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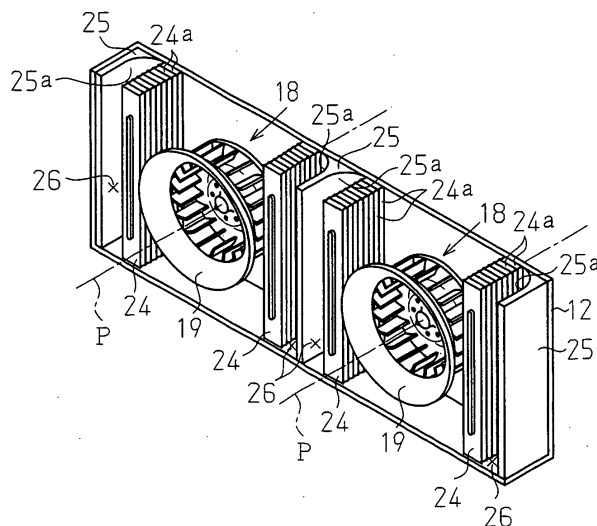
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(54) **AIR CONDITIONER**

(57) A centrifugal blower is arranged in the casing so as to extend its axis of rotation along the depth direction of an air conditioner. A pair of heat exchangers are arranged on the right and left sides of the centrifugal fan so as to superimpose on the centrifugal fan when viewed from the direction perpendicularly intersecting the axis

of rotation of the centrifugal fan. In other words, each heat exchanger is arranged symmetrically with respect to a vertical plane including the axis of rotation of the centrifugal fan. Accordingly, the centrifugal fan and the heat exchanger do not overlap in the depth direction of the air conditioner in the casing. Thus, the air conditioner can be made compact in the depth direction.

Fig. 2



Description

TECHNICAL FIELD

[0001] The present invention relates to an air conditioner in which a heat exchanger and a blower are arranged in a casing.

BACKGROUND ART

[0002] In the prior art, an indoor unit for an air conditioner (hereinafter referred to as "conventional air conditioner 1") such as that disclosed in patent publication 1 is known as the above type of air conditioner. In the conventional air conditioner 1, the heat exchanger is arranged facing an intake port formed in a front surface of the casing. A centrifugal blower is also arranged in the casing. The centrifugal blower is arranged at the rear side of the heat exchanger. In the conventional air conditioner 1, the centrifugal blower is first driven. This draws air into the casing from the intake port. The air then passes through the heat exchanger for temperature adjustment. Thereafter, the air is blown out of the casing through discharge ports formed in upper, left, and right surfaces of the casing.

[0003] In addition to the conventional air conditioner 1 using the centrifugal blower as a blower, an air conditioner indoor unit (hereinafter referred to as "conventional air conditioner 2") using a cross flow blower as a blower such as that disclosed in patent publication 2 is also known. In the conventional air conditioner 2, the cross flow blower is arranged in the upper part of a box-shaped casing. A heat exchanger is arranged below the cross flow blower in the casing. In the conventional blower 2, the cross flow blower is first driven. This draws air into the casing through an intake grille formed in an upper part of a front surface of the casing. The air then passes through the heat exchanger for temperature adjustment. Thereafter, the air is blown out of the casing from a discharge grille formed in a lower part of the front surface of the casing.

Patent Publication 1: Japanese Laid-Open Patent Publication No. 10-122589

Patent Publication 2: Japanese Laid-Open Patent Publication No. 9-217942

DISCLOSURE OF THE INVENTION

[0004] For recent air conditioners, there is a demand for miniaturization (reduction) in the depthwise direction to reduce installation space. In particular, if the air conditioner is a wall-hanging indoor unit installed on a wall surface in a room, the request for depth reduction becomes higher in order to improve the interior design of the room. Furthermore, there is a demand for miniaturization in the heightwise direction since installation space is limited for the wall-hanging indoor unit on the wall sur-

face in the room.

[0005] In the conventional air conditioner 1, the heat exchanger and the centrifugal blower are arranged in an overlapping manner in the depthwise direction in the casing. Thus, the demand for miniaturization in the depthwise direction cannot be sufficiently satisfied. Further, in the conventional air conditioner 2, the heat exchanger and the cross flow blower are arranged in an overlapping manner in the vertical direction in the casing. Thus, the demand for miniaturization in the heightwise direction cannot be sufficiently satisfied. Reduction in the fan diameter of the cross flow air conditioner may also be considered to reduce and miniaturize the conventional air conditioner 2 in the heightwise direction. However, in such a case, it is not easy to appropriately satisfy the reduction and miniaturization requests in the heightwise direction since the air flow amount would decrease and lower the performance of the air conditioner.

