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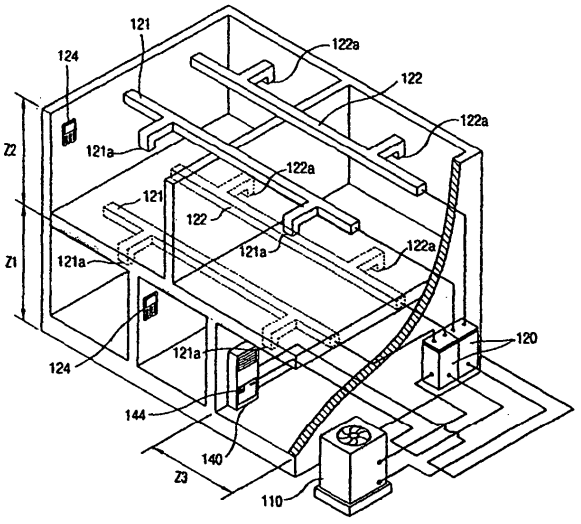
(54) Unitary air conditioning system

(57) A unitary air conditioning system comprises an outdoor unit including a compressor for compressing refrigerant, an outdoor heat exchanger for heat exchange of refrigerant, and an expander connected to the outdoor heat exchanger, for expanding refrigerant; a duct installed in each zone of a building; a plurality of central blower units, each unit having a heat exchanger connected to the outdoor unit by a refrigerant pipe and a blower for supplying the air heat-exchanged by the heat exchanger to the duct; and a cooling/heating control unit for selectively distributing a refrigerant from the outdoor unit toward the heat exchangers of the plurality of central blower units and controlling cooling or heating operation for each zone of the building. Accordingly, the plurality of blower units are systematically operated according to a load of each zone inside the building, so that the cooling or heating operation can be effectively performed on each zone.

FIG. 3



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Description

[0001] The present invention relates to an air conditioning system, and particularly, to a unitary air conditioning system provided with an outdoor unit and a plurality of blower units connected to the outdoor unit, for cooling or heating each zone inside a building.

[0002] In general, a unitary air conditioning system is a kind of central heating and cooling system in which cool air or warm air is made by using a heating and cooling device provided in a factory, an office, a hotel, a house or the like, and supplied to each zone through a pipe or a duct provided in a building.

[0003] In the unitary air conditioning system, to independently supply the cool or warm air to individual zones by distinguishing a zone requiring cooling or heating and a zone which does not so, a zone controller for distributing the cool or warm air is installed on a duct, or a plurality of heating and cooling devices are individually installed correspondingly to a plurality of zones.

[0004] As shown in FIGS. 1 and 2, a conventional unitary air conditioning system includes an outdoor unit 1 fixedly installed outside a building (a two-story building in the drawing); a supply duct 3 installed inside each zone (Z1) and (Z2) in the building, for distributing the cool or warm air to the zones (Z1) and (Z2); a return duct 4 for returning the cool or warm air in each zone (Z1) and (Z2); a central blower unit 2 connected with the outdoor unit 1 by refrigerant pipes, for sending cool or warm air to the supply duct 3; and a zone controller 5 installed between the central blower unit 2 and the supply duct 3 and between the central blower unit 2 and the return duct 4, for controlling a supply and a return of the air to and from the zones (Z1) and (Z2).

[0005] The outdoor unit 1 includes a compressor 1a for compressing refrigerant; a first heat exchanger 1b connected to the compressor 1 a by refrigerant pipes, for heat exchange between refrigerant and ambient air; an expander 1 c for expanding volume of refrigerant and reducing pressure of refrigerant; a four way valve 1 d disposed adjacent to the compressor 1 a, for circulating a compressed refrigerant discharged from the compressor 1a according to a heating cycle or a cooling cycle; and an accumulator 1e disposed in the vicinity of a refrigerant inlet of the compressor 1a, for filtering a liquefied refrigerant.

