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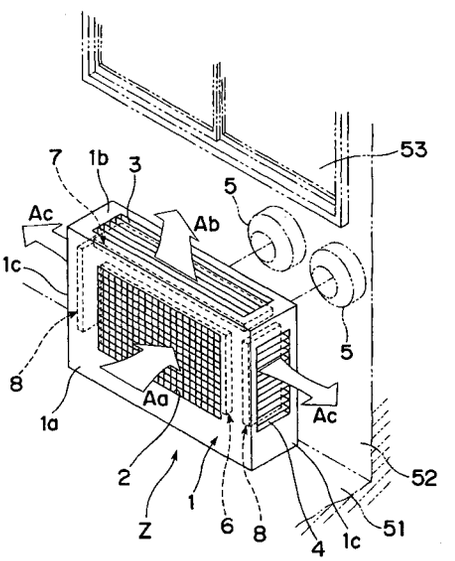
(54) INDOOR UNIT FOR AIR CONDITIONER

(57) An indoor unit for a low-place installation type air conditioner comprising a casing (1) having an air inlet (2) in the front surface (1a), an upper surface air outlet (3) in the upper surface (1b) and side surface air outlets (4) in the side surfaces (1c) and installed on an indoor floor (51) or in the vicinity thereof, and a fan (5) and a heat exchanger (6) that are disposed in the casing (1) such that the heat exchanger (6) lies on the suction side of the fan (5), wherein a second heat exchanger (7,8) is installed in the casing (1) to regulate the temperature of either the upper outlet air (Ab) or the side outlet air (Ac) such that the temperature of the upper outlet air (Ab) from the upper surface air outlet (3) is lower than the temperature of the side outlet air (Ac) from the side surface air outlet (4). The first heat exchanger (6) is positioned on the upstream side in the direction of airflow, while the second heat exchanger (7, 8) is positioned on the downstream side in the direction of airflow, and the second heat exchanger (7, 8) faces either the upper surface air outlet (3) or the side surface air outlet (4).

Fig. 1



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Description

TECHNICAL FIELD

[0001] The present invention relates to an indoor unit for an air conditioner, which is installed on an indoor floor or at a low place in the vicinity thereof so that conditioned air is blown upward and sideways.

BACKGROUND ART

[0002] In general, an air conditioner performs indoor cooling or heating by blowing cooled air or warmed air indoors and circulating it indoors through convection.

[0003] However, when performing indoor cooling or heating by such a forced convection system, an influence heat radiation from a perimeter zone to a central residence area becomes a problem. That is, for example, in summer or winter, the difference between the outdoor temperature and the indoor temperature is large, and heat enters the indoor side from the outdoor side. As a result, a cooling load or a heating load when air-conditioning increases, thus impairing comfortableness in cooling/heating.

[0004] As a technique to suppress deterioration of the comfortableness in cooling or heating due to the influence of heat from the perimeter zone, there is proposed a method of performing cooling/heating wherein an indoor unit for an air conditioner is installed on an indoor floor by an indoor wall or a window or at a low place in the vicinity of the floor, and conditioned air is blown upward and sideways to form an air barrier in the vicinity of the perimeter zone, thereby performing indoor cooling or heating while eliminating the influence of heat from the perimeter zone.

[0005] Fig. 26 shows an indoor unit Z_0 used for such a purpose, and Fig. 27 shows a refrigerant circuit of an air conditioner equipped with the indoor unit Z_0. In Fig. 27, arrow W in the broken line indicates the direction of the flow of a refrigerant when heating, while arrow C in the solid line indicates the direction of the flow of the refrigerant when cooling. The indoor unit Z_0 is constructed as follows: in a rectangular-shaped casing 1 having an air inlet 2 in the front surface 1a, an upper surface air outlet 3 in the upper surface 1b and side surface air outlets 4 in the side surfaces 1c, 1c, centrifugal fans 5, 5 are disposed with their suction sides directed to the air inlet 2, and a heat exchanger 6 is positioned between the suction side of the fans 5 and the inlet 2. Indoor air sucked by the fans 5 through the air inlet 2 is heat exchanged by the heat exchanger 6 to give cooled or warmed air. The resultant cooled or warmed air is blown upward from the upper surface air outlet 3 or blown sideways from the side surface air outlets 4, 4 respectively. As shown in Fig. 27, this indoor unit Z_0 is connected to an outdoor unit Y equipped with a compressor 9, a direction switching valve 10, an outdoor-side heat exchanger 11 and a main expansion valve 12, via refrigerant piping (collectively referred to as P), thus constituting an air conditioner.

[0006] However, such a low-place installation type conventional indoor unit Z_0 has a structure in which the heat exchanger 6 is positioned on the suction side of the fans 5, and the upper surface air outlet 3 and the side surface air outlets 4, 4 directly face the discharge side of the fans 5. Therefore, in both of the heating operation shown in Fig. 28 and the cooling operation shown in Fig. 29, sucked air Aa is heat exchanged by the heat exchanger 6 and then blown through the upper surface air outlet 3 as upper outlet air Ab and blown through the upper side surface air outlets 4 as side outlet air Ac. The upper outlet air and the side outlet air have the same temperature.

[0007] Accordingly, the upper outlet air Ab from the upper surface air outlet 3 and the side outlet air Ac from the side surface air outlets 4 form an air barrier by the window or by the wall thereby achieving a function of controlling entry of heat radiation. However, the temperature on the floor side is lowered in the heating operation due to rising of warm air from the indoor floor, while cold air is liable to remain on the floor side in the cooling operation. In both of these operations, realization of a "cooling a head and warming feet" ambience, which is an ambience of an ideal temperature distribution, is difficult, and there was a problem of impairing a comfortable air conditioning.

DISCLOSURE OF INVENTION

[0008] The present invention was made with the object of realizing a "cooling a head and warming feet" ambience of ideal temperature distribution a without a sense of draft and improving comfortableness of air conditioning in a low-place installation type conventional indoor unit.

[0009] In order to achieve the above object, in an indoor unit for an air conditioner comprising a casing having an air inlet in a front surface, an upper surface air outlet in an upper surface and a side surface air outlet in a side surface and installed on an indoor floor or in the vicinity of the indoor floor, and a fan and a heat exchanger that are disposed in the casing such that the heat exchanger lies on a suction side of the fan, the indoor unit of the present invention further comprises a means for regulating a temperature of either upper outlet air from the upper surface air outlet or side outlet air from the side surface air outlet such that the temperature of the upper outlet air is lower than the temperature of the side outlet air.

[0010] With this construction, in the cooling operation, colder air is blown to an upper part of a room, while relatively warm air is blown to a lower part of the room. Therefore, the "cooling a head and warming feet" ambience is realized, and a sensation of being comfortably cooled (comfortable cooling sensation) can be obtained by efficiently restraining cold air from gathering at one's

feet. On the other hand, in the heating operation, rising of warm air from the vicinity of the floor is controlled by the low-temperature air in the upper part of the room, whereby the "cooling a head and warming feet" ambience is realized, and a sensation of being comfortably heated (comfortable heating sensation) is obtained.

[0011] In one embodiment, the means for regulating a temperature of either upper outlet air from the upper surface air outlet or side outlet air from the side surface air outlet comprises a second heat exchanger within the casing, and the heat exchanger (referred to as the "first heat exchanger" below) is positioned upstream in a direction of airflow, while the second heat exchanger is positioned downstream in the direction of airflow, and the second heat exchanger faces any one of the upper surface air outlet and the side surface air outlet.

[0012] In the case where the second heat exchanger is provided on the side of the upper surface air outlet, in the cooling operation, the air to be blown upward through the upper surface air outlet passes both the first heat exchanger and the second heat exchanger to be cooled by both of them. Therefore, the temperature of the air becomes lower than that of air to be blown sideways through the side surface air outlet, the latter passing only the first heat exchanger. The cooler air is blown to the upper part of the room, while the relatively warm air is blown to the lower part of the room. Therefore, the "cooling a head and warming feet" state is realized, and a comfortable cooled sensation is obtained by efficiently suppressing cold air gathered at one's feet. That is, an operation that lays stress on the comfortableness in cooling is realized.

[0013] On the other hand, in the case where the second heat exchanger is provided for the side surface air outlet, in the heating operation, air to be blown sideways from the side surface air outlet passes both the first heat exchanger and the second heat exchanger. Therefore, the temperature of the air blown sideways becomes higher than that of air blown upward from the upper surface air outlet, which passes only the first heat exchanger, and warm air in the vicinity of the floor is restrained from rising by cold air in the upper part of the room. Therefore, the "cooling a head and warming feet" ambience is realized, and a comfortable heating sensation is obtained. That is, an operation that lays stress on the comfortableness in warming is realized.

[0014] The second heat exchanger may be formed integrally with or separately from the first heat exchanger. In the case where they are formed integrally, it is possible to reduce the production costs by reduction in the number of components or in the number of assembling process steps to thereby provide an indoor unit inexpensively. On the other hand, when the first and second heat exchangers are formed separately, or as separate pieces, the freedom of layout of the first and second heat exchangers relative to the casing is improved, so that it is possible to easily address diversification of needs regarding the indoor unit configuration

[0015] In one embodiment, the second heat exchanger is disposed facing the upper surface air outlet, and the second heat exchanger is made to function as an evaporator on a low-pressure side in a cooling operation, and, in a heating operation, as an evaporator on a side a little closer to a high-pressure side than in the cooling operation.

[0016] In this embodiment, in the heating operation, a relatively low-temperature air, which was first heated by the first heat exchanger and then cooled by the second heat exchanger functioning as the evaporator on the side closer to the low-pressure side than the first heat exchanger, is blown out from the upper surface air outlet. On the other hand, a relatively high-temperature air only heated by the first heat exchanger is blown out from the side surface air outlet. Thus, rising of the air having a relatively high temperature in the lower part of the room is suppressed by the air having a relatively low temperature in the upper part of the room. Therefore, "cooling a head and warming feet" is realized, and a comfortable warming sensation is obtained.

[0017] On the other hand, in the cooling operation, a low-temperature air, which passed both the first heat exchanger and the second heat exchanger and was cooled by both of them, is blown through the upper surface air outlet. In contrast, a relatively high-temperature air, which passed only the first heat exchanger, is blown through the side surface air outlet. Therefore, a "cooling a head and warming feet" ambience is realized, and a comfortable cooling sensation is obtained by efficiently restraining cold air from gathering at one's feet.

[0018] In another embodiment, the second heat exchanger is disposed facing the side surface air outlet, and the second heat exchanger is made to function as a condenser on a high-pressure side in a heating operation, and, in a cooling operation, as an evaporator on a side a little closer to a low-pressure side than in the heating operation.

[0019] In this embodiment, in the heating operation, a high-temperature air heated by the first heat exchanger and further heated by the second heat exchanger is blown from the side surface air outlet. In contrast, a relatively low-temperature air heated by only the first heat exchanger is blown from the upper surface air outlet. Thus, rising of the relatively high-temperature air from the lower part of the room is controlled by the relatively low-temperature air in the upper part of the room. Therefore, "cooling a head and warming feet" is realized, and a comfortable heating sensation is obtained.

[0020] On the other hand, in the cooling operation, a relatively high-temperature air first cooled by the first heat exchanger and then heated by the second heat exchanger functioning as the evaporator on the side closer to the high-pressure side than the first heat exchanger is blown out from the side surface air outlet. In contrast, a low-temperature air that passed only the first heat exchanger is blown from the upper surface air outlet. Therefore, "cooling a head and warming feet" is real-

ized, and a comfortable cooling sensation is obtained by efficiently suppressing cold air gathering at one's feet.

[0021] The heat exchanger and/or the second heat exchanger may be constructed of a stack type heat exchanger comprising a plurality of flat heat exchanger tubes and a plurality of fins being alternately stacked, with both end portions of each of the flat heat exchanger tubes being connected by headers, respectively. The characteristics of the stack-type heat exchanger make it possible to reduce the thickness of the heat exchanger, as compared with the case where each of the first heat exchanger and the second heat exchanger is constructed of a cross-fin type heat exchanger, for example. As a result, it becomes possible to achieve both downsizing and improvement in the performance of the indoor unit.

[0022] In another embodiment, the means for regulating a temperature of either upper outlet air from the upper surface air outlet or side outlet air from the side surface air outlet comprises a heater provided at the side surface air outlet.

[0023] In this indoor unit, in the heating operation, the temperature of the air heated by the heat exchanger and blown upward from the upper surface air outlet is lower than that of the air heated by both the heat exchanger and the heater and blown sideways from the side surface air outlet. Therefore, a relatively high-temperature air in the lower part of the room is prevented from rising by a relatively low-temperature air in the upper part of the room. This realizes "cooling a head and warming feet", and a comfortable heating sensation is obtained.