[0006] Accordingly, it is an object of the present invention to provide an air conditioner, which has a heat exchanger and blower arranged in a casing, for sufficiently satisfying miniaturization demands, particularly in the depthwise direction, without lowering the performance of the air conditioner.

[0007] In order to achieve the above object, in one aspect of the present invention, a centrifugal blower is arranged in a casing including an intake port and a discharge port for air so that a rotation axis of the centrifugal blower extends in a depthwise direction of the casing. Further, a heat exchanger is arranged to at least partially overlap the centrifugal blower when viewed from a direction perpendicular to the rotation axis of the centrifugal blower.

[0008] In the above structure, the centrifugal blower and the heat exchanger do not overlap in the casing in the depthwise direction of the casing and overlap each other when seen in a direction perpendicular to the depthwise direction of the casing. This optimally satisfies the demand for miniaturization in the depthwise direction of the air conditioner.

[0009] It is preferred that a plurality of heat exchangers are arranged in the casing, and the heat exchangers are arranged at an angular interval of 180 degrees or 90 degrees about the rotation axis of the centrifugal blower. In this case, the heat exchanger may be arranged at a plurality of locations at the side air is blown out from the centrifugal blower. This improves the heat exchanging efficiency in a satisfactory manner.

[0010] In the above air conditioner, it is preferred that heat exchangers be arranged at an angular interval of 180 degrees about the rotation axis of the centrifugal blower so as to be in planar symmetry with respect to a vertical plane or a horizontal plane including the rotation axis of the centrifugal blower. In this case, the flow amount of air passing through each heat exchanger and blown out of the casing from the discharge port is equally distributed.

[0011] In the above air conditioner, it is preferred that

fins of at least one of the heat exchangers are stacked in a direction diagonal to the rotation axis of the centrifugal blower. This ensures a large effective heat exchanging area and improves the heat exchanging efficiency in the air conditioner in a satisfactory manner.

[0012] In the above air conditioner, it is preferred that an air discharge passage in communication with the discharge port be arranged in the casing at a rear side of the heat exchanger when viewed from the centrifugal blower, and a guide surface be arranged on an inner surface of the air discharge passage facing towards the rear surface of the heat exchanger to smoothly guide air flow from the rear surface of the heat exchanger towards the discharge port. In this case, the air blown out from the rear surface of the heat exchanger is smoothly guided to the discharge port. This minimizes pressure loss in the flow of air blown out from the air discharge passage.

[0013] In the above air conditioner, it is preferred that the centrifugal blower be arranged facing towards the intake port in the front surface of the casing, and an air guide of which diameter is reduced towards the inner side of the casing be arranged between the intake port and the centrifugal blower. In this case, air smoothly flows into the centrifugal blower from the intake port through the air guide. This reduces the noise generated when drawing in air.

[0014] In the above air conditioner, it is preferred that the intake port be arranged in the front surface of the casing, and the discharge port be arranged in the front surface of the casing. In this case, the air drawn in from the front surface of the casing is blown out from the front surface of the casing. Therefore, flexible installation of the air conditioner becomes possible to optimize the blowing direction of the air in accordance with the surrounding environment in which the air conditioner is installed.

[0015] In the above air conditioner, it is preferred that the casing be arranged with a rear surface of the casing facing towards a wall surface of the room, and the intake port and the discharge port each being arranged in a front surface of the casing. In this case, the air drawn into the casing and the air blown out of the casing define front surface intake and front surface discharge. Therefore, the air conditioner, which is a wall-hanging indoor unit, may be installed near the ceiling. Furthermore, even if installed near a window, a temperature change that would be caused by heat exchange between the window and the air blown out of the discharge port is prevented.

[0016] In the above air conditioner, it is preferred that the intake port and the discharge port be arranged in the front surface of the casing so that a discharge port is arranged at each of the left and right sides of the intake port. In this case, the temperature-adjusted air is blown out towards the front from each discharge port arranged at the left and right sides of the intake port. Thus, the air is blown out over a wide range.