[0006] The central blower unit 2 includes a second heat exchanger 2a connected to the compressor 1 a and the expander 1 c by refrigerant pipes, respectively; and a supply fan (not shown) disposed adjacent to the second heat exchanger 2a, for supplying the cool or warm air to the supply duct 3.

[0007] A plurality of discharge openings 3a are formed at the supply duct 3 to supply the cool or warm air to a zone requiring cooling or heating, and a plurality of suction openings 4a through which the air of each zone is sucked are formed at the return duct 4.

[0008] The zone controller 5 is composed of valve 5a, 5b, 5c and 5d for selectively supplying the cool or warm air to each zone (Z1) and (Z2), wherein the valves are installed at the supply duct 3 and the return duct 4 arranged in the corresponding zone (Z1) and (Z2). By the zone controller 5, the cool or warm air is distributed thus to be supplied to each zone (Z1) and (Z2), or be selectively supplied to only one of the zones (Z1) and (Z2).

[0009] The conventional air conditioning system having such a structure is operated as follows.

[0010] First, in case that a load detected in each zone (Z1) and (Z2) is greater than a preset value, the cool or warm air is simultaneously supplied through the supply duct 3 of each zone (Z1) and (Z2). On the other side, in case that just one load of one of the zones (Z1) and (Z2) is greater than a preset value, the cool or warm air is supplied through the supply duct 3 of the corresponding zone, which requires cooling or heating, by operation of the zone controller 5.

[0011] For example, during the cooling operation, a refrigerant compressed by the compressor 1a of the outdoor unit 1 is condensed in the first heat exchanger 1b of the outdoor unit 1, and the condensed refrigerant passes through the expander 1c and then passes through the second heat exchanger 2a of the central blower unit 2, thereby exchanging its heat with the air introduced through the return duct 4. The air cooled in such a manner moves to the supply duct 3 by a supply fan (not shown).

[0012] At this time, the zone controller 5 is operated according to a load of each corresponding zone (Z1) and (Z2), thereby cooling the zone that requires cooling.

[0013] Meanwhile, during the heating operation, a flow of the refrigerant is converted by operation of the four way valve 1d, and a heating cycle is carried out as a reverse cycle of the cooling cycle.

[0014] However, the conventional air conditioning system constructed and operated as described above has following problems.

[0015] First, a zone controller for controlling a return and supply of air should be additionally installed when the cool or warm air is to be more intensively supplied to a zone having high loads, such as a kitchen, a sun room, an exercise room or the like in the building. However, operations for an additional installation of the duct and the zone controller are complicated.

[0016] Also, to independently correspond to a load of each zone, a plurality of outdoor units and a plurality of central blower units may be installed corresponding to the number of zones. However, it may cause an increase in cost, which is very inefficient.

[0017] Therefore, an aim of the present invention is to provide a unitary air conditioning system capable of effectively performing cooling or heating operation corresponding to a load of each zone by being provided with a cooling/heating control unit for selectively distributing a refrigerant from an outdoor unit to each blower unit for performing cooling or heating operation on each zone.

[0018] Another aim of the present invention is to provide a unitary air conditioning system capable of individ-

ually cooling or heating a specific zone having high loads or having no duct by employing an individual cooling and heating system within a central cooling and heating system performing heating and cooling operation on each zone in a building.

[0019] To achieve these and other advantages and in accordance with the purpose of the present invention, as embodied and broadly described herein, there is provided a unitary air conditioning system comprising an outdoor unit including a compressor for compressing refrigerant, an outdoor heat exchanger for heat exchange of refrigerant, and an expander connected to the outdoor heat exchanger, for expanding refrigerant; a duct installed in each zone of a building; a plurality of central blower units, each unit having a heat exchanger connected to the outdoor unit by a refrigerant pipe and a blower for supplying the air heat-exchanged by the heat exchanger to the duct; and a cooling/heating control unit for selectively distributing a refrigerant from the outdoor unit toward the heat exchangers of the plurality of central blower units and controlling cooling or heating operation for each zone of the building.

