from one side of the support pipe (5) and joined to the support pipe (5) again,
a gas refrigerant pipe (6) connected between an upper part of the gas-liquid separator (3) and the distributor (B),
a liquid refrigerant pipe (7) connected between a lower part of the gas-liquid separator (3) and the distributor (B),
a suction pipe (8) connected between the distributor (B) and the compressor (1),
a first bypass pipe (11) connected between the discharge pipe (4) and the gas refrigerant pipe (6), and
a second bypass pipe (12) connected between the discharge pipe (4) between the first bypass pipe (11) and the outdoor unit heat exchanger (2) and the suction pipe (8).

6. The multi-unit air conditioner as claimed in claim 5, wherein the discharge pipe (4) has a first solenoid valve (4a) provided on a position between the first bypass pipe (11) and the second bypass pipe (12).

7. The multi-unit air conditioner as claimed in claim 6, wherein the first solenoid valve (4a) is opened in operations all rooms are cooled, and a major number of rooms are cooled and a minor number of rooms are heated, and closed in operations all rooms are heated, and a major number of rooms are heated and a minor number of rooms are cooled.

8. The multi-unit air conditioner as claimed in one of claims 5 to 7, wherein the first bypass pipe (11) has a second solenoid valve (11a) provided thereon.

9. The multi-unit air conditioner as claimed in claim 8, wherein the second solenoid valve (11a) is closed in operations all rooms are cooled, and a major number of rooms are cooled and a minor number of rooms are heated, and opened in operations all rooms are heated, and a major number of rooms are heated and a minor number of rooms are cooled.

10. The multi-unit air conditioner as claimed in one of claims 5 to 9, wherein the second bypass pipe (12) has a third solenoid valve (12a) provided thereon.

11. The multi-unit air conditioner as claimed in claim 10, wherein the third solenoid valve (12a) is closed in operations all rooms are cooled, and a major number of rooms are cooled and a minor number of rooms are heated, and opened in operations all rooms are heated, and a major number of rooms are heated and a minor number of rooms are cooled.

12. The multi-unit air conditioner as claimed in one of claims 5 to 11, wherein the support pipe (5) has a first check valve (5a) provided thereon at a position between one point the parallel pipe (13) is branched therefrom and a point the parallel pipe (13) is joined thereto, for prevention of refrigerant flow from the gas-liquid separator (3) toward the outdoor unit heat exchanger (2).

13. The multi-unit air conditioner as claimed in one of claims 5 to 12, wherein the outdoor unit electric expansion valve (13a) is provided on the parallel pipe (13).

14. The multi-unit air conditioner as claimed in claim 13, wherein the outdoor unit electric expansion valve (13a) is closed in operations all rooms are cooled, and a major number of rooms are cooled and a minor number of rooms are heated, and operative in operations all rooms are heated, and a major number of rooms are heated and a minor number of rooms are cooled.

15. The multi-unit air conditioner as claimed in one of claims 5 to 14, wherein there is a second check valve (6a) provided on the gas refrigerant pipe (6) between the gas-liquid separator (3) and the first bypass pipe (11), for prevention of refrigerant flow from a first bypass pipe side to a gas-liquid separator side.

16. The multi-unit air conditioner as claimed in one of claims 5 to 15, wherein the accumulator (19) is provided on the suction pipe (8).

17. The multi-unit air conditioner as claimed in one of claims 5 to 16, wherein the distributor (B) includes;
a distributor piping for guiding gas or liquid refrigerant received through a gas refrigerant pipe (6) or a liquid refrigerant pipe (7) toward the indoor unit (C), and guiding refrigerant passed through the indoor unit (C) toward the outdoor unit (A) again, and
a valve part for controlling refrigerant flow in the distributor (B) piping such that gas or liquid refrigerant is selectively introduced into indoor units (C) in respective rooms and the refrigerant passed through the indoor unit (C) is re-introduced into the outdoor unit (A) according to different operation conditions.