[0024] On the other hand, in the cooling operation, a relatively high-temperature air cooled by the heat exchanger and then heated by the heater is blown sideways from the side surface air outlet. In contrast, a relatively low-temperature air only cooled by the heat exchanger is blown from the upper surface air outlet. Therefore, the relatively high-temperature air is present in the lower part of the room, and the relatively low-temperature air is present in the upper part of the room. This realizes a "cooling a head and warming feet" ambience that is of an ideal temperature distribution, and a comfortable cooling sensation can be obtained, with cold air gathering at one's feet suppressed efficiently.

[0025] In one embodiment, the means for regulating a temperature of either upper outlet air from the upper surface air outlet or side outlet air from the side surface air outlet comprises a circulation system which makes indoor air bypass the heat exchanger and blows indoor air toward the upper surface and/or the side surface.

[0026] In the case where the indoor air is blown toward the upper surface of the casing by the circulation system, in the heating operation, the air heated by the heat exchanger and the indoor air from the circulation system are mixed and blown upward from the upper surface air outlet, whereby the temperature of the air blown upward is relatively low. On the other hand, a relatively high-temperature air heated by the heat exchanger is let out through the side surface air outlet. Therefore, the relatively high-temperature air in the lower part of the room is restrained from rising by the relatively low-temperature air in the upper part of the room. This realizes "cooling a head and warming feet", and a comfortable heating sensation is obtained. That is, an operation that places importance on comfortableness in heating is obtained.

[0027] On the other hand, in the case where the indoor air is blown sideways by the circulation system, in the cooling operation, a relatively low-temperature air cooled by the heat exchanger is blown upward from the upper surface air outlet, while a relatively high-temperature mixture of the air cooled by the heat exchanger and the indoor air from the circulation system is blown from the side surface air outlet. This controls cold air remaining at one's heat as much as possible, and the operation that lays stress on the comfortableness in cooling is realized.

BRIEF DESCRIPTION OF THE DRAWINGS

[0028]

Fig. 1 is a perspective view showing an installation state of an indoor unit for an air conditioner of the present invention;

Fig. 2 is a cross-sectional view showing an arrangement of heat exchangers of the indoor unit in the air conditioner of a first embodiment of the present invention;

Fig. 3 is a refrigerant circuit diagram of the air conditioner shown in Fig. 2;

Fig. 4 is an operation diagram of the air conditioner shown in Fig. 2 in a heating operation;

Fig. 5 is an operation diagram of the air conditioner shown in Fig. 2 in a cooling operation;

Fig. 6 is a plan view showing the structure of a stack-type heat exchanger;

Fig. 7 is a refrigerant circuit-diagram of an air conditioner of a second embodiment of the present invention;

Fig. 8 is an operation diagram of the air conditioner shown in Fig. 7 in a heating operation;

Fig. 9 is an operation diagram of the air conditioner shown in Fig. 7 in a cooling operation;

Fig. 10 is a sectional view showing an arrangement of heat exchangers of an indoor unit in an air conditioner of a third embodiment of the present invention;

Fig. 11 is a refrigerant circuit diagram of the air conditioner shown in Fig. 10;

Fig. 12 is an operation diagram of the air conditioner shown in Fig. 10 in a heating operation;

Fig. 13 is an operation diagram of the air conditioner shown in Fig. 10 in a cooling operation;

Fig. 14 is a refrigerant circuit diagram of an air con-

ditioner of a fourth embodiment of the present invention;
Fig. 15 is an operation diagram of the air conditioner shown in Fig. 14 in a heating operation;
Fig. 16 is an operation diagram of the air conditioner shown in Fig. 14 in a cooling operation;
Fig. 17 is a refrigerant circuit diagram of an air conditioner of a fifth embodiment of the present invention;
Fig. 18 is an operation diagram of the air conditioner shown in Fig. 17 in a heating operation;
Fig. 19 is an operation diagram of the air conditioner shown in Fig. 17 in a cooling operation;
Fig. 20 is a refrigerant circuit diagram of an air conditioner of a sixth embodiment of the present invention;
Fig. 21 is an operation diagram of the air conditioner shown in Fig. 20 in a heating operation;
Fig. 22 is an operation diagram of the air conditioner shown in Fig. 20 in a cooling operation;
Fig. 23 is a refrigerant circuit diagram of an air conditioner of a seventh embodiment of the present invention;
Fig. 24 is a sectional view of an indoor unit in an air conditioner of an eighth embodiment of the present invention;
Fig. 25 is a sectional view of an indoor unit in an air conditioner of a ninth embodiment of the present invention;
Fig. 26 is a sectional view showing an arrangement of heat exchangers of an indoor unit in a conventional air conditioner;
Fig. 27 is a refrigerant circuit diagram of the conventional air conditioner;
Fig. 28 is an operation diagram of the conventional air conditioner in a heating operation; and
Fig. 29 is an operation diagram of the conventional air conditioner in a cooling operation.

BEST MODE FOR CARRYING OUT THE INVENTION

[0029] The present invention will be specifically described based on several preferred embodiments.

[0030] First, Fig. 1 shows an indoor unit Z of a separate type air conditioner for which the present invention is intended. As shown in Fig. 1, this indoor unit Z is a floor installation type indoor unit, which is preferably installed in a perimeter zone having a particularly high air conditioning load in the interior of a room, such as in a region in the vicinity of a window part 53, so as to contrive a reduction in the air conditioning load. The indoor unit is installed on an indoor floor 51 against a room wall 52 below of the window part 53, and performs indoor air conditioning by blowing conditioned airflow upward and sideways at the same time, while suppressing entry of radiant heat from the window part 53 and so on.

[0031] The indoor unit Z has a rectangular casing 1 that is advantageous to installation against a wall surface. The front surface 1a, the upper surface 1b, and the left and right side surfaces 1c, 1c of the casing 1 are provided with an air inlet 2, an upper surface air outlet 3, and side surface air outlets 4, 4, respectively.

[0032] Within the casing 1, right and left centrifugal fans 5, 5 are laterally juxtaposed at a predetermined interval with their suction sides opposed to the air inlet 2. A first heat exchanger 6 is positioned between the suction side of the fans 5, 5 and the air inlet 2. The constitution in which the first heat exchanger 6 is positioned on the suction sides of the fans 5, as described above, is a basic constitution of the indoor unit Z. In addition to the above basic constitution, the present invention further comprises a means for regulating the temperature of either of the upper outlet air Ab from the upper surface air outlet 3 or the side outlet air Ac from the side surface air outlets 4 so that the temperature of the upper outlet air Ab from the upper outlet 3 is lower than the temperature of the side outlet air Ac from the side surface air outlets 4. More specifically, as an example of such a means, selective provision of a second heat exchanger 7 for the upper surface air outlet 3 or of the second heat exchangers 8 for the side surface air outlets 4 is made in accordance with required conditions such as indoor air conditioning characteristics so that the comfortableness in cooling and heating is enhanced.

[0033] When the upper surface air outlet 3 is provided with the second heat exchanger 7, sucked air Aa sucked through the air inlet 2 passes the first heat exchanger 6. Then, a part of the sucked air further passes the second heat exchanger 7 and is blown upward as the upper outlet air, while another part is blown sideways as it is from the side surface air outlets 4 as the side outlet air Ac.

[0034] When the side surface air outlets 4 are provided with the second heat exchangers 8, the sucked air Aa passes the first heat exchanger 6 and then one part of the sucked air further passes the second heat exchangers 8 and is blown sideways from the side surface air outlets 4 as the side outlet air, while another part is blown upward from the upper surface air outlet 3 as the upper outlet air Ab.

[0035] The indoor unit for an air conditioner of the present invention will be specifically described below based on the preferred embodiments.

First Embodiment (see Figs. 2-5)

[0036] As shown in Fig. 2, an indoor unit Z_1 of a first embodiment is structured such that the first heat exchanger 6 is disposed in correspondence with the air inlet 2 of the casing 1, and that, of the upper surface air outlet 3 and the right and left side surface air outlets 4, the second heat exchangers 8 are provided for the respective side surface air outlets 4, 4. Therefore, with the operation of the fans 5, 5, the sucked air Aa sucked from the air inlet 2 pass the first heat exchanger 6 and then, one part of the sucked air is blown as it is from the upper surface air outlet 3 as the upper outlet air Ab, while an-

other part of the sucked air further passes the second heat exchanger 8 and is blown from the side surface air outlet 4 as the side outlet air Ac.

[0037] The constitution of a refrigerant circuit of the whole air conditioner including the indoor unit Z_1 is shown in Fig. 3. This air conditioner is composed of the indoor unit Z_1 and an outdoor unit Y connected to each other via refrigerant piping P. The outdoor unit Y is provided with a compressor 9, a direction switching valve 10, an outdoor heat exchanger 11 and an expansion valve 12, while the indoor unit Z_1 is provided with the first heat exchanger 6 and the second heat exchangers 8. In the indoor unit of this embodiment, the arrangement of the first heat exchanger 6 and the second heat exchangers 8 is set so that the second heat exchangers 8 are positioned on the upstream side of the first heat exchanger 6 in the circulation direction of the refrigerant in the cycle of cooling operation.

[0038] Next, functions of the indoor unit Z_1 of this embodiment in the heating and cooling operations will be described.

[0039] In the indoor unit Z_1 of this embodiment, the second heat exchangers 8 are disposed on the side of the side surface air outlets 4, and no heat exchanger is provided on the side of the upper surface air outlet 3. Therefore, in both heating and cooling operations, the side outlet air Ac to be blown from the side surface air outlet 4 is subjected to heat exchange by the first heat exchanger 6 and the second heat exchanger 8, while the upper outlet air Ab to be blown from the upper surface air outlet 3 is subjected to heat exchange by only the first heat exchanger 6. As a result, a temperature difference arises between the side outlet air Ac and the upper outlet air Ab. This indoor unit Z_1 is intended to improve the comfortableness particularly in heating operations, using this temperature difference between the side outlet air Ac and the upper outlet air Ab efficiently.

[0040] That is, as shown in Fig. 4, in the heating operation of the indoor unit Z_1, of the sucked air Aa, the upper outlet air Ab to be blown from the upper surface air outlet 3 is subjected to heating by only the first heat exchanger 6, and the side outlet air Ac to be blown from the side surface air outlets 4 is subjected to heating by both of the first heat exchanger 6 and the second heat exchanger 8. Therefore, the upper outlet air Ab has a relatively low temperature, while the side outlet air Ac has a relatively high temperature. As a result, the air having a relatively high temperature is present in the vicinity of the floor 51, or a lower part of the room, and the air having a relatively low temperature is present in an upper part of the room. Thus, rising of the air. having a high temperature in the vicinity of the floor is controlled by the air having a low temperature in the upper part of the room, and "cooling a head and warming feet" that is the ideal temperature distribution is realized. That is, the operation that considers the comfortableness in heating is realized.

[0041] On the other hand, in the cooling operation of the indoor unit Z_1, as shown in Fig. 5, a low-temperature air subjected to cooling by the first heat exchanger 6 and the second heat exchanger 8 is blown from the side surface air outlets 4 as the side outlet air Ac. On the other hand, a relatively high-temperature air cooled by only the first heat exchanger 6 is blown from the upper surface air outlet 3 as the upper outlet air Ab. For that reason, if the comfortableness is desired also in the cooling operation, for example, the side surface air outlets 4 may be closed, or the side surface air outlet 4 may be opposed to a wall with little interval therebetween so that the discharge of the side outlet air Ac from the side surface air outlet 4 is suppressed.

[0042] As the first heat exchanger 6 and the second heat exchangers 7, 8, a "cross-fin type heat exchanger" is generally adopted. From the viewpoint of downsizing the indoor unit Z_1, it is preferred that the first heat exchanger 6 and/or the second heat exchanger 7, 8 is composed of a stack-type heat exchanger 30 comprising a plurality of flat heat exchanger tubes 31, 31, ···, and a plurality of corrugated fins 32, 32, ···, which are alternately stacked, both end portions of each of the flat heat exchanger tubes 31 being connected by headers 33, 34 respectively.

[0043] Furthermore, generally, in an indoor unit wherein paired fans 5, 5 are disposed at a predetermined lateral distance within a casing 1 as in the present embodiment, such fans 5, 5 are arranged to rotate in the same direction. However, when the paired fans 5, 5 are rotated in the same direction as described above, obliquely downward velocity components of the side outlet air Ac blown from the side surface air outlets 4 increase, and a sense of downdraft increases particularly in the cooling operation. Therefore, such an arrangement is not preferred in view of comfortableness.

[0044] In order to control such a downdraft efficiently, it is useful to set the rotational directions of the fans 5, 5 such that both of these fans 5, 5 are rotated in opposite outward directions as seen from their suction side. Contrary to this, when the paired fans 5, 5 are arranged such that they are rotated inwardly as seen from their suction sides, the downdraft controlling effect is reduced, but the distance between the two fans 5, 5 can be reduced. Therefore, the latter arrangement is advantageous in view of a reduction in the size of the indoor unit.

[0045] It is also possible to constitute the indoor unit so that the numbers of revolutions of the fans 5, 5 are independently controlled. When this constitution is adopted, zoning according to the demand for air conditioning becomes available; e.g., the number of revolutions of the fan 5 positioned on the side closer to a region where someone is present may be set higher, while the number of revolutions of the fan 5 positioned on the side closer to a region where no one is present may be set lower, and so on. Thus, a further improvement in the comfortableness can be expected.