[0020] To achieve these and other advantages and in accordance with the purpose of the present invention, as embodied and broadly described herein, there is provided a unitary air conditioning system comprising an outdoor unit including a compressor for compressing refrigerant, an outdoor heat exchanger for heat exchange of refrigerant, and an expander connected to the outdoor heat exchanger, for expanding refrigerant; a duct installed in each zone of a building; a central blower unit having a heat exchanger connected to the outdoor unit by a refrigerant pipe, and a blower for supplying the air heat-exchanged by the heat exchanger to the duct; an individual blower unit including a heat exchanger connected to the outdoor unit by a refrigerant pipe and a fan for sending the air heat-exchanged by the heat exchanger, and disposed in a zone inside the building, for individually cooling or heating the zone; and a cooling/heating control unit for selectively distributing the refrigerant from the outdoor unit toward the heat exchangers of the central blower unit and the individual blower unit and controlling cooling or heating operation for each zone of the building.

[0021] The foregoing and other aims, features, aspects and advantages of the present invention will become more apparent from the following detailed description of the present invention when taken in conjunction with the accompanying drawings.

[0022] The accompanying drawings, which are included to provide a further understanding of the invention and are incorporated in and constitute a unit of this specification, illustrate embodiments of the invention and together with the description serve to explain the principles of the invention.

[0023] In the drawings:

FIG. 1 is a schematic view showing one example of a conventional air conditioning system;

FIG. 2 is a block diagram showing the air conditioning system of FIG. 1;

FIG. 3 is a schematic view showing an air conditioning system in accordance with an embodiment of the present invention;

FIG. 4 is a block diagram showing the air conditioning system of FIG. 3; and

FIG. 5 is a control block diagram of the air conditioning system of FIG. 3.

[0024] Reference will now be made in detail to the preferred embodiments of the present invention, examples of which are illustrated in the accompanying drawings.

[0025] As shown in FIGS. 3 to 5, a unitary air conditioning system in accordance with an embodiment of the present invention includes an outdoor unit 110 installed outside a building; a plurality of ducts 121 and 122 installed at each zone (Z1) and (Z) in the building, for distributing cool or warm air inside the building; a central blower unit 120 connected to the outdoor unit 110 and installed inside or outside the building, for supplying the cool or warm air inside the building through the ducts 121 and 121; an individual blower unit 140 connected to the outdoor unit 110 and installed at a specific zone (Z3) in the building, such as a kitchen or the like, for individually supplying the cool or warm air to the specific zone; and a cooling/heating control unit 300 for selectively distributing a refrigerant from the outdoor unit 110 toward the central blower unit 120 and the individual blower unit 140 and controlling the cooling and heating operation for each zone (Z1), (Z2) and (Z3).

[0026] The outdoor unit 110 includes a compressor 111 for compressing refrigerant; an outdoor heat exchanger 113 for heat exchange between refrigerant and ambient air; a four way valve 117 for circulating the refrigerant discharged from the compressor 111 according to a cooing cycle or a heating cycle; an accumulator 118 disposed in the vicinity of a refrigerant inlet of the compressor 111, for filtering a liquefied refrigerant; an expander 114 connected to the outdoor heat exchanger 113, for expanding volume of refrigerant and reducing pressure of refrigerant; and a fan 119 disposed adjacent to the outdoor heat exchanger 113.

[0027] The plurality of ducts 121 and 122 are divided to be arranged in a plurality of zones (Z1) and (Z2) in the building, respectively, and are composed of a supply duct 121 having a plurality of discharge openings 121a; and a returned duct 122 having a plurality of suction openings 122a.

[0028] Preferably, the number of central blower units 120 corresponds to the number of zones (Z1) and (Z2), and the central blower units 120 are installed in parallel, so that the cool or warm air can be independently supplied to the zones (Z1) and (Z2) in the building. In the present embodiment, a two-story building is divided into a first zone (Z1) on the first story and a second zone (Z2) on the second story, and an air conditioning system in

which two central blower units corresponding to the first and second zones (Z1) and (Z2) are installed in parallel will be now be described.