18. The multi-unit air conditioner as claimed in claim 17, wherein the distributor (B) piping includes;
a gas refrigerant connection pipe (21) connected to the gas refrigerant pipe (6),
gas refrigerant branch pipes (22a,22b,22c) each branched from the gas refrigerant connection pipe (21) and connected to the indoor unit heat exchanger (62a,62b,62c) in each of the rooms,
a liquid refrigerant connection pipe (23) connected to the liquid refrigerant pipe (7),
liquid refrigerant branch pipes (24a,24b,24c) each branched from the liquid refrigerant connection pipe (23) and connected to the electric expansion valve (61a,61b,61c) in each of the rooms,
a connection branch pipe (25a,25b,25c) branched from each of the gas refrigerant branch pipes (22a, 22b,22c), and
a common branch pipe having the connection branch pipes joined thereto and connected to the suction pipe (8).

19. The multi-unit air conditioner as claimed in claim 18, wherein the valve part (30) includes a plurality of solenoid valves (4a,11a,12a) provided to the gas refrigerant branch pipes (22a,22b,22c), the liquid refrigerant branch pipes (24a,24b,24c), the connection branch pipes (25a,25b,25c) and controlled.

20. The multi-unit air conditioner as claimed in claim 19, wherein the valve part (30) in the distributor (B) is controlled such that the solenoid valve on the refrigerant connection pipe on an indoor unit side which

heats the room, and the solenoid valve (31a,31b, 31c) on the gas refrigerant branch pipe (22a,22b, 22c) on an indoor unit side which cools the room are only closed.

21. The multi-unit air conditioner as claimed in one of claims 5 to 20, wherein the check valves (5a,6a) and the solenoid valves (4a,11a,12a) make different refrigerant flow control depending on operation conditions of cooling all rooms, heating all rooms, a major number of rooms are cooled and a minor number of rooms are heated, a major number of rooms are heated and a minor number of rooms are cooled.

22. The multi-unit air conditioner as claimed in claim 21, wherein the check valves (5a,6a) and the solenoid valves (4a,11a,12a) are controlled in the operation of cooling all room such that entire refrigerant discharged from the compressor (1) is introduced into the compressor (1) after passed through the outdoor unit heat exchanger (2), the gas-liquid separator (3), the distributor (B), the electric expansion valve (13a), the indoor unit heat exchanger (62a, 62b,62c), and the distributor (B) in succession.

23. The multi-unit air conditioner as claimed in claim 21 or 22, wherein the check valves (5a,6a) and the solenoid valves (4a,11a,12a) are controlled in the operation of heating all room such that entire refrigerant discharged from the compressor (1) is introduced into the compressor (1) the second bypass pipe (12) after passed through the first bypass pipe (11), the distributor (B), the indoor unit heat exchanger (62a,62b,62c), the electric expansion valve (61a,61b,61c), the distributor (B), the gas-liquid separator (3), the outdoor unit expansion valve, and the outdoor unit heat exchanger (2) in succession.

24. The multi-unit air conditioner as claimed in claim 21 to 23, wherein the check valves (5a,6a) and the solenoid valves (4a,11a,12a) are controlled in the operation of cooling a major number of rooms and heating a minor number of rooms such that entire refrigerant discharged from the compressor (1) is introduced into the outdoor unit heat exchanger (2) and the gas-liquid separator (3), wherefrom liquid refrigerant is introduced into the compressor (1) after passed through the distributor (B), the cooling room electric expansion valves (61a,61b,61c), the cooling room indoor unit heat exchangers (62a,62b, 62c), and the distributor (B) in succession, and gas refrigerant is introduced into the compressor (1) through the distributor (B), a heating room indoor unit heat exchanger (62a,62b,62c) and a heating room electric expansion valve (61a,61b,61c), joined with the liquid refrigerant in the distributor (B), and passed through the cooling room electric expansion valves (61a,61b,61c), cooling room indoor unit heat exchangers (62a,62b,62c), and the distributor (B).