[0017] In the above air conditioner, it is preferred that a plurality of intake ports be arranged in the front surface

of the casing, a plurality of centrifugal blowers facing the intake ports be arranged in the casing, the heat exchanger be arranged in the casing on left and right sides of the centrifugal blower, and an air discharge passage for guiding air flow from the rear surface of each heat exchanger towards each discharge port is arranged between the rear surface of each heat exchanger and each discharge port. In this case, the air conditioner can be enlarged in accordance with the dimensions of the indoor space in which the air conditioner is installed.

[0018] Therefore, in the air conditioner of the present invention in which the heat exchanger and the air blower are arranged in the casing sufficiently satisfies demands for miniaturization particularly in the depthwise direction without lowering the performance of the air conditioner.

BRIEF DESCRIPTION OF THE DRAWINGS

[0019]

Fig. 1 is an outer perspective view showing an air conditioner of a preferred embodiment in an installed state;

Fig. 2 is a partial perspective view showing the inner structure of the air conditioner;

Fig. 3 is a cross-sectional plan view of the air conditioner;

Fig. 4 is a partial perspective view showing the inner structure of a modified air conditioner;

Fig. 5 is a partial perspective view showing the inner structure of a modified air conditioner;

Fig. 6 is a partial perspective view showing the inner structure of a modified air conditioner;

Figs. 7(a) and (b) are partial perspective views showing the inner structure of a modified air conditioner; Fig. 8 is a cross-sectional view of a modified air conditioner; and

Fig. 9 is an outer perspective view showing a modified air conditioner in an installed state.

BEST MODE FOR CARRYING OUT THE INVENTION

[0020] An air conditioner according to one embodiment of the present invention will now be described with reference to Figs. 1 to 3.

[0021] As shown in Fig. 1, an air conditioner 10 of the present embodiment includes a laterally elongated box-shaped casing 11. The air conditioner 10 is a wall-hanging thin-type indoor unit, and the rear surface (back surface) of the casing 11 is arranged facing the room wall surface, such as wall surface W, near a ceiling. The casing 11 includes a casing main body 12 having an open front surface and a front surface panel 13 for closing the open front surface of the casing main body 12. Intake ports 14 are formed at two spaced apart locations in the left and right sides of the front surface panel 13. Each intake port 14 is formed by arranging a plurality of elongated flaps in the heightwise direction. Discharge ports

15 are formed at inner and outer sides of the intake ports 14. Each discharge port 15 is formed by arranging a plurality of short flaps in the heightwise direction. A pair of cooling medium pipes 16 extends from the right side wall 12b of the casing main body 12. A connection unit 17 is attached to the extended end of each cooling medium pipe 16.

[0022] The structure of the members arranged in the casing 11 will now be described with reference to Figs. 2 and 3. Fig. 2 is a schematic perspective view showing the air conditioner 10 of Fig. 1. In Fig. 2, the front surface panel 13 is detached from the casing 11, and the upper side wall 12a and the right side wall 12b of the casing main body 12 are not shown. In Fig. 2, the piping and drain of the cooling medium pipes 16 in the casing 11 are not shown. Fig. 3 is a cross-sectional plan view taken at an intermediate position in the heightwise direction of the air conditioner 10 shown in Fig. 1.

[0023] As shown in Figs. 2 and 3, a plurality of centrifugal blowers 18 are arranged in the casing 11. Each centrifugal blower 18 is arranged on the rear surface of the casing 11, with its rotation axis P extending in the forward-rearward direction (i.e., depthwise direction of the casing 11). Each centrifugal blower 18 is arranged facing the corresponding intake port 14. An air guide (bell mouse) 19 having an annular shape when viewed from the front view is arranged between each intake port 14 and the centrifugal blower 18. Each air guide 19 is arranged coaxially with the corresponding centrifugal blower 18. The diameter of each air guide 19 is reduced from the front surface towards the rear surface of the casing 11. As shown in Fig. 3, the circumferential edge of the front opening of each air guide 19 is fitted into and supported by the front surface panel 13 from the rear surface of the intake port 14. This fixes each air guide 19 to the casing 11. With regards to each air guide 19, the rear circumferential edge formed with a diameter smaller than the front circumferential edge extends to the vicinity of the front end of the centrifugal blower 18. Each air guide 19 smoothly guides air into the casing 11 from the intake port 14 towards the centrifugal blower 18.