[0029] The central blower unit 120 includes a first heat exchanger 123 connected to the outdoor unit 110 through a first refrigerant pipe 150; and a blower 125 for supplying the air heat-exchanged by the first heat exchanger 123 to the supply duct 121.

[0030] The individual blower unit 140 includes a second heat exchanger 141 connected to the outdoor unit 110 by the second refrigerant pipe 160; and a blower fan 142 for sending the air heat-exchanged by the second heat exchanger 141.

[0031] The individual blower unit 140 is disposed in a zone where there are relatively high loads or a duct is not installed, such as a kitchen or a sun room inside the building, and subsidiarily cools or heats the zone (Z3).

[0032] Various types, such as a panel type, cabinet type, a slim type, a ceiling type, or the like can be employed for the individual blower unit 140, and the number of individual blower units 140 may be installed correspondingly to the number of zones requiring subsidiary cooling or heating.

[0033] The cooling/heating control unit 300 includes a plurality of first temperature controllers 124 installed inside each zone (Z1) and (Z2) in the building, for detecting a temperature of each zone (Z1) and (Z2) and receiving a set temperature value of a user; a second temperature controller 144 installed at the individual blower unit 140, for receiving a set temperature value of the user and detecting a temperature of a room where the individual blower unit 140 is installed; control valves 151, 152, 161 and 162 respectively installed at the first and second refrigerant pipes 150 and 160; and a control unit 301 connected with the first temperature controller 124 and the second temperature controller 144, for comparing room temperatures inputted from the first and second temperature controller 124 and 144 with a set temperature, and controlling operation of the control valves 151, 152, 161 and 162 and the compressor 111.

[0034] The first and second refrigerant pipes 150 and 160 are opened and closed by the operation of the control valves 151, 152, 161, and 162. According to this, the operation of the central blower unit 120 and the individual blower unit 140 is controlled, and the cooling or heating for each zone (Z1), (Z2) and (Z3) in the building is selectively controlled.

[0035] Meanwhile, preferably, the control unit 301 is directly connected with the second temperature controller 144 through a communication line.

[0036] Operation of the air conditioning system having such a structure in accordance with an embodiment of the present invention will now be described. Here, a case that the air conditioning system performs the cooling operation will be explained as an example.

[0037] First, if a temperature value of each zone (Z1), (Z2) and (Z3), which is detected from the first and second temperature controllers 124 and 144 of the cooling/heating control unit 300, and a temperature value set by a user are inputted to the control unit 301, the control unit 301 compares a room temperature of each zone (Z1), (Z2) and (Z3) with the set value of the user.

[0038] At this time, if the room temperatures of the zones (Z1), (Z2) and (Z3) exceed the set value, the control unit 301 outputs a signal for driving the compressor 111 and simultaneously, outputs a signal for opening the control valves 151, 152, 161 and 162.

[0039] Here, if all the temperature values of the zones (Z1), (Z2) and (Z3) exceed the set value, the control unit 301 opens all of the control valves 151, 152, 161 and 162. And if just one temperature value of one of the zones (Z1), (Z2) and (Z3) exceeds the set value, the control unit 301 opens only one set of control valves that are connected to the blower unit related to the corresponding zone, of the control valves 151, 152, 161 and 162.

[0040] For example, if a load of the first or second zone (Z1) and (Z2) exceeds a preset value and a load of the third zone (Z3) is smaller than the preset value, that is, if the cooling is required only for the first or second zone (Z1) and (Z2), the compressor 111 is driven by a signal of the control unit 301, the control valves 151 and 152 connected to the central blower unit 120 related to cooling operation for the first or second zone (Z1) and (Z2) are opened, and the control valves 161 and 162 connected to the individual blower unit 140 related to cooling operation for the third zone (Z3) maintains a closed state.

[0041] And a refrigerant compressed by the compressor 111 is introduced to the outdoor heat exchanger 113 through the four way valve 117 to be condensed, and the condensed refrigerant passes through the expander 114, thereby being expanded, reducing the pressure. And the refrigerant expanded in the expander 114 moves to the first heat exchanger 123 and is evaporated to thereby exchange its heat with ambient air of the first heat exchanger 123. And then, the air moves toward the outdoor unit 110.