25. The multi-unit air conditioner as claimed in claim 21 to 24, wherein the check valves (5a,6a) and the solenoid valves (4a,11a,12a) are controlled in the operation of heating a major number of rooms and cooling a minor number of rooms such that entire refrigerant discharged from the compressor (1) is introduced into the distributor (B) through the first bypass pipe (11), and, therefrom, reintroduced into the distributor (B) via the heating room indoor unit heat exchangers (62a,62b,62c) and the heating room electric expansion valves (61a,61b,61c), and a portion of which refrigerant is introduced into the compressor (1) via the cooling room electric expansion valve (61a,61b,61c) and the cooling room indoor unit heat exchanger (62a,62b,62c) and the distributor (B), and the other portion of which refrigerant is introduced into the compressor (1) via the gas-liquid separator (3), the outdoor unit electric expansion valve (13a), and the outdoor unit heat exchanger (2) and through the second bypass pipe (12).

26. The multi-unit air conditioner as claimed in one of claims 1 to 25, wherein the electric expansion valve (61a,61b,61c) for the indoor unit (C) which heats the room is opened fully.

27. The multi-unit air conditioner as claimed in one of claims 1 to 26, wherein the electric expansion valve (61a,61b,61c) for the indoor unit (C) which cools the room is controlled to expand the refrigerant.

28. A method for controlling operation of an outdoor unit fan (2a) in a multi-unit air conditioner, in particular in the multi-unit air conditioner according to one of claims 1 to 27, the method comprising the steps of:

measuring a temperature of gas-liquid mixture refrigerant discharged from an outdoor unit heat exchanger (2);

comparing a measured refrigerant temperature to a preset refrigerant temperature, to detect a gas-liquid mixture ratio; and

varying a rotational speed of the outdoor unit fan (2a) so that a detected gas-liquid mixture ratio becomes identical to a preset mixture ratio required for an intended operation condition.