Second Embodiment (see Figs. 7-9)

[0046] Fig. 7 shows a refrigerant circuit of the whole air conditioner provided with an indoor unit Z_2 of a second embodiment of the present invention. In the indoor unit Z_1 of the first embodiment, the refrigerant path is set so that the first heat exchanger 6 is positioned downstream of the heat exchangers 8 in the cooling cycle. Contrary to this, in the indoor unit Z_2 of the second embodiment, a refrigerant path is set so that the first heat exchanger 6 is positioned upstream of the second heat exchangers 8 in the cooling cycle.

[0047] Therefore, as shown in Figs. 8 and 9, in the same manner as in the indoor unit Z_1 of the first embodiment, in both of the heating operation and the cooling operation, the side outlet air Ac from the side surface air outlet 4 is heated or cooled by the first heat exchanger 6 and the second heat exchanger 8, and the upper outlet air Ab from the upper surface air outlet 3 is heated or cooled by only the first heat exchanger 6. Thus, a temperature difference arises between the side outlet air Ac and the upper outlet air Ab. As a result, in the same manner as in the indoor unit Z_1 of the first embodiment, the operation that lays stress on the comfortableness in heating operation is realized.

Third Embodiment (see Fig. 10-13)

[0048] As shown in Fig. 10, an indoor unit Z_3 of a third embodiment is structured such that the first heat exchanger 6 is disposed in correspondence with the air inlet 2 of the casing 1, and that, of the upper surface air outlet 3 and the right and left side surface air outlets 4, the second heat exchanger 7 being provided for the upper surface air outlet 3. Therefore, with the operation of the fans 5, 5, the sucked air Aa sucked through the air inlet 2 passes the first heat exchanger 6 and then a part of the sucked air is blown as it is from the side surface air outlets 4 as the side outlet air Ac, while another part of the sucked air further passes the second heat exchanger 7 and is blown from the upper surface air outlet 3 as the upper outlet air Ab.

[0049] The constitution of a refrigerant circuit of the whole air conditioner including the indoor unit Z_3 is shown in Fig. 11. This air conditioner is composed of the indoor unit Z_3 and an outdoor unit Y connected to each other via refrigerant piping P. The outdoor unit Y is provided with a compressor 9, a direction switching valve 10, an outdoor heat exchanger 11 and an expansion valve 12, while the indoor unit Z_3 is provided with the first heat exchanger 6 and the second heat exchanger 8. In the indoor unit of this embodiment, the first heat exchanger 6 and the second heat exchanger 7 are arranged such that the second heat exchanger 7 is positioned downstream of the first heat exchanger 6 in the circulation direction of the refrigerant in the cooling operation cycle.

[0050] Subsequently, the functions of the indoor unit Z_3 of this embodiment in the heating and cooling operations will be described.

[0051] In the indoor unit Z_3 of this embodiment, the second heat exchanger 7 is disposed on the side of the upper surface air outlet 3, and no heat exchanger is provided on the side of side surface air outlets 4. Therefore, in both of the heating operation and the cooling operation, the upper outlet air Ab to be blown from the upper surface air outlet 3 is subjected to heat exchange by the first heat exchanger 6 and the second heat exchanger 7, while the side outlet air Ac to be blown from the side surface air outlets 4 is subjected to heat exchange by only the first heat exchanger 6. As a result, a temperature difference arises between the side outlet air Ac and the upper outlet air Ab. This indoor unit Z_3 is intended to improve the comfortableness particularly in cooling, using this temperature difference between the side outlet air Ac and the upper outlet air Ab efficiently.

[0052] That is, as shown in Fig. 13, in the cooling operation of the indoor unit Z_3, of the sucked air Aa, the side outlet air Ac to be blown from the side surface air outlets 4 is subjected to a cooling action by only the first heat exchanger 6, and the upper outlet air Ab to be blown from the upper surface air outlet 3 is subjected to a cooling action by both of the first heat exchanger 6 and the second heat exchanger 7. Therefore, the upper outlet air Ab is set to a relatively low temperature, while the side outlet air Ac is set to a relatively high temperature. As a result, cooler air is blown to an upper part of the room, while relatively warm air is blown to a lower part of the room. This realizes the "cooling a head and warming feet" ambience, and a comfortable cooling sensation can be obtained by efficiently restraining cold air from gathering at one's feet. That is, the operation that lays stress on the comfortableness in cooling is realized.

[0053] On the other hand, in the heating operation of the indoor unit Z_3, as shown in Fig. 12, a high-temperature air subjected to heating by the first heat exchanger 6 and the second heat exchanger 7 is blown from the upper surface air outlet 3 as the upper outlet air Ab. On the other hand, a relatively low-temperature air heated by only the first heat exchanger 6 is blown from the side surface air outlets 4 as the side outlet air Ac. For that reason, if the comfortableness is desired also in the heating operation, for example, the upper surface air outlet 3 may be closed so that the output of the upper outlet air Ab from the upper surface air outlet 3 is controlled.

Fourth Embodiment (see Figs. 14-16)

[0054] Fig. 14 shows a refrigerant circuit of the whole air conditioner provided with an indoor unit Z_4 of a fourth embodiment of the present invention. In the indoor unit Z_3 of the third embodiment, the refrigerant path is set so that the first heat exchanger 6 is positioned upstream of the heat exchanger 7 in the cooling cycle. Contrary to this, in the indoor unit Z_4 of the fourth embodiment, a

refrigerant path is set so that the first heat exchanger 6 is positioned downstream of the second heat exchanger 7 in the circulation direction of the refrigerant in the cooling cycle.

[0055] Therefore, as shown in Figs. 15 and 16, in the same manner as in the indoor unit Z_3 of the third embodiment, in both of the heating operation and the cooling operation, the upper outlet air Ab to be output from the upper surface air outlet 3 is heated or cooled by both the first heat exchanger 6 and the second heat exchanger 7, but the side outlet air Ac to be output from the side surface air outlet 4 is heated or cooled by only the first heat exchanger 6. Thus, a temperature difference arises between the side outlet air Ac and the upper outlet air Ab. As a result, the operation that particularly lays stress on the comfortableness in cooling is realized in the same manner as in the indoor unit Z_3 of the third embodiment.

Fifth Embodiment (see Figs. 17-19)

[0056] This embodiment is directed to an indoor unit structured such that, in the same manner as in the indoor unit Z_1 of the first embodiment, the first heat exchanger 6 is disposed in correspondence with the air inlet 2 of the casing 1, and that, of the upper surface air outlet 3 and the right and left side surface air outlets 4, 4, the second heat exchangers 8 are provided for the respective side surface air outlets 4, 4 (see Fig. 2). Therefore, with the operation of the fans 5, 5, the sucked air A_a sucked from the air inlet 2 passes the first heat exchanger 6 and then one part of the sucked air is blown as it is from the upper surface air outlet 3 as the upper outlet air Ab, while another part further passes the second heat exchanger 8 and is output from the side surface air outlet 4 as the side outlet air Ac.

[0057] The constitution of a refrigerant circuit of the whole air conditioner including the indoor unit Z_5 is shown in Fig. 17. This air conditioner is composed of the indoor unit Z_5 and an outdoor unit Y connected to each other via refrigerant piping P. A compressor 9, a direction switching valve 10, an outdoor-side heat exchanger 11 and an expansion valve 12 are provided in the outdoor unit Y, while the indoor unit Z_5 is provided with the first heat exchanger 6 and the second heat exchangers 8.

[0058] In the indoor unit Z_5 of this embodiment, the first heat exchanger 6 is connected via an auxiliary expansion valve 13 to the second heat exchangers 8, and the first heat exchanger 6 and the second heat exchangers 8 are arranged such that the second heat exchangers 8 are located upstream of the first heat exchanger 6 in the circulation direction of the refrigerant in the cycle of cooling operation.

[0059] Operative relationships between the auxiliary expansion valve 13 and the main expansion valve 12 in the outdoor unit Y are set in a relative manner. That is, in the heating operation, the main expansion valve 12 is set to "throttled" and the auxiliary expansion valve 13 is set to "full open". On the other hand, in the cooling operation, the main expansion valve 12 is set to "slightly throttled" and the auxiliary expansion valve 13 is set to "throttled".

[0060] Subsequently, functions of the indoor unit Z_5 of this embodiment in the heating and cooling operations will be described.

[0061] As described above, in the heating operation, the main expansion valve 12 is set to "throttled" and the auxiliary expansion valve 13 is set to "full open". Therefore, as shown in Fig. 18, both of the first heat exchanger 6 and the second heat exchangers 8 function as compressors on the high-pressure side. Thus, a relatively low-temperature air heated by only the first heat exchanger 6 is blown upward from the upper surface air outlet 3 as the upper outlet air Ab, while a relatively high-temperature air heated by both the first heat exchanger 6 and the second heat exchanger 8 is blown sideways from the side surface air outlet 4 as the side outlet air Ac. Therefore, rising of the air having a relatively high temperature in a lower part of the room is suppressed by the air having a relatively low temperature in an upper part of the room, and a "cooling a head and warming feet" ambience that is of an ideal temperature distribution ambience is realized. Thereby, the comfortable heating sensation is obtained.

[0062] On the other hand, as described above, in the cooling operation, the main expansion valve 12 is set to "slightly throttled" and the auxiliary expansion valve 13 is set to "throttled". Therefore, as shown in Fig. 19, the first heat exchanger 6 functions as an evaporator on the low-pressure side, while the second heat exchangers 8 function as evaporators at an intermediate pressure between the high-pressure side and the low-pressure side. Thus, a relatively low-temperature air cooled by only the first heat exchanger 6 is blown upward from the upper surface air outlet 3 as the upper outlet air Ab, while a relatively high-temperature air is blown sideways from the side surface air outlets 4 as the side outlet air Ac, which was first cooled by the first heat exchanger 6 and then cooled by the second heat exchanger 8 having a temperature higher than the first heat exchanger 6 so that the temperature of the air is raised. As a result, the "cooling a head and warming feet" ambience that is an ideal temperature distribution ambience is realized. A comfortable cooling sensation is obtained by controlling cold air remaining at one's feet efficiently.

Sixth Embodiment (see Figs. 20-22)

[0063] In the fifth embodiment, the indoor unit Z_5 is provided with the second heat exchangers 8 on the sides of the side surface air outlets 4, and the second heat exchangers 8 are positioned upstream of the first heat exchanger 6, with the auxiliary expansion valve 13 disposed therebetween, in the circulation direction of the refrigerant in the cycle of cooling operation. On the other hand, in an indoor unit Z_6 of a sixth embodiment,

the second heat exchanger 7 is provided on the side of the upper surface air outlet 3, and the heat exchanger 7 is disposed upstream of the first heat exchanger 6 in the circulation direction of the refrigerant.

[0064] In the indoor unit Z_6 of this embodiment, operative relationships between the auxiliary expansion valve 13 and the main expansion valve 12 in the outdoor unit Y are set in a relative manner. That is, in the heating operation, the main expansion valve 12 is set to "throttled" and the auxiliary expansion valve 13 is set to "slightly throttled". On the other hand, in the cooling operation, the main expansion valve 12 is set to "throttled" and the auxiliary expansion valve 13 is set to "full open".

[0065] Next, the functions of the indoor unit Z_6 in the heating and cooling operations of this embodiment will be described.

[0066] As described above, in the heating operation, the main expansion valve 12 is set to "throttled" and the auxiliary expansion valve 13 is set to "slightly throttled". Therefore, as shown in Fig. 21, the first heat exchanger 6 functions as an evaporator on the high-pressure side, and the second heat exchanger 7 functions as an evaporator at an intermediate pressure between the high-pressure side and the low-pressure side. Thus, the upper outlet air Ab blown from the upper surface air outlet 3 was heated by the first heat exchanger 6 and then cooled by passing the second heat exchanger functioning as the evaporator at an intermediate pressure to give a relatively low-temperature air. Contrary to this, the side outlet air Ac blown sideways from the side surface air outlet 4 was only heated by the first heat exchanger 6, and thus the temperature of the air is relatively high. Therefore, the air having a relatively high temperature is present in a lower part of the room, while in an upper part of the room, the air having a relatively low temperature is present. As a result, the "cooling a head and warming feet" state of an ideal temperature distribution is realized, and a comfortable heating sensation is obtained by efficiently restraining cold air from gathering at one's feet.

[0067] On the other hand, as described above, in the cooling operation, the main expansion valve 12 is set to "throttled", and the auxiliary expansion valve 13 is set to "full open". Therefore, as shown in Fig. 22, both of the first heat exchanger 6 and the second heat exchanger 7 function as evaporators on the low-pressure side. Thus, the upper outlet air Ab blown from the upper surface air outlet 3 was cooled by both of the first heat exchanger 6 and the second heat exchanger 7, while the side outlet air Ac blown from the side surface air outlets 4 was cooled by only the first heat exchanger 6. Thus, the air having a relatively low temperature is present in the upper part of the room, while the air having a relatively high temperature is present in the lower part of the room. As a result, the "cooling a head and warming feet" ambience that is an ideal temperature distribution ambience is realized, and a comfortable cooling sensation is obtained by efficiently restraining cold air from gathering at one's feet.