[0042] And the air heat-exchanged by the first heat exchanger 123 is discharged to supply duct 121 by the blower 125 and to the first and second zones (Z1) and (Z2) through the discharge openings 121a. And the air having completed its cooling operation in the first or second zone (Z1) and (Z2) is introduced to the return duct 122 through the suction openings 122a, is reintroduced to the central blower unit 120 and passes through the first heat exchanger 123, thereby being cooled again. Such processes are repeated, so that the central cooling operation is performed on the first or second zone (Z1) and (Z2).

[0043] Meanwhile, if the sum of loads of the third zone (Z3) having specially high loads, such as a kitchen, a sun room or the like is greater than a preset value, the second refrigerant pipe 160 connecting the individual blower unit 140 with the outdoor unit 110 is opened by operation of the control valves 161 and 162. According to this, the refrigerant having passed through the outdoor heat exchanger 113 and the expander 114 is introduced to the second heat exchanger 141 of the individual blower unit

140 and exchanges it heat with ambient air of the second heat exchanger 141. And the air heat-exchanged by the second heat exchanger 141 is sent to the third zone (Z3) by the fan 141, thereby individually cooling the third zone (Z3).

[0044] Meanwhile, the control unit 301 compares a room temperature of each zone (Z1), (Z2) and (Z3) with a set value. If all the room temperatures of the zones (Z1), (Z2) and (Z3) are lower than the set value, the control unit 301 outputs a signal for stopping the compressor 111 and simultaneously outputs a signal for closing the control valves 151, 152, 161 and 162. According to this, the compressor 111 is stopped, the first and second refrigerant pipes 150 and 160 that respectively connects the central blower unit 120 and the individual blower unit 140 with the outdoor unit 110 are closed, thereby stopping the cooing operation for each zone.

[0045] In case that the air conditioning system in accordance with the present invention performs heating operation, a flow of a refrigerant is changed by the operation of the four way valve 116, and the refrigerant moves in reverse order of the above-described cooling cycle.

[0046] In the unitary air conditioning system in accordance with the present invention, a central blower unit performing central cooling or heating operation through a duct and an individual blower unit for individually cooling or heating a specific zone where there are relatively high loads or a duct is not installed are installed to be connected in parallel to one outdoor unit. Accordingly, cooling or heating operation can be performed zone by zone using a duct and simultaneously, individual cooling or heating operation can be additionally performed on a specific zone, so that a cost is lowered and the cooling and heating operation for the building can be efficiently carried out.

[0047] In addition, by providing a cooling/heating control unit which can circulate a refrigerant by distributing the refrigerant between one outdoor unit and a plurality of blower units, the plurality of blower units are systematically operated according to a load of each zone in a building. Accordingly, the cooling or heating operation for each zone can be effectively carried out.

[0048] As the present invention may be embodied in several forms without departing from the spirit or essential characteristics thereof, it should also be understood that the above-described embodiments are not limited by any of the details of the foregoing description, unless otherwise specified, but rather should be construed broadly within its spirit and scope as defined in the appended claims, and therefore all changes and modifications that fall within the metes and bounds of the claims, or equivalence of such metes and bounds are therefore intended to be embraced by the appended claims.

Claims

1. A unitary air conditioning system comprising:

an outdoor unit including a compressor for compressing refrigerant, an outdoor heat exchanger for heat exchange of refrigerant, and an expander connected to the outdoor heat exchanger, for expanding refrigerant;
a duct installed in each zone of a building;
a plurality of central blower units, each unit having a heat exchanger connected to the outdoor unit by a refrigerant pipe and a blower for supplying the air heat-exchanged by the heat exchanger to the duct; and
a cooling/heating control unit for selectively distributing a refrigerant from the outdoor unit toward the heat exchangers of the plurality of central blower units and controlling cooling or heating operation for each zone of the building.