FIG. 1

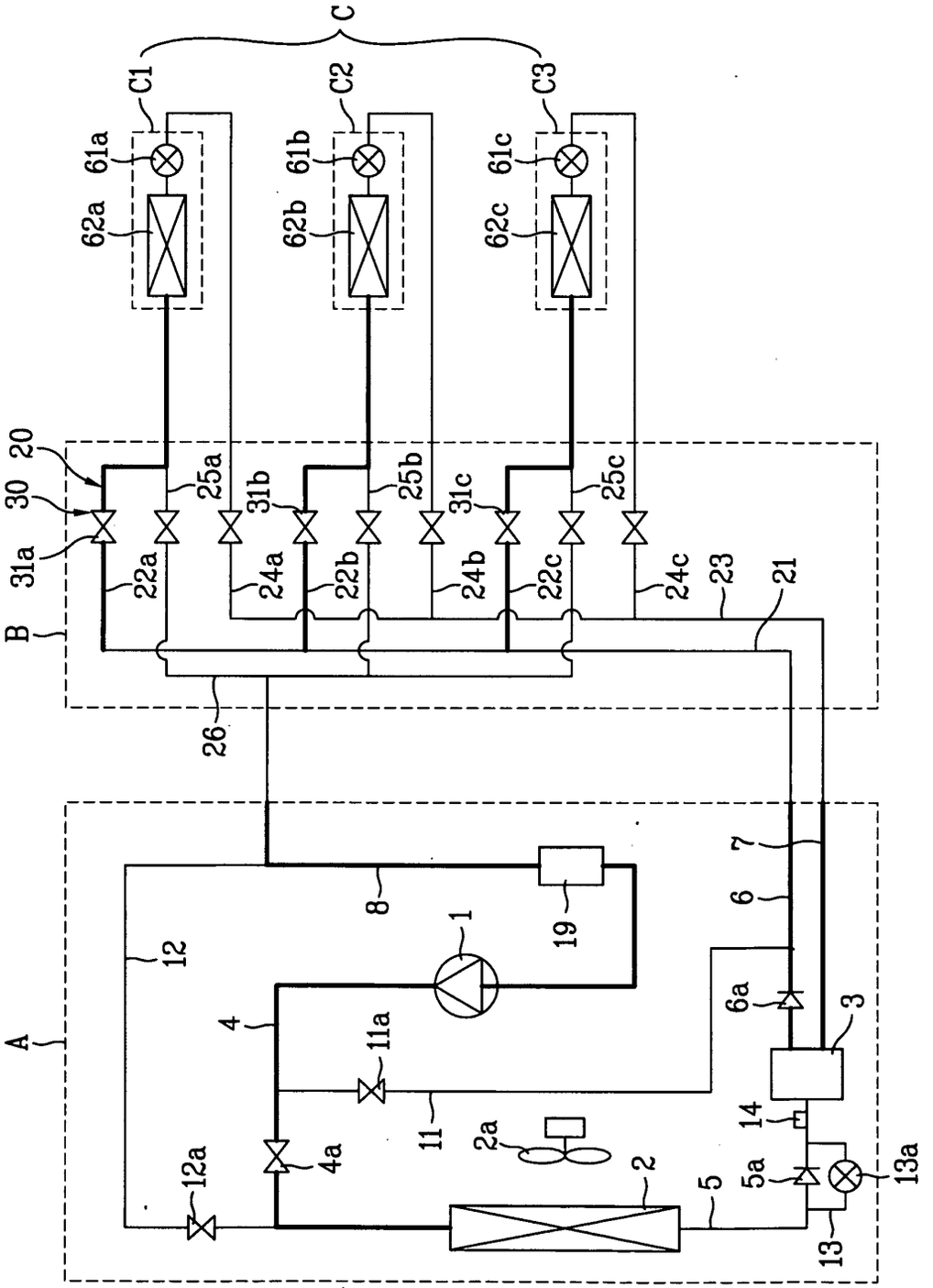

C
C1
C2
C3
61a
61b
61c
62a
62b
62c
20
30
31a
25a
31b
25b
31c
25c
B
22a
24a
22b
24b
22c
24c
23
21
26
A
8
19
1
12
4
11a
6a
3
7
6
14
11
2a
4a
12a
2
5
5a
13a
13