[0024] The centrifugal blower 18 includes a vane portion 22 and a motor 23 for driving the vane portion 22. The vane portion 22 includes a generally disk-shaped hub 20 and a number of blades 21. Each blade 21 extends from the front surface of the circumferential part of the hub 20 towards the front. The outer shape of the vane portion 22 when seen from the front is shaped and sized in a manner generally identical to that of the opening at the rear circumferential edge of the air guide 19. In each centrifugal blower 18, the motor 23 is fixed to the rear side wall surface of the casing 11, and a support shaft 23a projects from the motor 23 towards the front. The vane portion 22 of each centrifugal blower 18 is rotatably supported by the distal end of the support shaft 23a about the rotation axis P. Centrifugal force is generated by the rotation of the vane portion 22 in the centrifugal blower 18. The centrifugal force then blows out air

from the centrifugal blower 18 in the centrifugal direction (radial direction).

[0025] A pair of heat exchangers 24 are arranged on the left and right sides of the centrifugal blower 18 in the casing 11 (casing main body 12). Each heat exchanger 24 is formed by stacking a plurality of fins 24a. In the present embodiment, the fins 24a are stacked in a direction parallel to a vertical plane including the rotation axis P of the centrifugal blower 18. The center positions of the heat exchangers 24 are arranged at an angular interval of 180 degrees about the rotation axis P of the centrifugal blower 18. The heat exchangers 24 that form a left and right pair are arranged so as to be symmetric with respect to the vertical plane including the rotation axis P of the centrifugal blower 18. Each heat exchanger 24 is arranged so as to partially overlap the centrifugal blower 18 when seen from a direction perpendicular to the rotation axis P of the centrifugal blower 18. In the present embodiment, the depthwise dimension of the centrifugal blower 18 is set to be substantially the same as the depthwise dimension of the heat exchanger 24.

[0026] A guide block 25 is arranged in the casing 11 towards the rear of the heat exchanger 24 when viewed from the centrifugal blower 18. The guide block 25 has a guide surface 25a having an arcuate cross-section, with the guide surface 25a facing the heat exchanger 24. An air discharge passage 26, which is in communication with the discharge port 15, is formed between the guide block 25 and the heat exchanger 24. Thus, the air blown out of the centrifugal blower 18 in the radial direction flows through the fins 24a of the heat exchanger 24 into the air discharge passage 26 and is then smoothly guided to the discharge port 15 along the guide surface 25a of the guide block 25.

[0027] The operation of the air conditioner 10 of the present embodiment will now be described.

[0028] When the motor 23 is driven and the vane portion 22 of the centrifugal blower 18 is rotated, air is drawn into each intake port 14 at the front surface of the casing 11 towards the centrifugal blower 18, as shown by arrows A in Fig. 3. A large amount of air, which is drawn into each intake port 14, smoothly flows towards the centrifugal blower 18 along the inner surface of the air guide 19. The air that flows into the centrifugal blower 18 is blown out in the radial direction, as shown by arrows a in Fig. 3.

[0029] The air blown out from the centrifugal blower 18 flows through the fins 24a of each heat exchanger 24 arranged on the left and right sides of the centrifugal blower 18. The air exchanges heat with a cooling medium flowing through the heat exchanger 24 from the cooling medium pipe 16 and undergoes temperature adjustment (heating or cooling). The heat exchangers 24 are arranged so as to be in planar symmetry with the vertical plane including the rotation axis P of the centrifugal blower 18. Therefore, the air flow amount distribution of the air flowing through each heat exchanger 24 and blown out from the rear surface thereof is substantially the same

at the left and right sides.

[0030] The air blown out from the rear surface of each heat exchanger 24 then flows into the air discharge passage 26 between the heat exchanger 24 and the guide block 25. The air, which flows into the air discharge passage 26, is smoothly guided to the discharge port 15 along the guide surface 25a of the guide block 25, as shown by arrows b in Fig. 3. This reduces pressure loss of the blown-out air flow in the air discharge passage 26 in an optimal manner.

[0031] The air guided through the air discharge passage 26 to the discharge port 15 is blown out of the casing 11 from the discharge port 15. In other words, in the air conditioner 10 of the present embodiment, the air in the room is drawn into the front surface of the casing 11, undergoes temperature adjustment, and is then blown out into the room from the front surface of the casing 11. The air is blown out of the casing 11 from each discharge port 15 on the left and right sides of the intake port 14, as shown by arrows B in Fig. 3. The temperature-adjusted air is thus blown out over a wide range.