Seventh Embodiment (see Fig. 23)

[0068] In the indoor units Z_1-Z_6 of the first to sixth embodiments, improvement in the comfortableness in cooling or heating was contrived by additionally providing the second heat exchanger 7 or 8. On the other hand, in an indoor unit Z_7 of a seventh embodiment, the comfortableness in cooling or heating is achieved by providing heaters 15 on the air outlet sides of the fans 5.

[0069] That is, in the indoor unit Z_7, as shown in Fig. 23, only the first heat exchanger 6 is disposed on the suction side of the fans 5. On the other hand, on the discharge side of the fans 5, no heat exchangers are provided but the heaters 15 are disposed at the side surface air outlets 4. The heaters 15 are energized in both the heating operation and the cooling operation.

[0070] With the above construction, in the heating operation, a relatively high-temperature air first heated by the first heat exchanger 6 and further heated by the heaters 15 is blown from the side surface air outlets 4 as the side outlet air Ac, and a relatively low-temperature air heated only by the first heat exchanger 6 is blown from the upper surface air outlet 3. As a result, the air having a relatively low temperature is present in the upper part of the room, while the air having a relatively high temperature is present in the lower part of the room, so that the relatively high-temperature air in the lower part of the room is restrained from rising by the relatively low-temperature air in the upper part of the room. Therefore, a "cooling a head and warming feet" ambience is realized, and a comfortable heating sensation is obtained.

[0071] In the cooling operation, a relatively high-temperature air cooled by the first heat exchanger 6 and then heated by the heater 15 is blown from the side surface air outlet 4 as the side outlet air Ac, while a relatively low-temperature air only cooled by the first heat exchanger 6 is blown from the upper surface air outlet 3. As a result, the air having a relatively high temperature is present in the lower part of the room, while the air having a relatively low temperature is present in the upper part of the room. Therefore, a "cooling a head and warming feet" ambience that is an ideal thermal space is realized. Accordingly, a comfortable cooling sensation can be obtained, with the cold air gathering at one's feet efficiently suppressed.

Eighth Embodiment (see Fig. 24)

[0072] Fig. 24 shows an indoor unit Z_8 of an eighth embodiment. In this indoor unit Z_8, differently from the indoor units Z_1-Z_7 of the first to seventh embodiments in which the discharge temperatures themselves of the upper outlet air Ab and the side outlet air Ac are controlled, the indoor air (namely, air having a temperature lower than that of the conditioned air blown from the indoor unit in the heating operation, and air having a tempera-

ture higher than that of the conditioned air in the cooling operation) is made to detour or bypass the heat exchanger 6 and return to the inside of the room. By so doing, temperature adjustment between the upper outlet air Ab and the side outlet air Ac is performed to obtain the comfortableness in the air conditioning.

[0073] That is, as shown in Fig. 24, the indoor unit Z_8 has a circulation system X composed of a curved bypass 20 extending from the upper part of the air inlet 2 to the vicinity of the upper surface air outlet 3 of the upper surface of the casing 1 and a fan 21 disposed within the bypass 20.

[0074] With this constitution, particularly in the heating operation, the upper outlet air Ab heated by the first heat exchanger 6 and then blown upward from the upper surface air outlet 3 is mixed with the indoor air Ab' blown upward from the vicinity of the upper surface air outlet 3 by the circulation system X, whereby the upper discharge temperature is made relatively low. On the other hand, the air heated by the first heat exchanger, which has a relatively high temperature, is blown from the side surface air outlets 4 as the side outlet air Ac. As a result, the air in the lower part of the room, which has a relatively high temperature, is prevented from going up by the air in the upper part of the room, which has a relatively low temperature. Therefore, "cooling a head, and warming feet" is realized, and a comfortable cooling sensation is obtained. During the cooling operation, the operation of the circulation system X is stopped.

Ninth Embodiment (see Fig. 25)

[0075] Fig. 25 shows an indoor unit Z_9 of a ninth embodiment. The indoor unit Z_8 of the eighth embodiment lays stress on the comfortableness in the heating operation, while this indoor unit Z_9 lays stress on the comfortableness in the cooling operation.

[0076] That is, on its right and left sides, the indoor unit Z_9 has circulation systems X each composed of a bypass 22 detouring the heat exchanger 6 to provide communication between the air inlet 2 and the vicinity of the corresponding side surface air outlet 4, and a fan 23 provided within the bypass 22.

[0077] Therefore, in the cooling operation, a mixture of the side outlet air Ac cooled by the first heat exchanger 6 and blown from the side surface air outlet 4 and the indoor air Ac' blown from the vicinity of the side surface air outlet 4, which has a relatively high temperature, is blown sideways of the indoor unit Z_8. Contrary to this, upward of the indoor unit Z_9, the air cooled by the heat exchanger 6, which has a low temperature, is blown as it is from the upper surface air outlet 3 as the upper outlet air Ab. As a result, the air having a relatively low temperature is present in the upper part of the room, while the air having a relatively high temperature is present in the lower part of the room. Therefore, "cooling a head and warming feet", which is the ideal temperature distribution, is realized, and a comfortable cooling sensation can be obtained without remaining of cold air at one's feet.

Claims

1. An indoor unit for an air conditioner comprising a casing (1) having an air inlet (2) in a front surface (1a), an upper surface air outlet (3) in an upper surface (1b) and a side surface air outlet (4) in a side surface (1c) and installed on an indoor floor (51) or in the vicinity of the indoor floor, and a fan (5) and a heat exchanger (6) that are disposed in the casing (1) such that the heat exchanger (6) lies on a suction side of the fan (5),

   wherein said indoor unit further comprises a means (7, 8, 13, 15, X) for regulating a temperature of either upper outlet air (Ab) from the upper surface air outlet (3) or side outlet air (Ac) from the side surface air outlet (4) such that the temperature of the upper outlet air (Ab) is lower than the temperature of the side outlet air (Ac).

2. The indoor unit for an air conditioner according to claim 1, wherein said means for regulating a temperature of either upper outlet air (Ab) from the upper surface air outlet or side outlet air (Ac) from the side surface air outlet comprises a second heat exchanger within the casing (1); and

   the heat exchanger (6) is positioned upstream in a direction of airflow, while the second heat exchanger (7, 8) is positioned downstream in the direction of airflow, and the second heat exchanger (7, 8) faces any one of the upper surface air outlet (3) and the side surface air outlet (4).

3. The indoor unit for an air conditioner according to claim 2, wherein the second heat exchanger (7, 8) is formed integrally with or separately from the heat exchanger (6).

4. The indoor unit for an air conditioner according to claim 2, wherein the second heat exchanger (7) is disposed facing the upper surface air outlet (3), and the second heat exchanger (7) is made to function as an evaporator on a low-pressure side in a cooling operation, and, in a heating operation, as an evaporator on a side a little closer to a high-pressure side than in the cooling operation.

5. The indoor unit for an air conditioner according to claim 2, wherein the second heat exchanger (8) is disposed facing the side surface air outlet (4), and the second heat exchanger (8) is made to function as a condenser on a high-pressure side in a heating operation, and, in a cooling operation, as an evaporator on a side a little closer to a low-pressure side than in the heating operation.

6. The indoor unit for an air conditioner according to claim 4 or 5, wherein the first heat exchanger (6) is connected to the second heat exchanger (7, 8) via an expansion valve (13).

7. The indoor unit for an air conditioner according to claim 2, wherein the heat exchanger (6) and/or the second heat exchanger (7, 8) is constructed of a stack type heat exchanger (30) comprising a plurality of flat heat exchanger tubes (31) and a plurality of fins (32) being alternately stacked, with both end portions of each of the flat heat exchanger tubes (31) being connected by headers (33, 34), respectively.

8. The indoor unit for an air conditioner according to claim 1, wherein said means for regulating a temperature of either upper outlet air (Ab) from the upper surface air outlet or side outlet air (Ac) from the side surface air outlet comprises a heater (15) provided at the side surface air outlet(4).

9. The indoor unit for an air conditioner according to claim 1, wherein said means for regulating a temperature of either upper outlet air (Ab) from the upper surface air outlet or side outlet air (Ac) from the side surface air outlet comprises a circulation system (X) which makes indoor air bypass the heat exchanger (6) and blows the indoor air to the upper surface (1b) and/or the side surface (1c).