2. The system of claim 1, wherein the cooling/heating control unit comprises:

a plurality of temperature controllers installed inside each zone in the building, for detecting a temperature of each zone and receiving a set temperature value of a user;
control valves installed at refrigerant pipes for respectively connecting the outdoor unit with the plurality of central blower units, for controlling a flow rate of a refrigerant; and
a control unit connected to the temperature controllers, for comparing a room temperature inputted from each temperature controller with a set temperature value of a user, and controlling the control valves.

3. A unitary air conditioning system comprising:

an outdoor unit including a compressor for compressing refrigerant, an outdoor heat exchanger for heat exchange of refrigerant, and an expander connected to the outdoor heat exchanger, for expanding refrigerant;
a duct installed in each zone of a building;
a central blower unit having a heat exchanger connected to the outdoor unit by a refrigerant pipe, and a blower for supplying the air heat-exchanged by the heat exchanger to the duct;
an individual blower unit including a heat exchanger connected to the outdoor unit by a refrigerant pipe and a fan for sending the air heat-exchanged by the heat exchanger, and disposed in a zone inside the building, for individually cooling or heating the zone; and
a cooling/heating control unit for selectively distributing the refrigerant from the outdoor unit toward the heat exchangers of the central blower unit and the individual blower unit, and controlling cooling or heating operation for each zone of the building.

4. The system of claim 3, wherein the cooling/heating control unit comprises:

a plurality of first temperature controllers installed inside each zone in the building, for detecting a temperature of each zone and receiving a set temperature value of a user;
a second temperature controller installed at the individual blower unit, for receiving a set temperature value of the user and detecting a temperature of a room where the individual blower unit is installed;
control valves respectively installed at refrigerant pipes that respectively connect the outdoor unit with the central blower units and a refrigerant pipe that connects the outdoor unit with the individual blower unit; and
a control unit connected with the first temperature controllers and the second temperature controller, for comparing the room temperatures inputted from the first and second temperature controllers with the set temperature value, and controlling the control valves.

5. The system of claim 4, wherein the second temperature controller and the control unit are directly connected to each other through a communication line.