[0032] When installing the air conditioner 10 in the room, the rear surface of the casing 11 is fixed to the wall surface W of the room, as shown in Figs. 1 and 3. In the air conditioner 10 of the present embodiment, the centrifugal blower 18 and the heat exchanger 24 are not overlapped in the casing 11 when viewed in the depthwise direction, that is, in the forward-rearward direction of the air conditioner 10, but is arranged adjacent to each other. The centrifugal blower 18 and the heat exchanger 24 are also not overlapped in the casing 11 in the vertical direction. Thus, the size in the forward-rearward direction and the heightwise direction of the air conditioner 10 is reduced. This reduces bulging of the air conditioner 10 into the room when it is arranged, for example, on the wall surface near the ceiling, and the interior design of the room is not adversely affected.

[0033] The air conditioner 10 of the above embodiment has the advantages described below.

(1) In the casing 11, the centrifugal blower 18 and the heat exchanger 24 are not overlapped in the forward-rearward direction of the casing 11 (depthwise direction of the air conditioner 10) but are overlapped with each other when viewed from a direction perpendicular to the rotation axis P of the centrifugal blower 18. This optimally miniaturizes the air conditioner 10 in the depthwise direction as is demanded to improve the interior design of the room. Further, sufficient air flow amount is ensured, and the performance of the air conditioner 10 is not lowered since the centrifugal blower 18 does not need to be miniaturized when the above arrangement is adopted.

(2) In the casing 11, the heat exchanger 24 is arranged at the left and right sides (plural positions) from where air is blown out from the centrifugal blow-

er 18. The air blown out in the radial direction from the centrifugal blower 18 thus undergoes heat exchange in each heat exchanger 24, and the heat exchanging efficiency is enhanced.

(3) A pair of heat exchangers 24 are arranged on both sides of each centrifugal blower 18. Each heat exchanger 24 is arranged so as to be in planar symmetry with the vertical plane including the rotation axis P of the centrifugal blower 18. This equally distributes the flow of air blown out from each discharge port 15 after the air is temperature-adjusted when passing through each heat exchanger 24.

(4) The air blown out from the rear surface of the heat exchanger 24 and flowing into the air discharge passage 26 is smoothly guided to the discharge port 15 along the guide surface 25a of the guide block 25. This minimizes pressure loss of the blown-out air flow in the air discharge passage 26.

(5) The air drawn into the centrifugal blowers 18 in the casing 11 from the intake ports 14 is smoothly guided into the centrifugal blowers 18 by the air guides 19 arranged between the centrifugal blowers 18 and the intake ports 14. This optimally reduces noise, which is generated when air is drawn into the casing 11 from the intake port 14.

(6) In the present embodiment, after the air drawn into the intake ports 14 formed in the front surface of the casing 11 undergoes temperature adjustment, the air is blown out towards the front from the discharge ports 15, which are also formed in the front surface of the casing 11 like the intake ports 14. Therefore, when the air conditioner 10 is of a wall-hanging type in which the rear surface of the casing 11 contacts the wall surface W of the room, flexible installation of the air conditioner 10 becomes possible while taking into consideration the blowing direction of the air and the surrounding environment, such as curtain rails and ceiling surfaces.

(7) In a structure in which air is drawn in from the front surface and blown out from the front surface like in the air conditioner 10 of the present embodiment, there are not limitations implied to the drawing and blowing of air even if the wall-hanging air conditioner 10 is installed at the upper part of the wall surface W of the room (near the ceiling). Furthermore, even if the wall-hanging air conditioner 10 is installed near a window or the like, air is not blown out along the surface of the window. This prevents the blown out temperature-adjusted air from exchanging heat with the window and changing temperature.

(8) A pair of discharge ports 15 is formed on both

sides of each intake port 14, and the temperature-adjusted air is blown out from each discharge port 15. The temperature-adjusted air is thus blown out from the front surface of the casing 11 over a wide range in the room.

(9) In the present embodiment, an air conditioning unit including the centrifugal blower 18, the heat exchanger 24, the guide block 25 etc. is arranged in the casing 11 in pluralities (in the present embodiment, two, one on the left and the other on the right side). The air drawn into the intake ports 14 of each air conditioning unit undergoes temperature adjustment and is then blown out from each discharge ports 15 of the air conditioning unit. Therefore, an appropriate air conditioning performance corresponding to the installation environment is provided by adjusting the number of air conditioning units in accordance with the environment (size of indoor space) in which the air conditioner 10 is to be installed.