Fig. 1

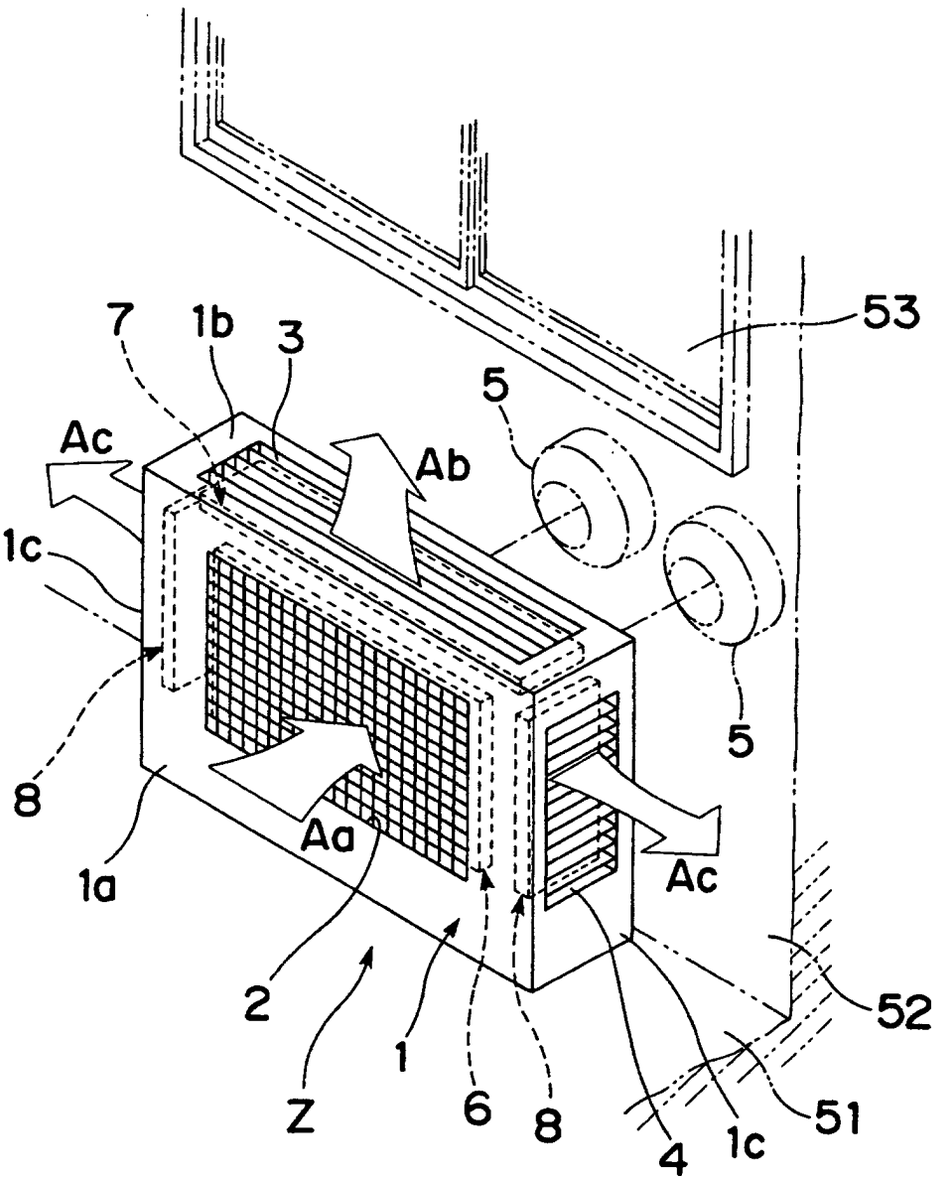


Fig.2

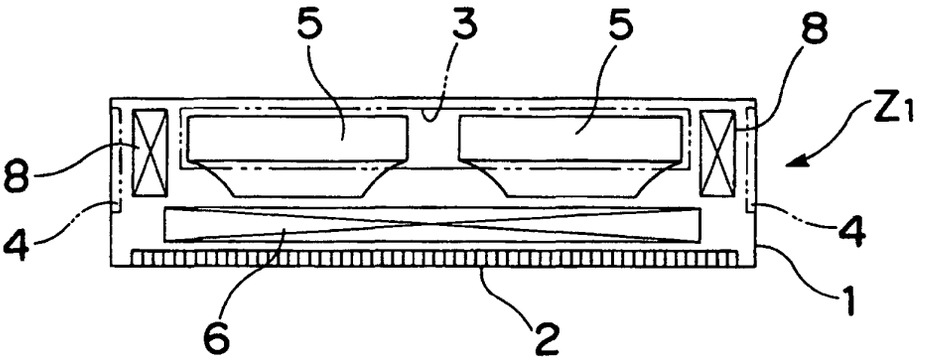


Fig.4

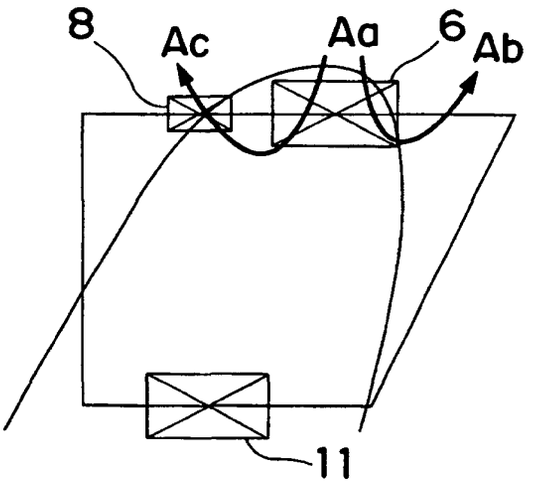


Fig.5

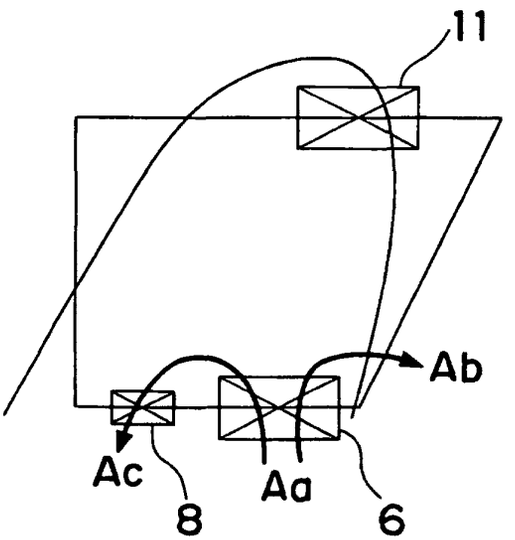


Fig.3

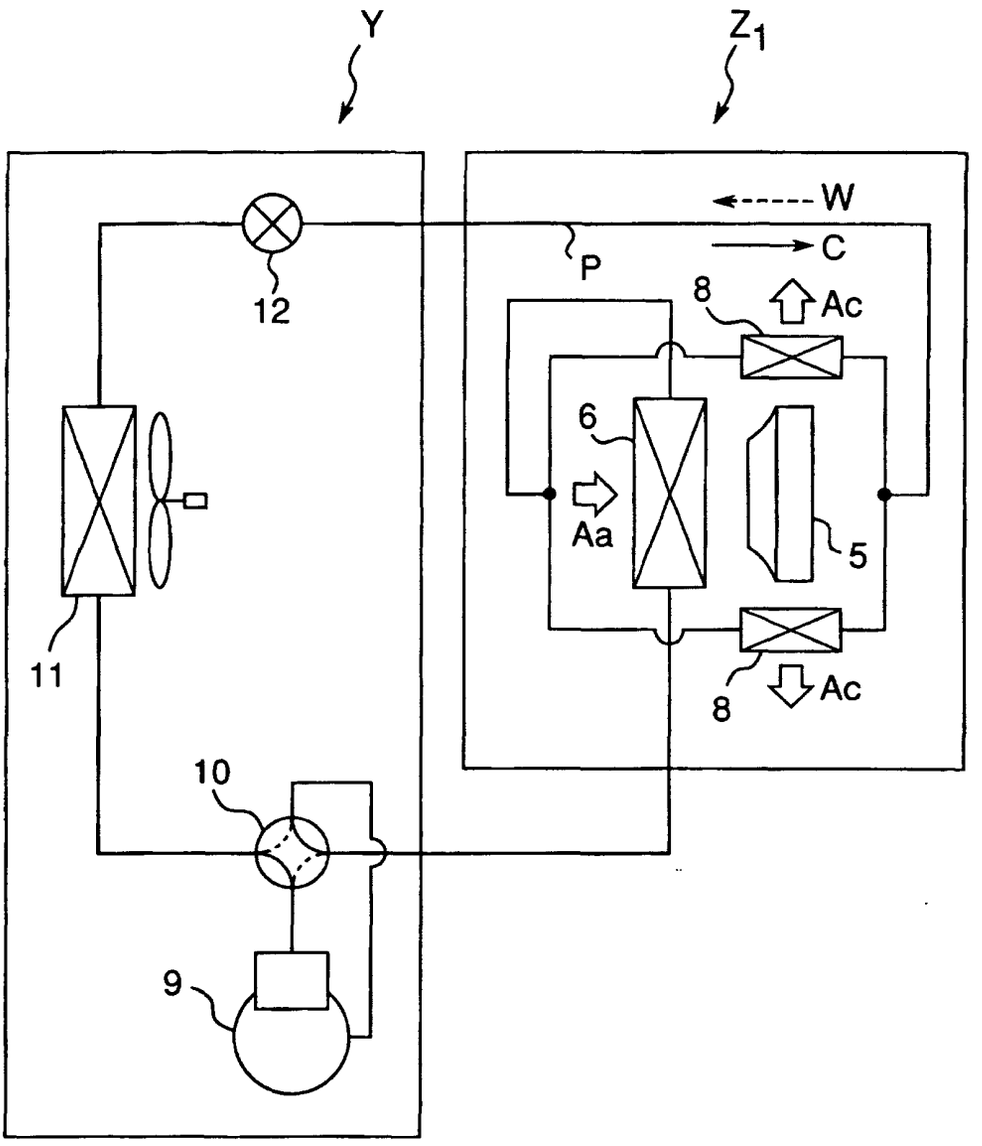


Fig.6

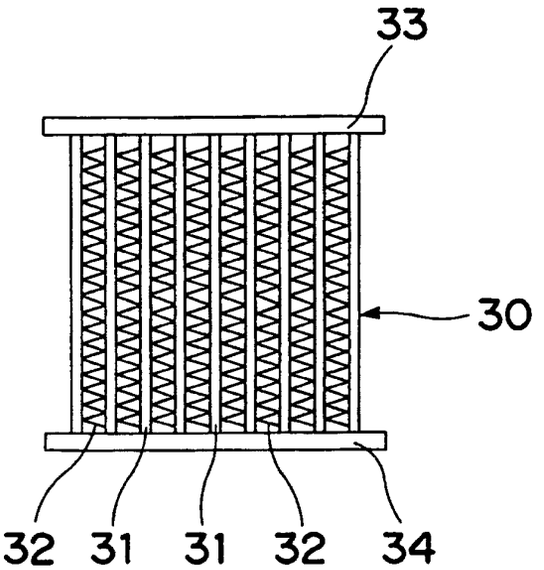


Fig.10

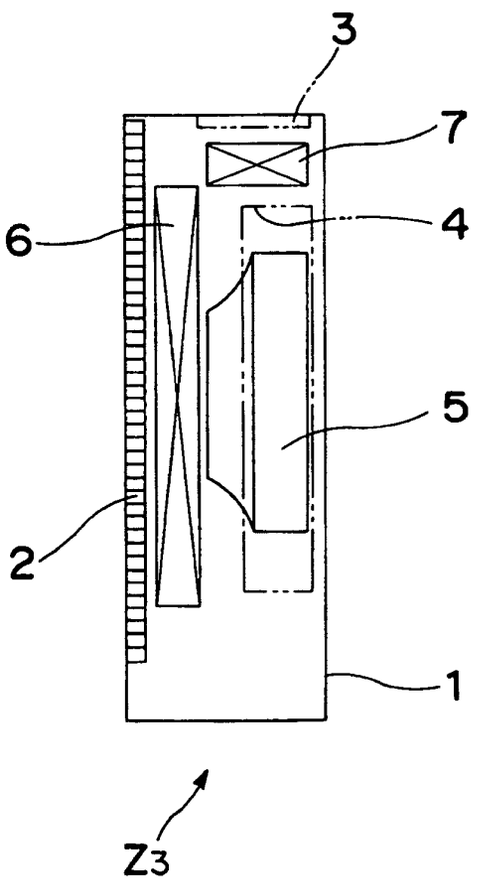


Fig.7

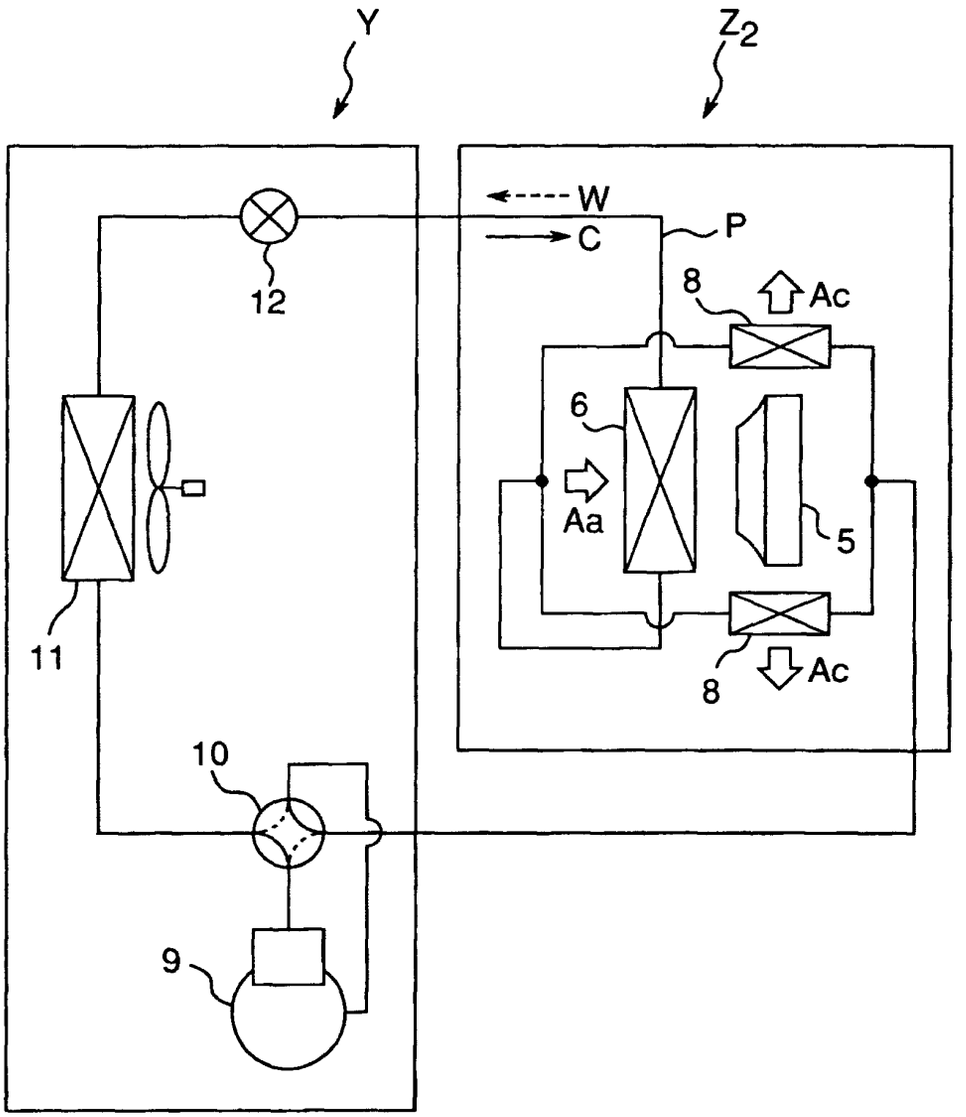


Fig.8