FIG. 1

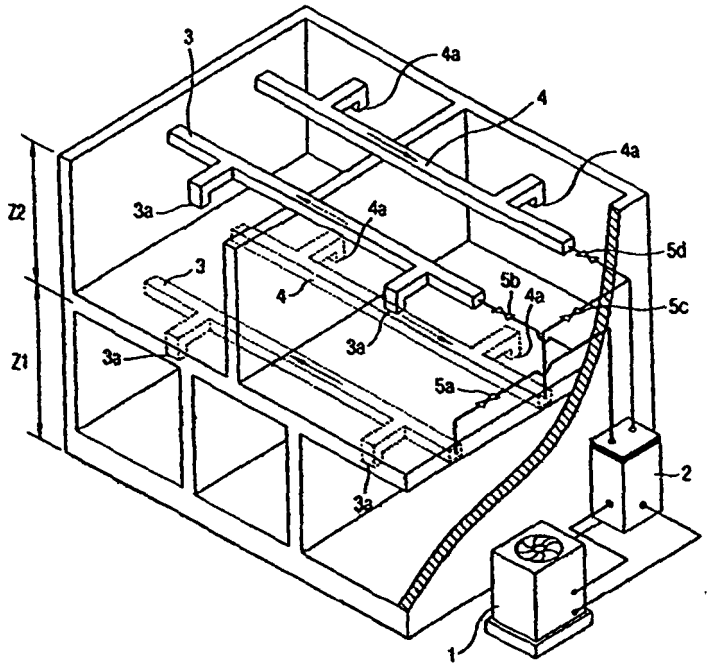


FIG. 2

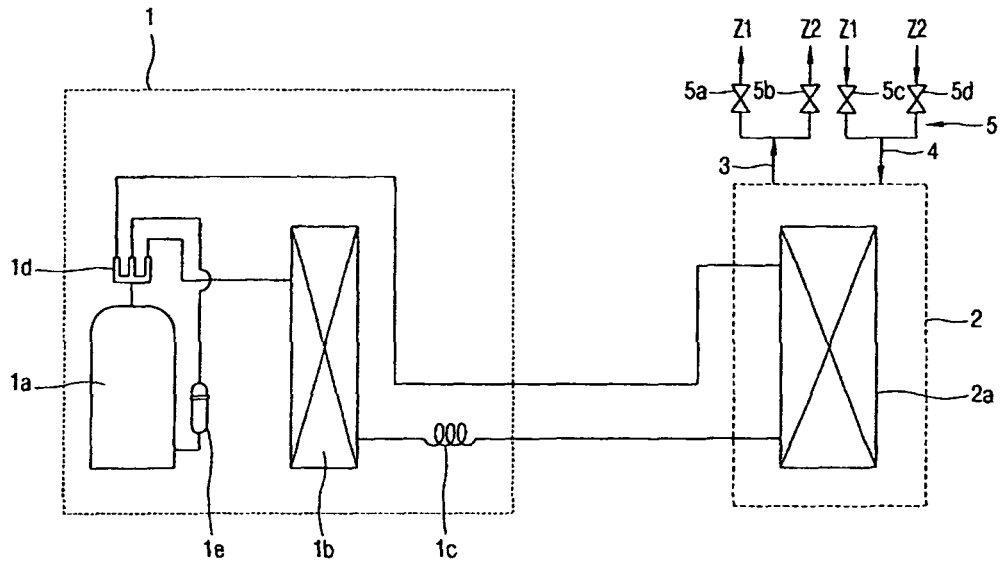
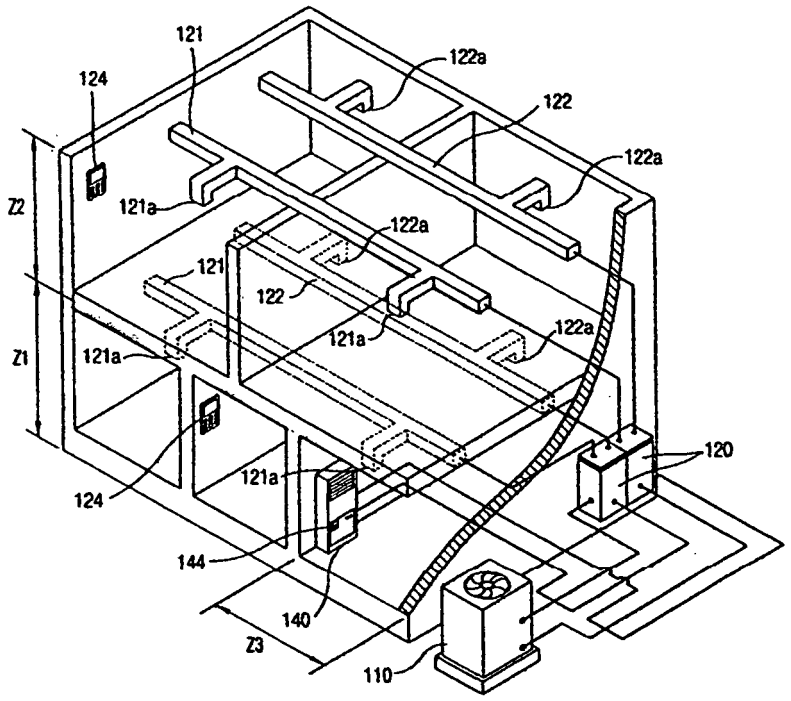