[0034] The above embodiment may be modified as described below.

[0035] As shown in Fig. 4, the heat exchanger 24 may be arranged on the upper and lower sides of the centrifugal blower 18. That is, a pair of heat exchangers 24 may be arranged on the upper and lower sides of each centrifugal blower 18, with the guide block 25 arranged at the rear side of each heat exchanger 24, and the air discharge passage 26 formed between the heat exchanger 24 and the guide block 25. In this case, the stacking direction of the fin 24a is arranged parallel to a horizontal plane including the rotation axis P of the centrifugal blower 18 in the heat exchanger 24. Further, the pair of upper and lower heat exchanger 24 are arranged in planar symmetry with respect to the horizontal surface. The locations of the discharge ports 15 formed in the front surface of the casing 11 also changes in accordance with changes in the position of the air discharge passage 26. The locations of the discharge ports 15 also change in air conditioners 10 shown in Figs. 5 to 7, which will be described later. In the modification of Fig. 4, it is preferred that a partition member 27 be arranged between the left and right air conditioning units. Each heat exchanger 24 is overlapped with the centrifugal blower 18 when viewed in a direction perpendicular to the rotation axis P. Thus, the same advantages as the above embodiment are obtained when employing this arrangement.

[0036] As shown in Fig. 5, two heat exchangers 24 may be arranged at an angular interval of 90 degrees about the rotation axis P of the centrifugal blower 18 as the center. That is, two heat exchangers 24 may be arranged in an L-shaped manner, one at the upper side and one at either the left or right side of each centrifugal blower 18, with the guide block 25 arranged at the rear side of each heat exchanger 24, and the air discharge passage 26 formed between the heat exchanger 24 and the guide block 25. In this case as well, it is preferred that

the partition member 27 be arranged between the left and right air conditioning units. Each heat exchanger 24 is overlapped with the centrifugal blower 18 when viewed in a direction perpendicular to the rotation axis P. Thus, the same advantages as the above embodiment are obtained when employing this arrangement.

[0037] As shown in Fig. 6, in the casing 11, two heat exchangers 24 may be arranged at an angular interval of 180 degrees about the rotation axis P of the centrifugal blower 18. From one of these heat exchangers 24, one heat exchanger 24 may be arranged at an angular interval of 90 degrees. In other words, three heat exchangers 24 may be arranged in a U-shaped manner at the upper, left, and right sides of each centrifugal blower 18. Each heat exchanger 24 is overlapped with the centrifugal blower 18 when viewed in a direction perpendicular to the rotation axis P. Thus, the same advantages as the above embodiment are obtained when employing this arrangement.

[0038] As shown in Figs. 7(a) and 7(b), air conditioning units, each including the centrifugal blower 18, the heat exchanger 24, and the guide block 25, may be continuously arranged in the vertical direction in the casing 11. In the air conditioner 10 shown in Fig. 7(a), the air conditioner 10 of Fig. 4 is rotated by 90 degrees. In the air conditioner 10 shown in Fig. 7(b), the air conditioner 10 of the embodiment shown in Fig. 2 is rotated by 90 degrees. Each heat exchanger 24 is overlapped with the centrifugal blower 18 when viewed in a direction perpendicular to the rotation axis P. Thus, the same advantages as the above embodiment are obtained when employing these arrangements.

[0039] In the air conditioner 10 of the embodiment shown in Figs. 1 to 3 and the modifications shown in Figs. 4 to 7, the direction of each heat exchanger 24 arranged in the casing 11 may be changed so that it is arranged diagonally as shown in Fig. 8. That is, each heat exchanger 24 may be arranged so that the fins 24a in the heat exchanger 24 are stacked in a direction diagonally intersecting the vertical plane (or horizontal plane) including the rotation axis P. In other words, each heat exchanger 24 may be arranged so that the fins 24a of the heat exchanger 25 are stacked in a direction diagonal to the rotation axis P of the centrifugal blower 18. This increases the effective heat exchanging area of the heat exchanger 24 that receives the air blown out from the centrifugal blower 18 and improves the heat exchanging efficiency of the air conditioner 10.