FIG. 2A

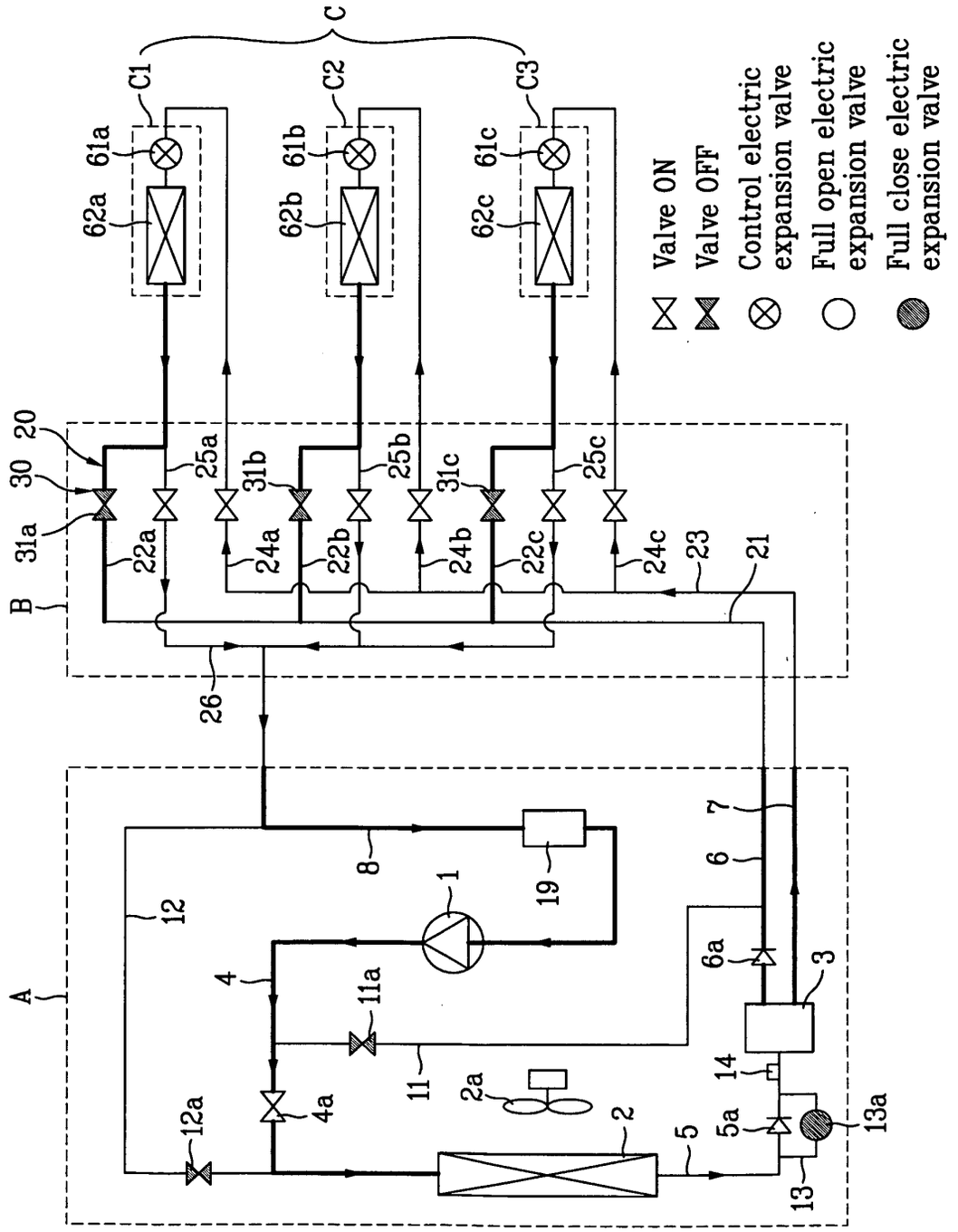

C
C1
C2
C3
61a
61b
61c
62a
62b
62c
Valve ON
Valve OFF
Control electric expansion valve
Full open electric expansion valve
Full close electric expansion valve
20
30
31a
B
22a
24a
25a
31b
22b
24b
25b
31c
22c
24c
25c
23
21
26
A
12
8
19
1
7
6
6a
3
4
11a
14
11
2a
4a
12a
2
5
5a
13a
13