FIG. 3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Z1
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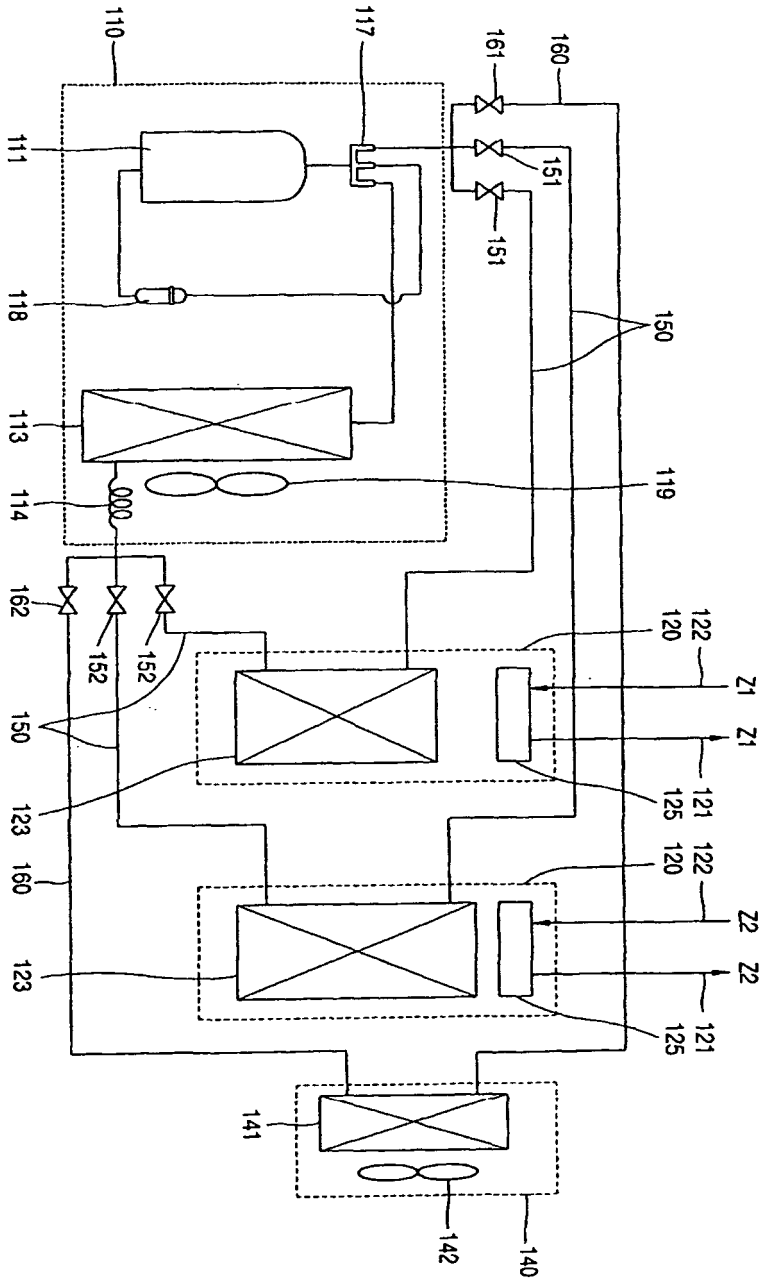
144
140
Z3
110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Z1
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123
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Z2
Z2
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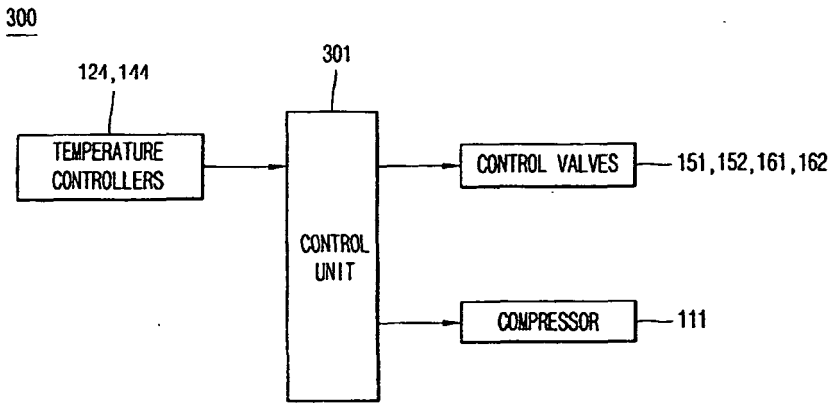
121
125
141
142
140

FIG. 4

FIG. 5


300
124,144
301
TEMPERATURE CONTROLLERS
CONTROL UNIT
CONTROL VALVES
151,152,161,162
COMPRESSOR
111