[0040] As shown in Fig. 9, the intake ports 14 formed in the front surface (front surface panel 13) of the casing 11 may be covered by a plurality of closing panels 13a (two for each intake port 14 in Fig. 9). A structure for covering each intake port 14 with a single large closing panel may of course be adopted. In this case as well, the closing panel 13a swings toward the front about a lower end to perform an opening operation that opens the intake port 14 in the front surface of the casing 11. This obtains the same advantages as the air conditioners 10

that draw in air from the front surface and blow out air from the front surface as in the above embodiment and each of the modifications.

[0041] In the above embodiment and each of the modifications, each discharge port 15 is formed in the front surface of the casing 11 together with the intake port 14. However, the discharge ports 15 may be formed in the upper, lower, left, and right side surfaces in accordance with the environmental condition (room environment etc.) in which the air conditioner 10 is installed.

[0042] The air guide 19 arranged between the intake port 14 and the centrifugal blower 18 may be omitted.

[0043] The guide surface 25a for guiding the air, which flows into the air discharge passage 26, to the discharge port 15 may be an inclined surface. Alternatively, the guide block 25 may be omitted and the guide surface 25a may be formed on the inner surface of the casing 11.

[0044] In Fig. 8, the plurality of heat exchangers 24 arranged in the casing 11 on both sides of the centrifugal blower 18 only needs to have, for example, at least one of the heat exchangers 24 arranged diagonally.

[0045] The present embodiment and each of the modifications are embodied in an indoor unit for a wall-hanging air conditioner arranged on a wall surface W of a room. However, the present embodiment and each of the modifications are not limited to wall-hanging types and may be embodied in a floor-installed air conditioner or in an outdoor unit.

Claims

1. An air conditioner comprising:

a centrifugal blower arranged in a casing including an intake port and a discharge port for air so that a rotation axis of the centrifugal blower extends in a depthwise direction of the casing; and a heat exchanger arranged to at least partially overlap the centrifugal blower when viewed from a direction perpendicular to the rotation axis of the centrifugal blower.

2. The air conditioner according to claim 1, wherein a plurality of heat exchangers are arranged in the casing, the heat exchangers being arranged at an angular interval of 180 degrees or 90 degrees about the rotation axis of the centrifugal blower.

3. The air conditioner according to claim 2, wherein the heat exchangers are arranged at an angular interval of 180 degrees about the rotation axis of the centrifugal blower so as to be in planar symmetry with respect to a vertical plane or a horizontal plane including the rotation axis of the centrifugal blower.

4. The air conditioner according to claim 2, wherein fins of at least one of the heat exchangers are stacked

in a direction diagonal to the rotation axis of the centrifugal blower.

5. The air conditioner according to any one of claims 1 to 4, comprising:

an air discharge passage in communication with the discharge port and arranged in the casing at a rear side of the heat exchanger when viewed from the centrifugal blower; and a guide surface arranged on an inner surface of the air discharge passage facing towards the rear surface of the heat exchanger to smoothly guide air flow from the rear surface of the heat exchanger towards the discharge port.

6. The air conditioner according to any one of claims 1 to 5, wherein the centrifugal blower is arranged facing towards the intake port in the front surface of the casing, and an air guide of which diameter is reduced towards the inner side of the casing is arranged between the intake port and the centrifugal blower.

7. The air conditioner according to any one of claims 1 to 6, wherein the intake port is arranged in the front surface of the casing, and the discharge port is arranged in the front surface of the casing.

8. The air conditioner according to any one of claims 1 to 7, wherein the casing is arranged with a rear surface of the casing facing towards a wall surface of the room, and the intake port and the discharge port are each arranged in a front surface of the casing.

9. The air conditioner according to claim 8, wherein the intake port and the discharge port are arranged in the front surface of the casing so that a discharge port is arranged at each of left and right sides of the intake port.

10. The air conditioner according to claim 9, wherein a plurality of intake ports are arranged in the front surface of the casing, a plurality of centrifugal blowers facing the intake ports are arranged in the casing, the heat exchanger is arranged in the casing on left and right sides of the centrifugal blower, and an air discharge passage for guiding air flow from the rear surface of each heat exchanger towards each discharge port is arranged between the rear surface of each heat exchanger and each discharge port.