FIG. 2B

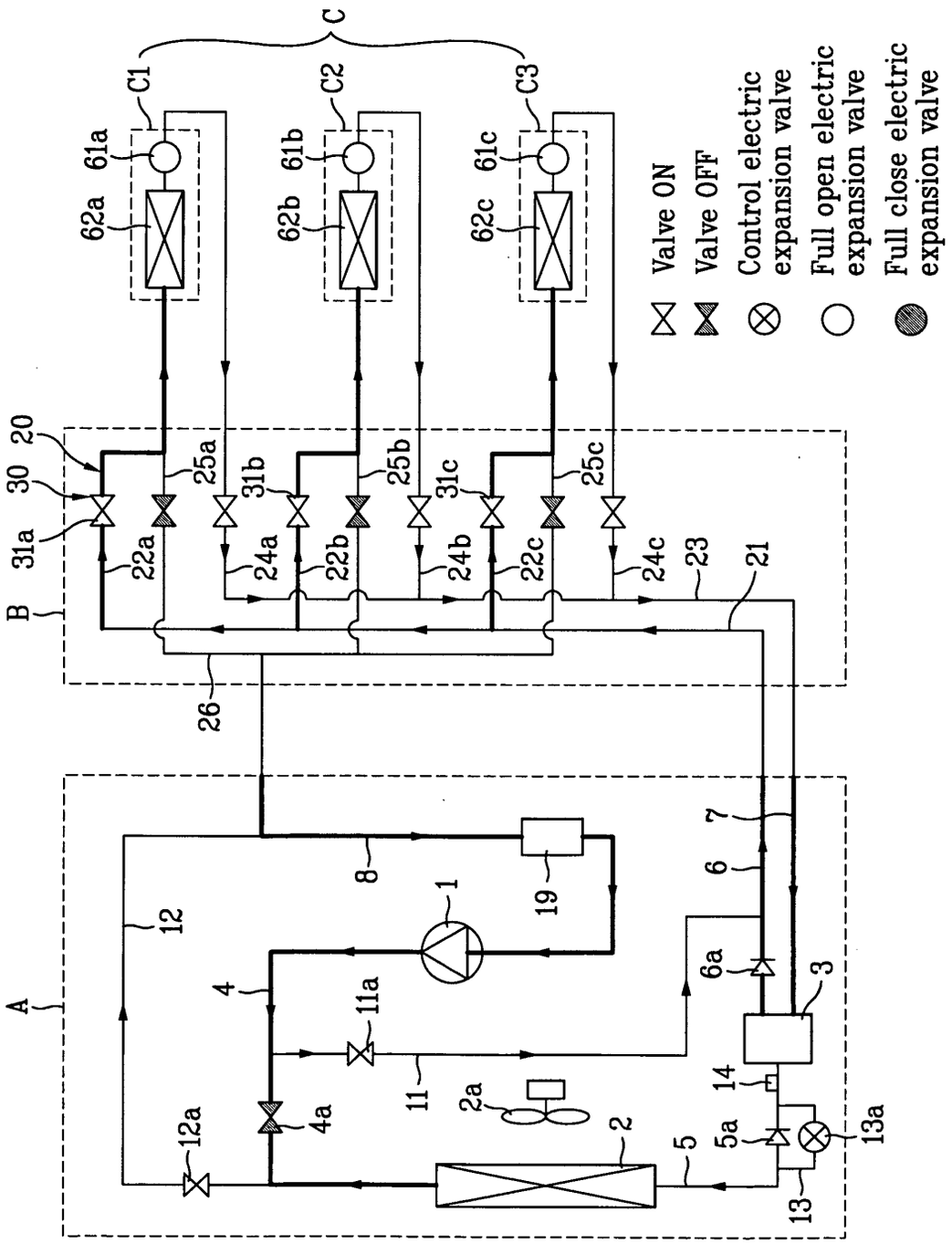

C
C1
C2
C3
61a
61b
61c
62a
62b
62c
Valve ON
Valve OFF
Control electric expansion valve
Full open electric expansion valve
Full close electric expansion valve
20
30
31a
25a
31b
25b
31c
25c
22a
24a
22b
24b
22c
24c
23
21
B
26
A
8
19
1
12
4
11a
6
7
6a
3
14
11
2a
4a
12a
2
5
5a
13a
13