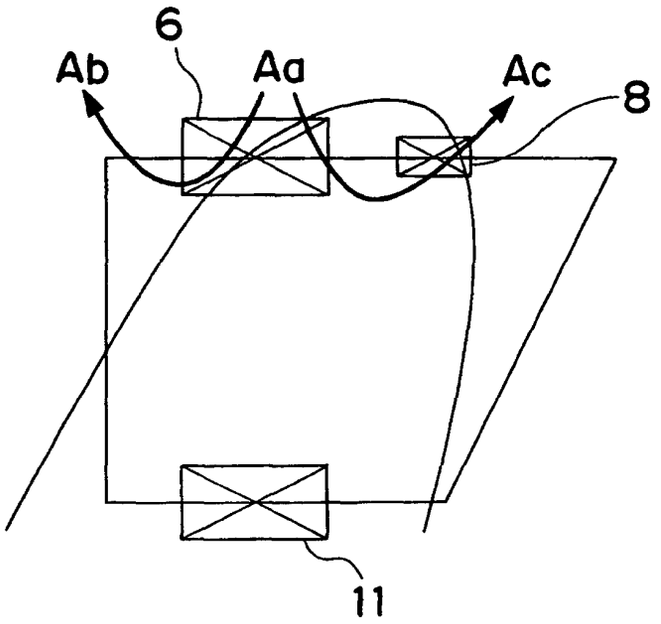


Fig.9

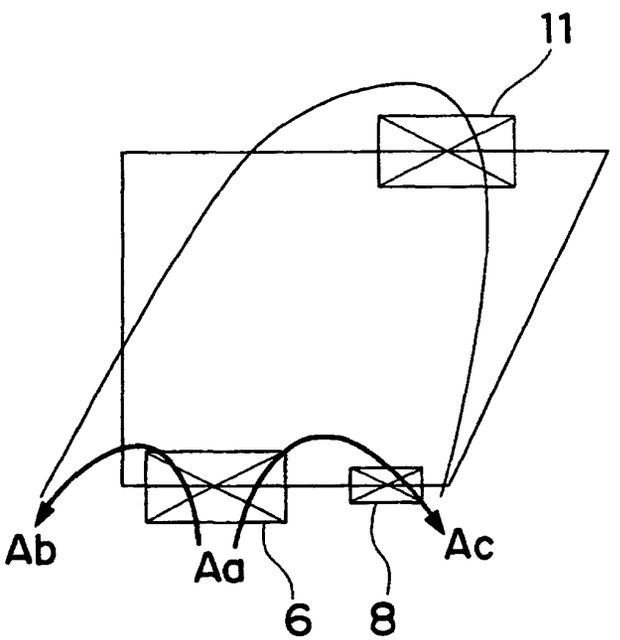
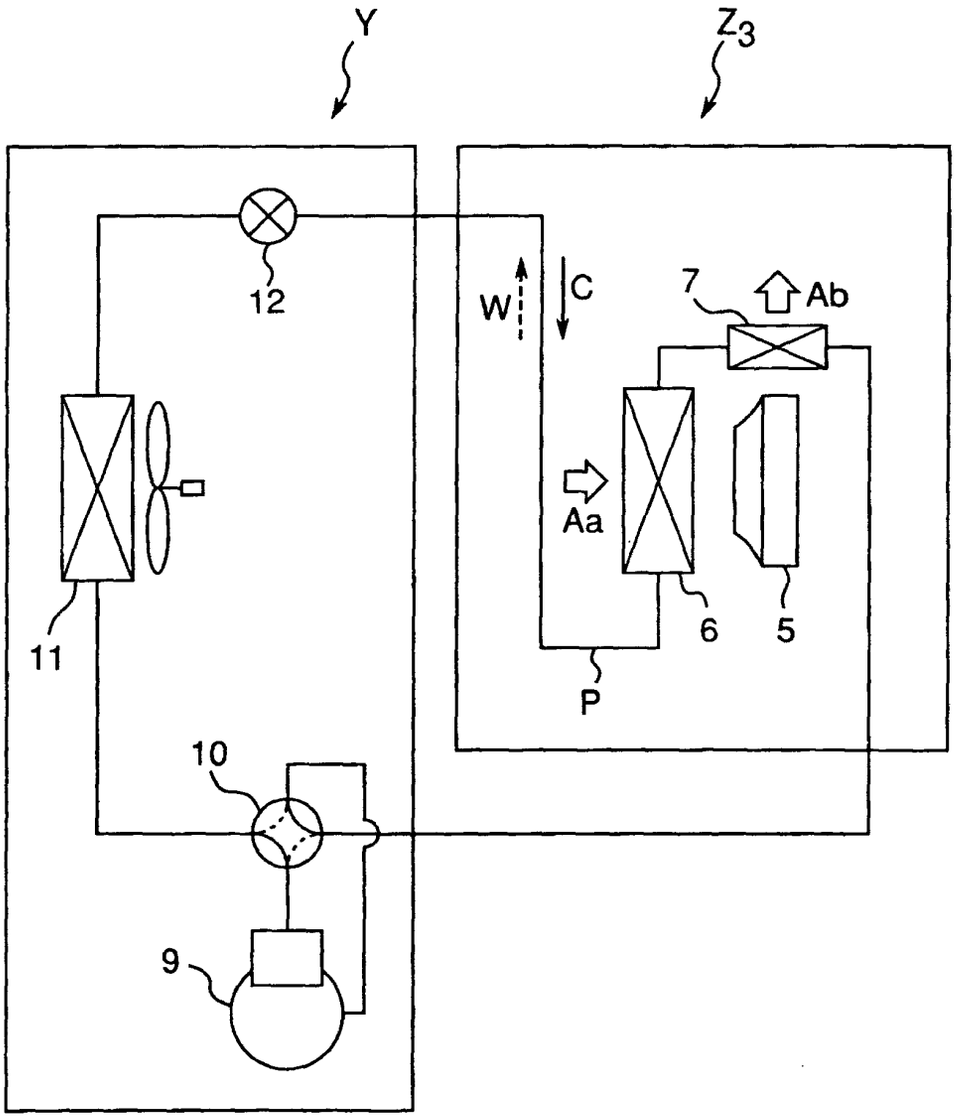


Fig.11



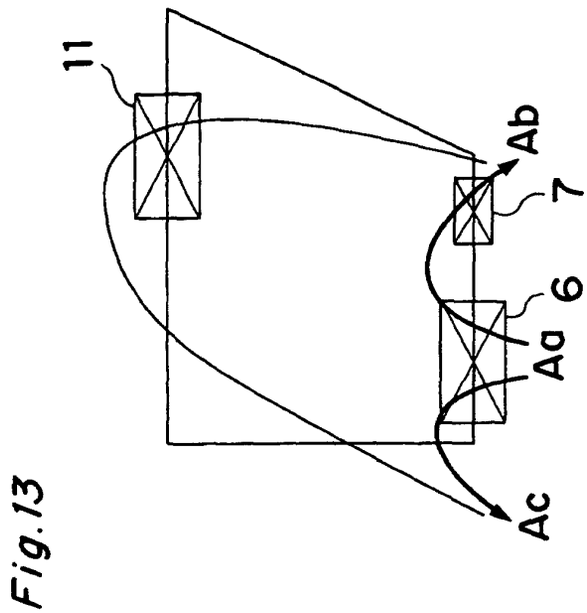


Fig.13

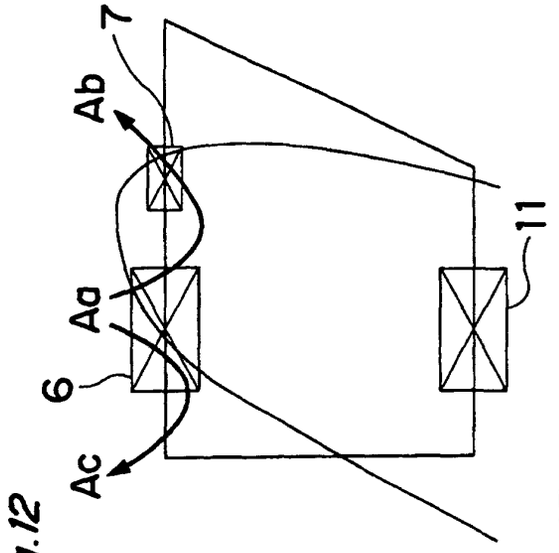


Fig.12

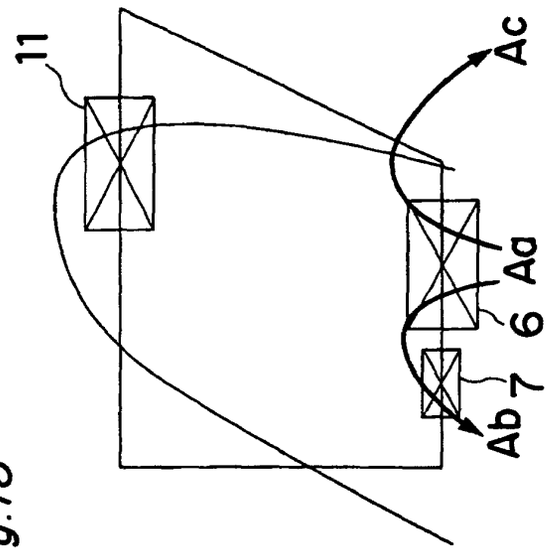


Fig.16

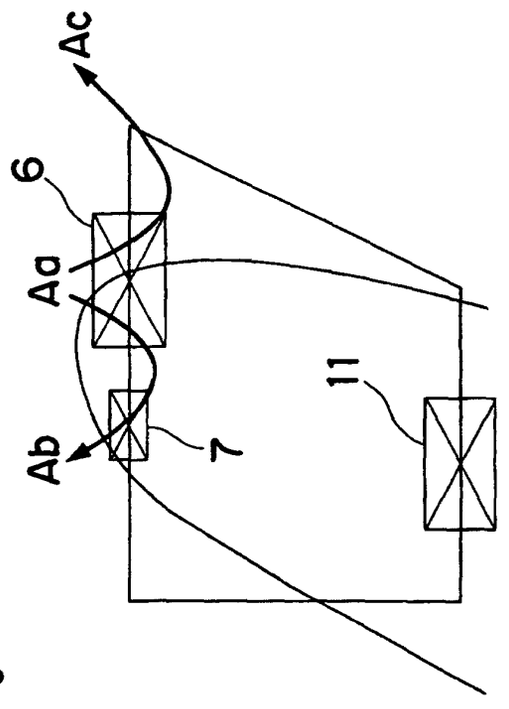


Fig.15

Fig.14

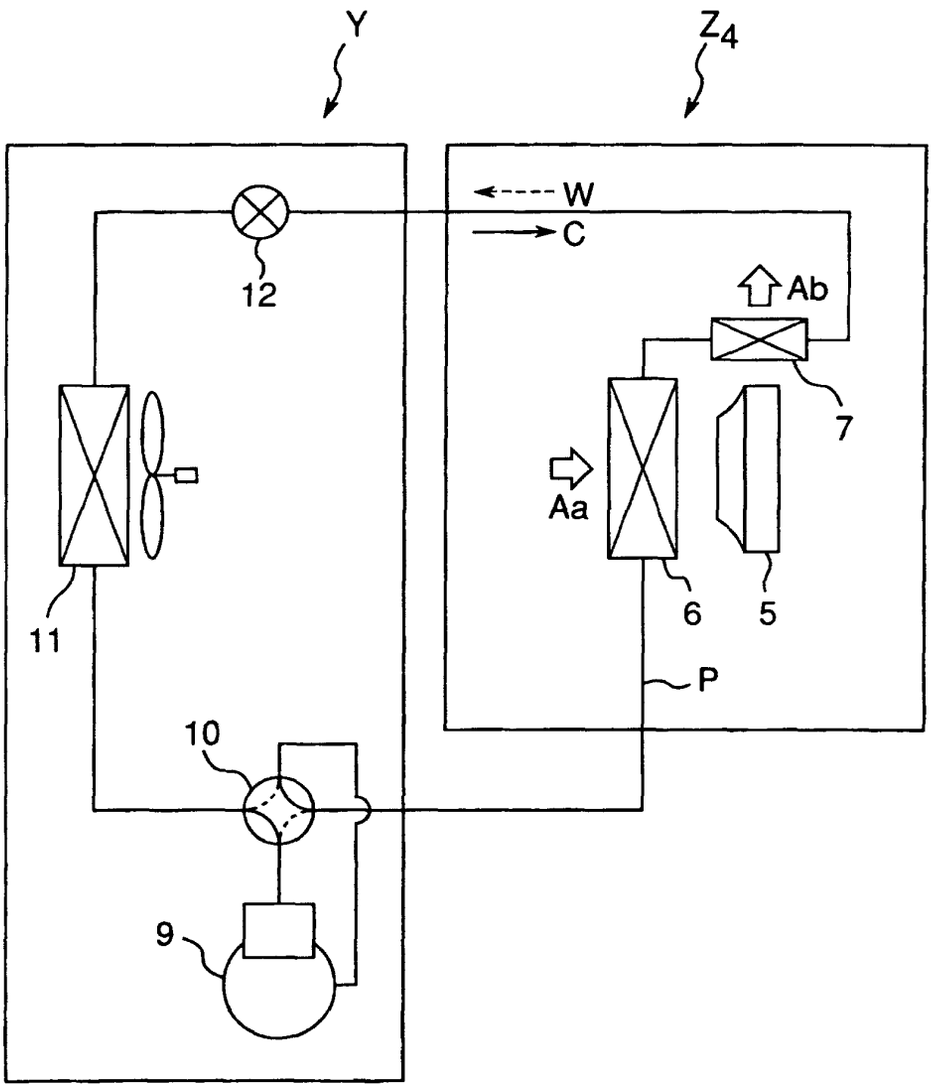
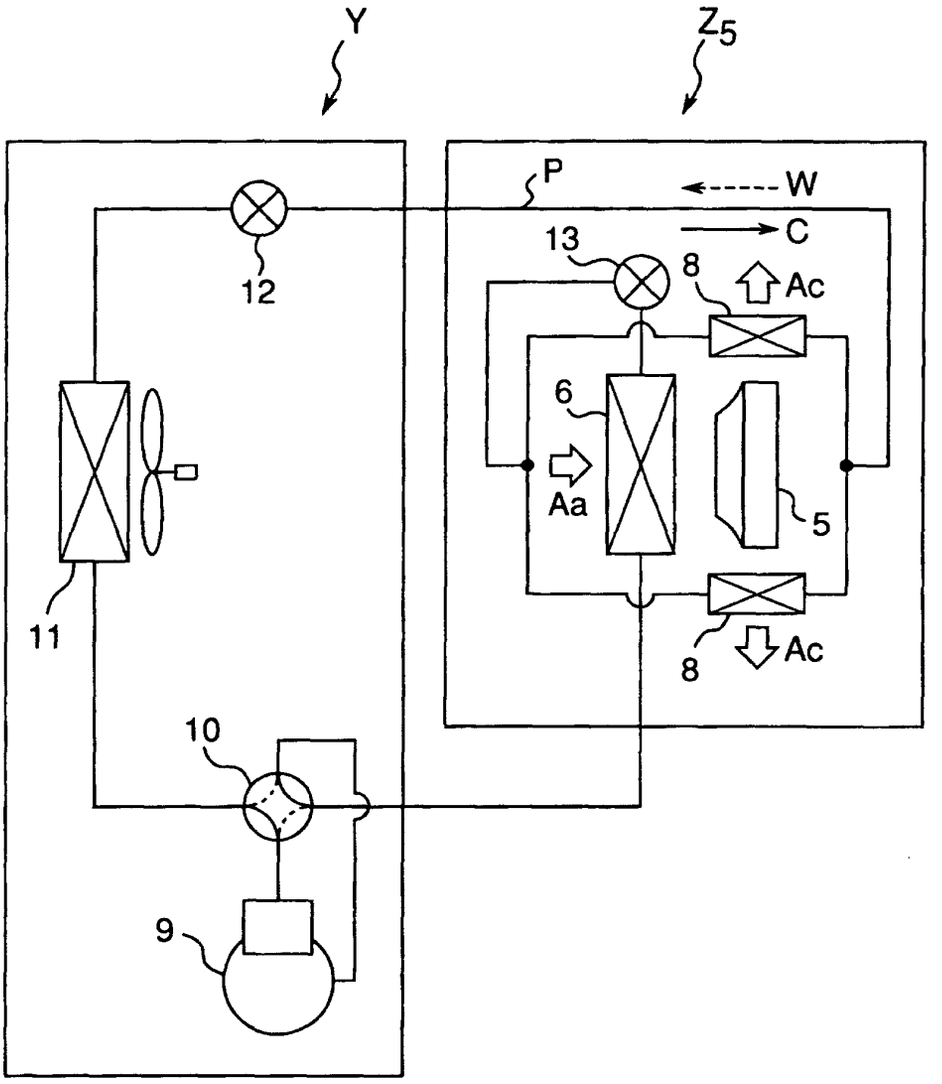


Fig.17



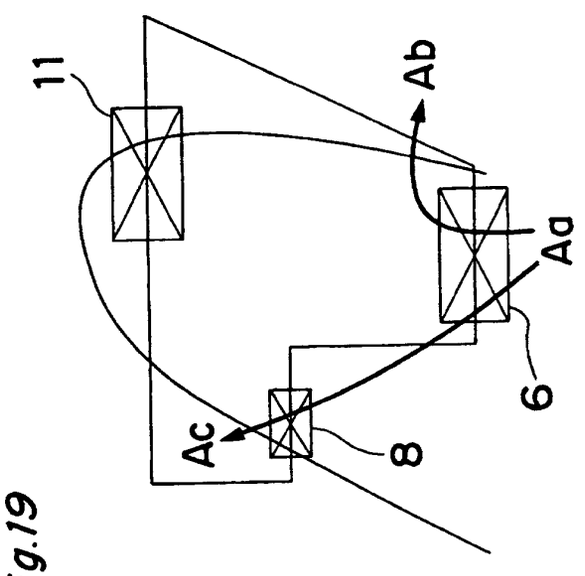


Fig.19

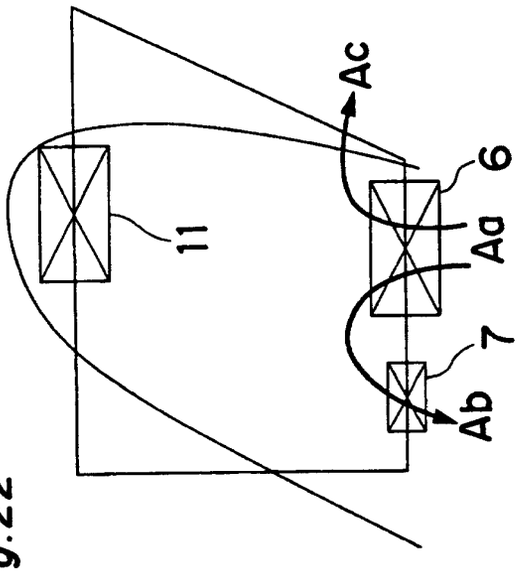


Fig.22

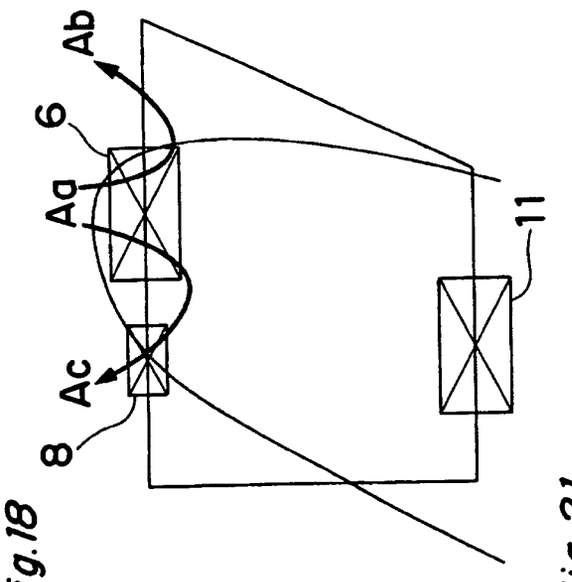


Fig.18

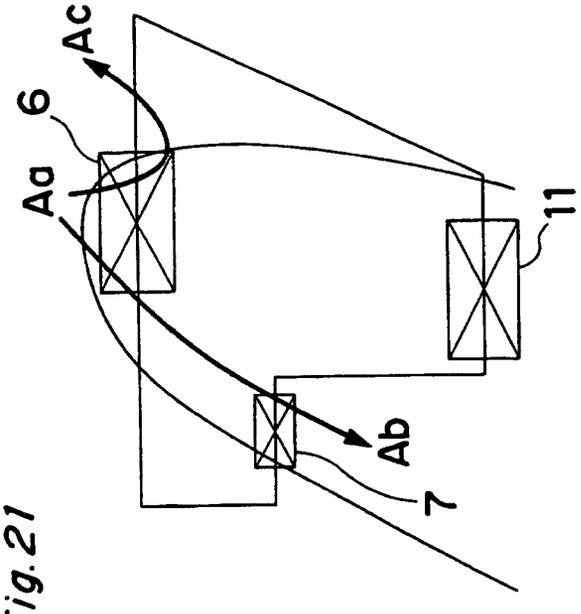


Fig.21

Fig.20

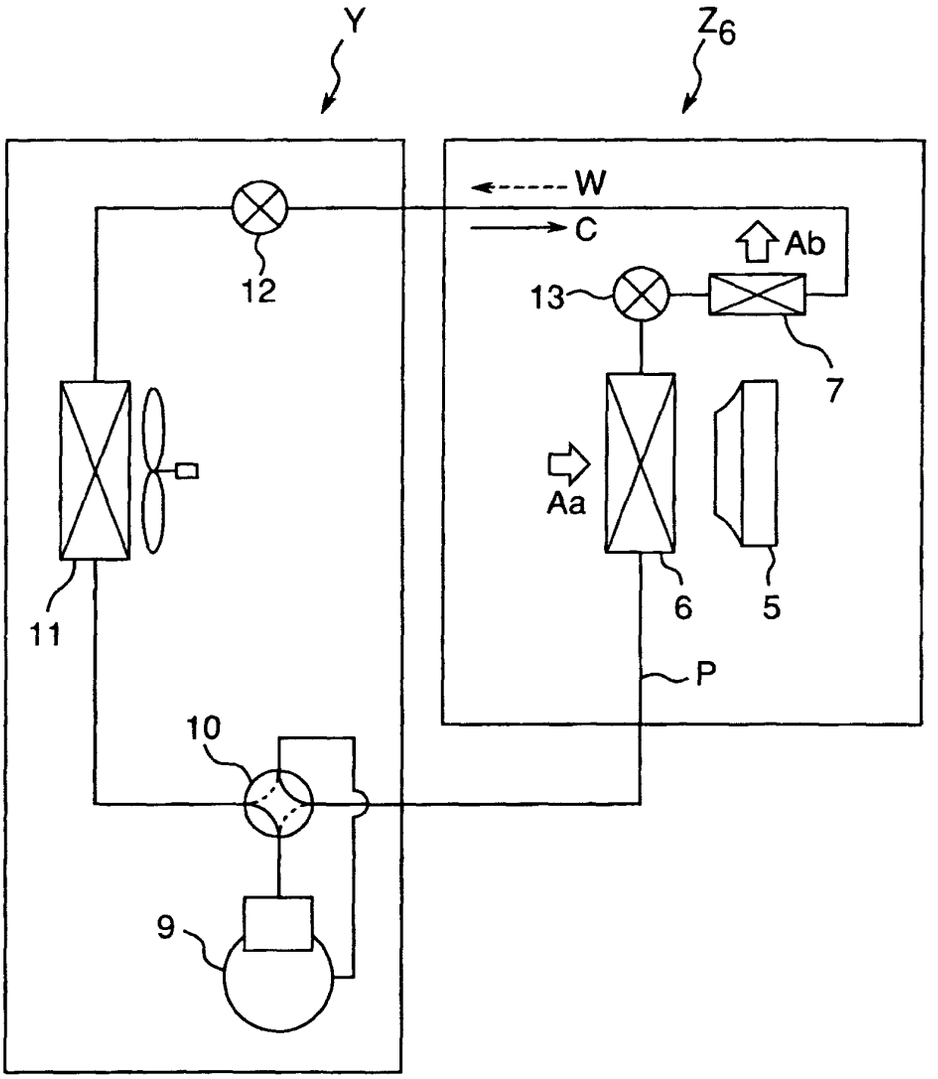


Fig.23

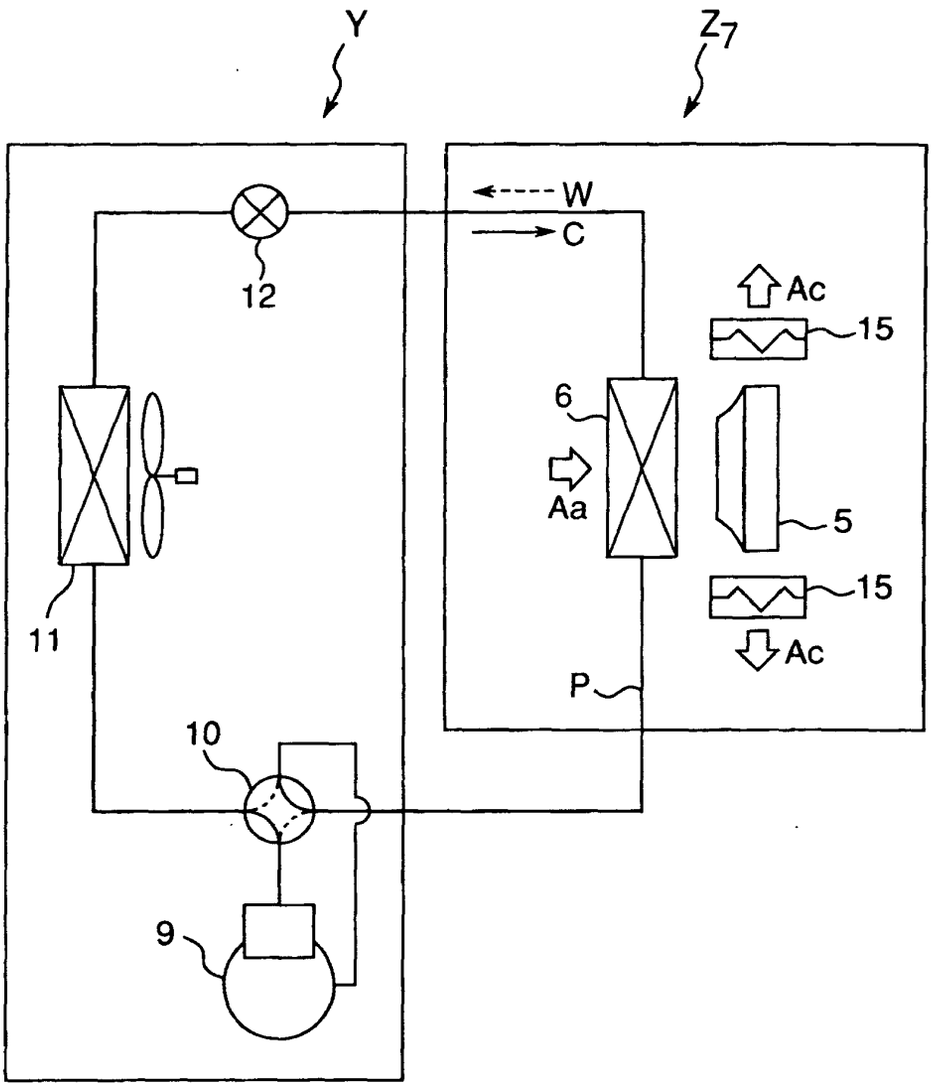
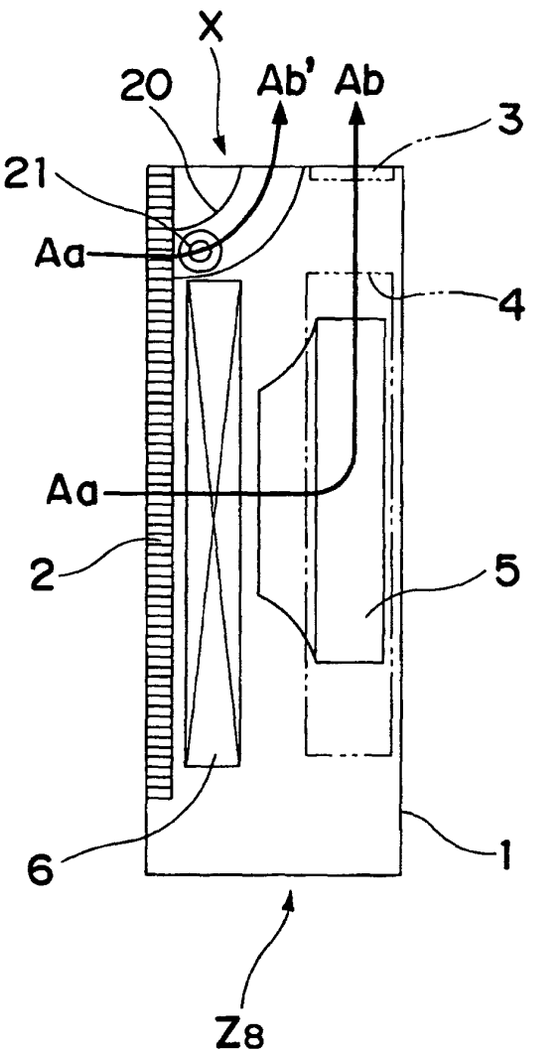


Fig. 24



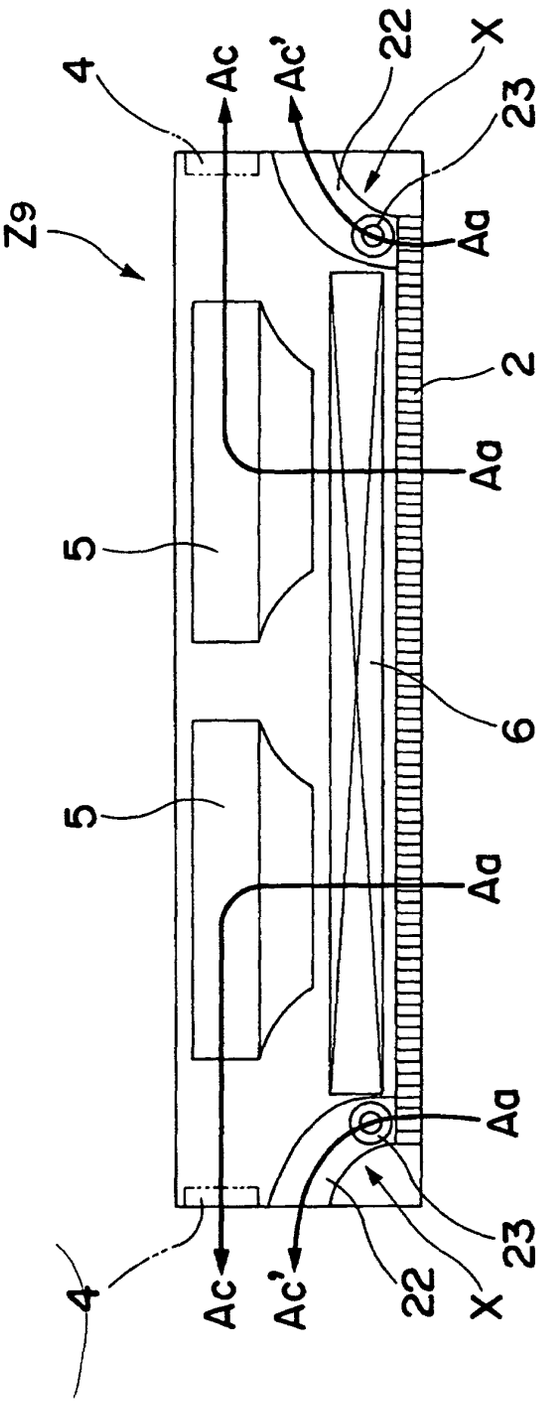


Fig.25

Fig.26

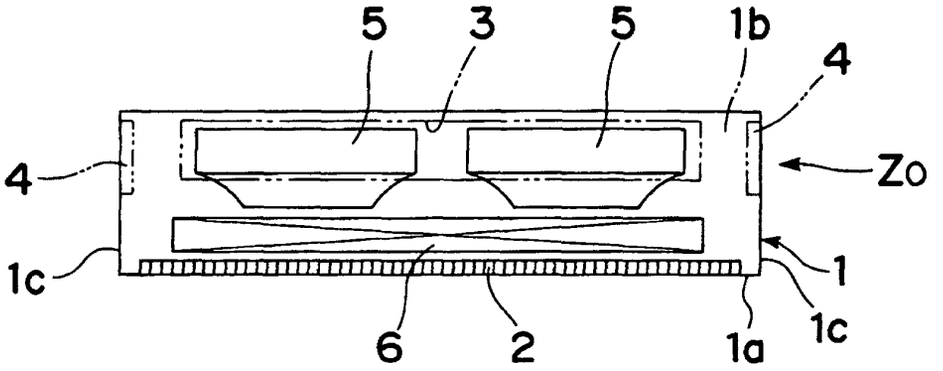


Fig.28

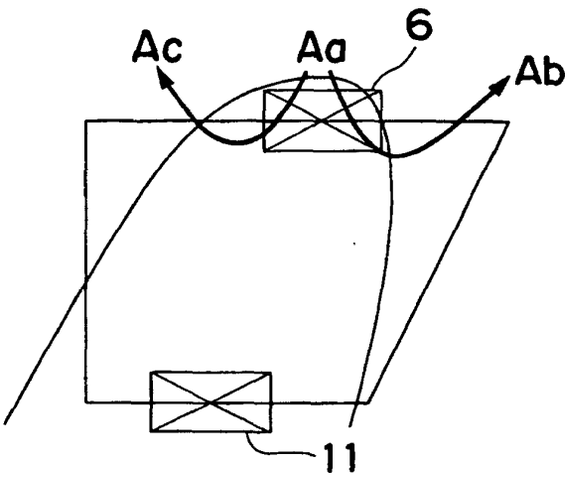


Fig.29

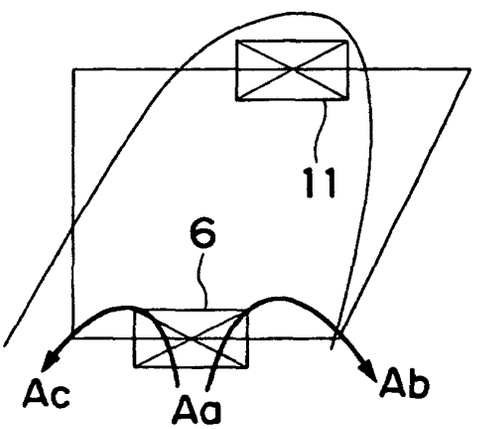
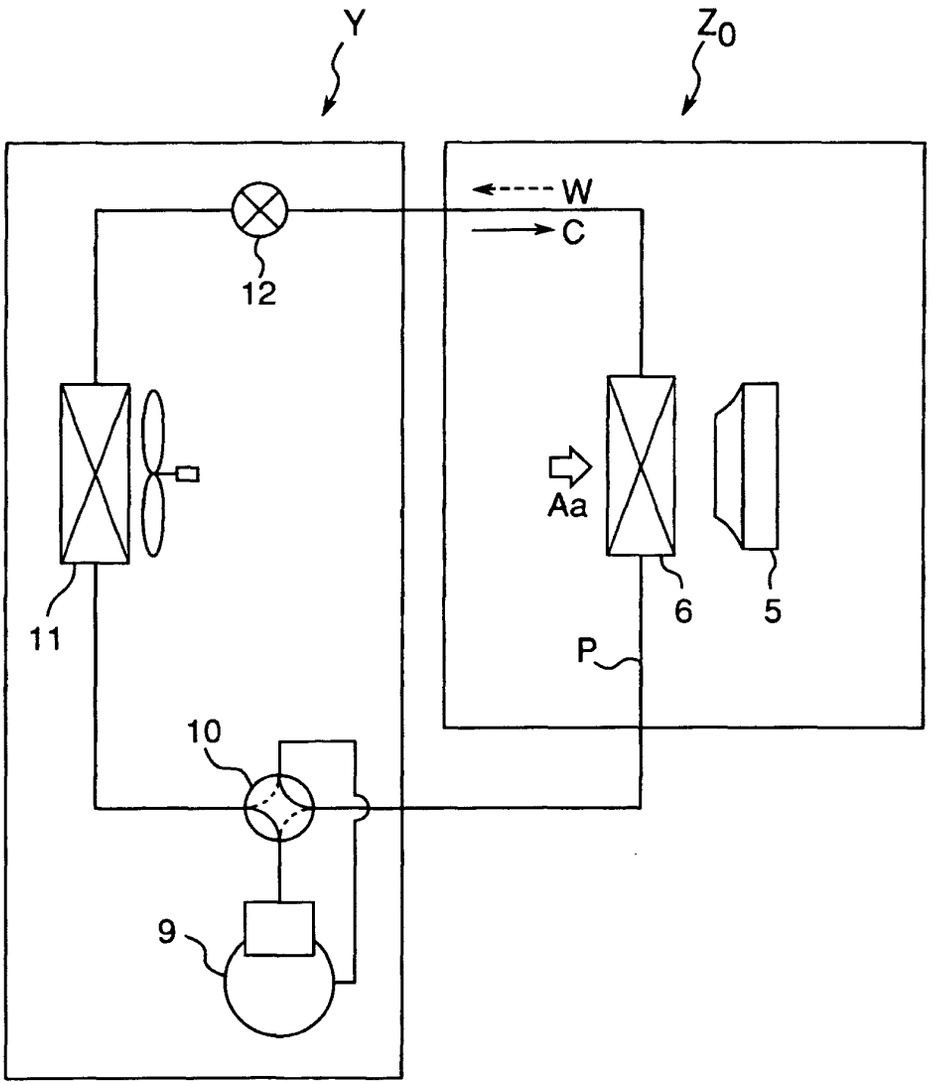


Fig.27



INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP01/11318

A. CLASSIFICATION OF SUBJECT MATTER
Int.Cl[7] F24F1/00

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
Int.Cl[7] F24F1/00, F25B5/02, F25B5/04

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

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Kokai Jitsuyo Shinan Koho	1971-2002	Jitsuyo Shinan Toroku Koho	1996-2002

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y A	JP, 8-105652, A (Toshiba Corp.), 23 April, 1996 (23.04.96), Full text; all drawings (Family: none)	1 2-9
Y A	JP, 9-264557, A (Daikin Industries, Ltd.), 07 October, 1997 (07.10.97), Full text; all drawings (Family: none)	1 2-9
A	JP, 6-241491, A (Sharp Corp.), 30 August, 1994 (30.08.94), Full text; all drawings (Family: none)	7
A	JP, 11-63546, A (Daikin Industries, Ltd.), 05 March, 1999 (05.03.99), Full text; all drawings (Family: none)	1-9

☒ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

* Special categories of cited documents:
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Date of the actual completion of the international search	Date of mailing of the international search report
02 April, 2002 (02.04.02)	16 April, 2002 (16.04.02)
Name and mailing address of the ISA/ Japanese Patent Office	Authorized officer
Facsimile No.	Telephone No.

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INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP01/11318

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	Microfilm of the specification and drawings annexed to the request of Japanese Utility model Application No. 180820/1978 (Laid-open No. 96329/1980) (Tokyo Shibaura Electric Co., Ltd.), 04 July, 1980 (04.07.80), Full text; all drawings	1-9
A	JP, 63-187028, A (Toshiba Corp.), 02 August, 1988 (02.08.88), Full text; all drawings (Family: none)	2-7

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