FIG. 3A

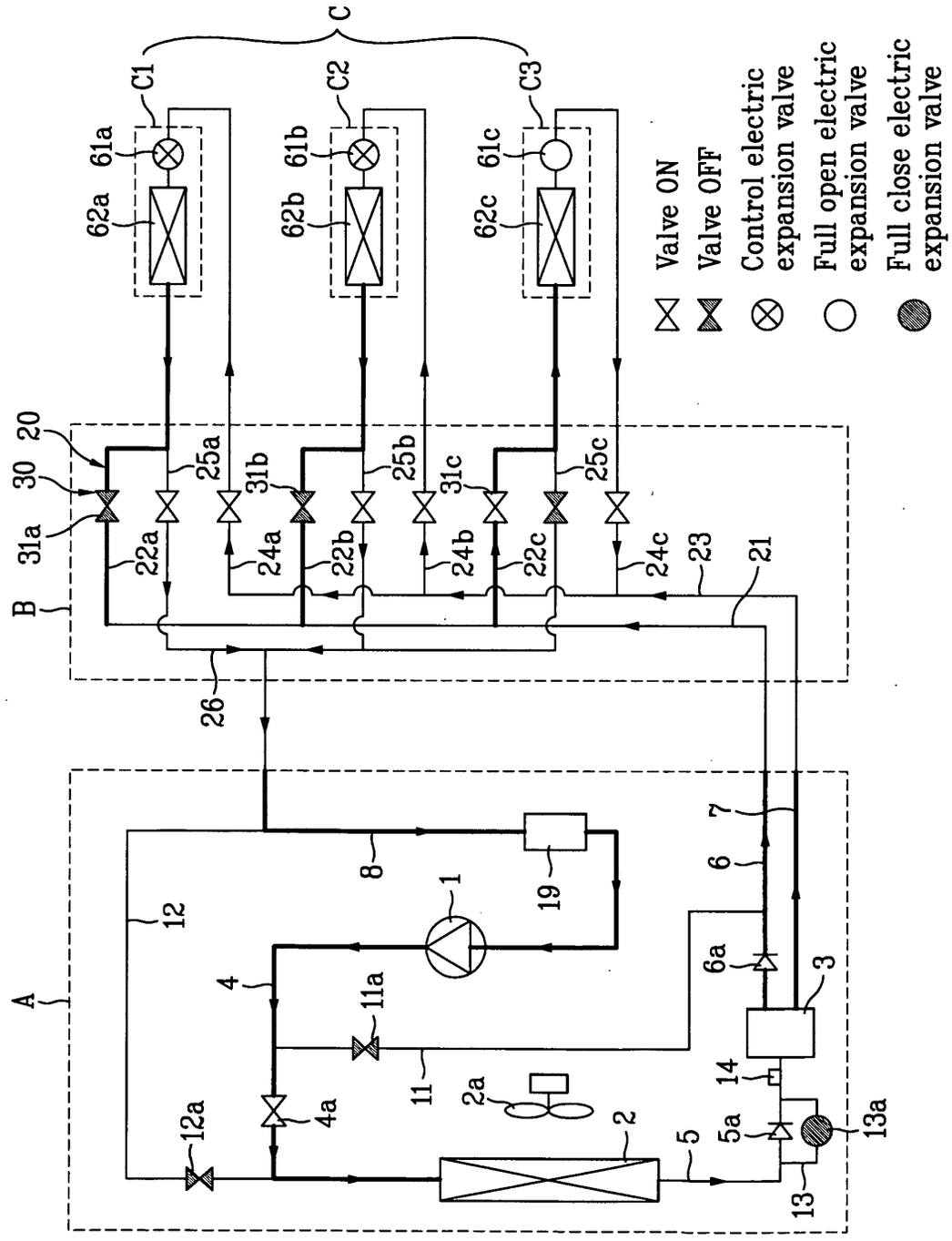
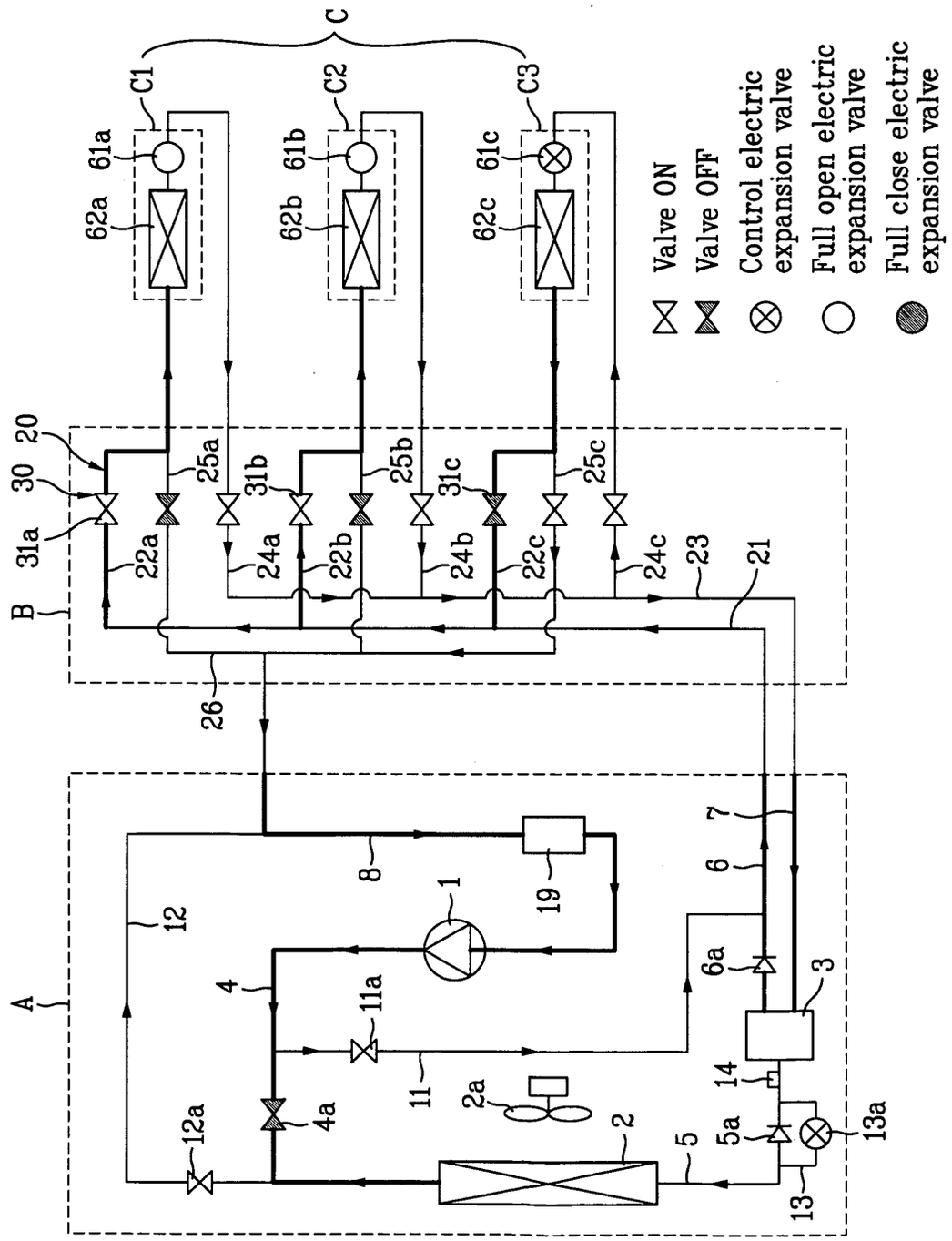

C
C1
C2
C3
61a
61b
61c
62a
62b
62c
Valve ON
Valve OFF
Control electric expansion valve
Full open electric expansion valve
Full close electric expansion valve
A
B
1
2
2a
3
4
4a
5
5a
6
6a
7
8
11
11a
12
12a
13
13a
14
19
20
21
22a
22b
22c
23
24a
24b
24c
25a
25b
25c
26
30
31a
31b
31c

FIG. 3B


C
C1
C2
C3
61a
61b
61c
62a
62b
62c
Valve ON
Valve OFF
Control electric expansion valve
Full open electric expansion valve
Full close electric expansion valve
20
30
31a
25a
31b
25b
31c
25c
22a
24a
22b
24b
22c
24c
23
21
B
26
A
8
19
1
12
4
11a
6
6a
7
3
14
11
2a
12a
4a
2
5
5a
13a
13