Fig. 3

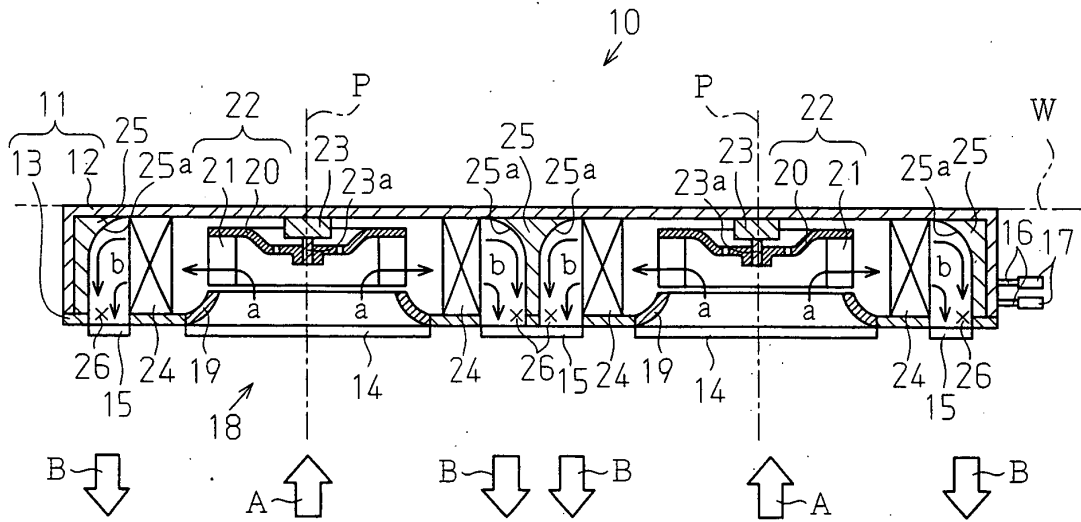


Fig. 4

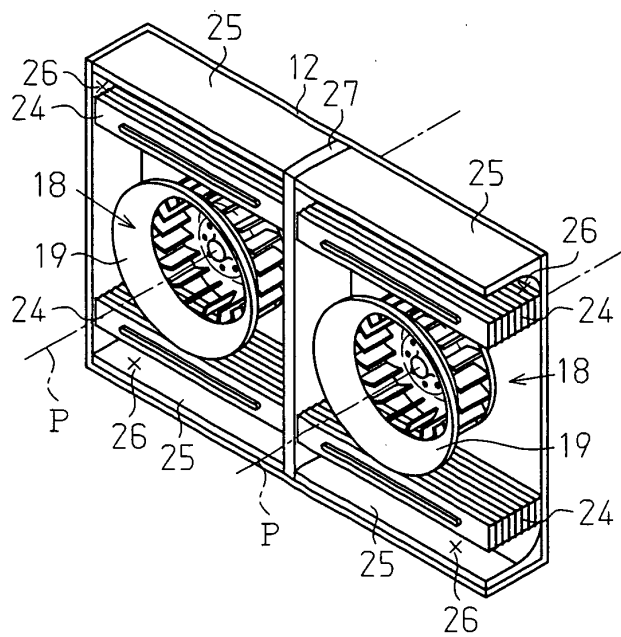


Fig. 5

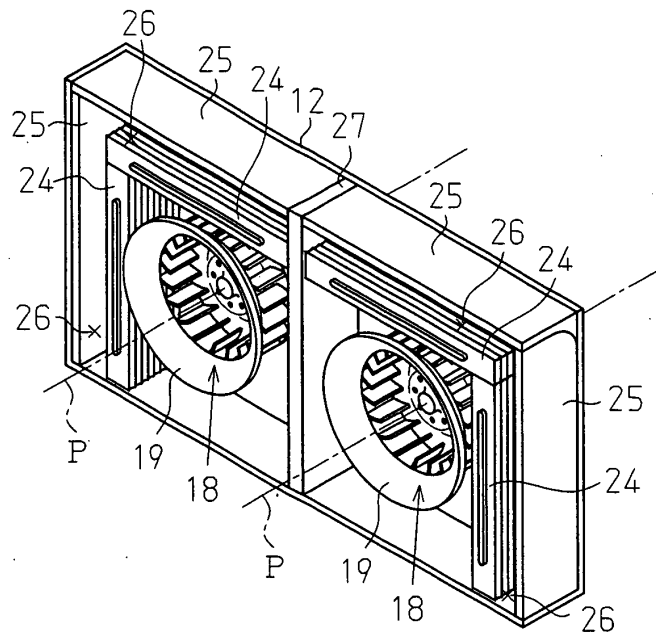


Fig. 6

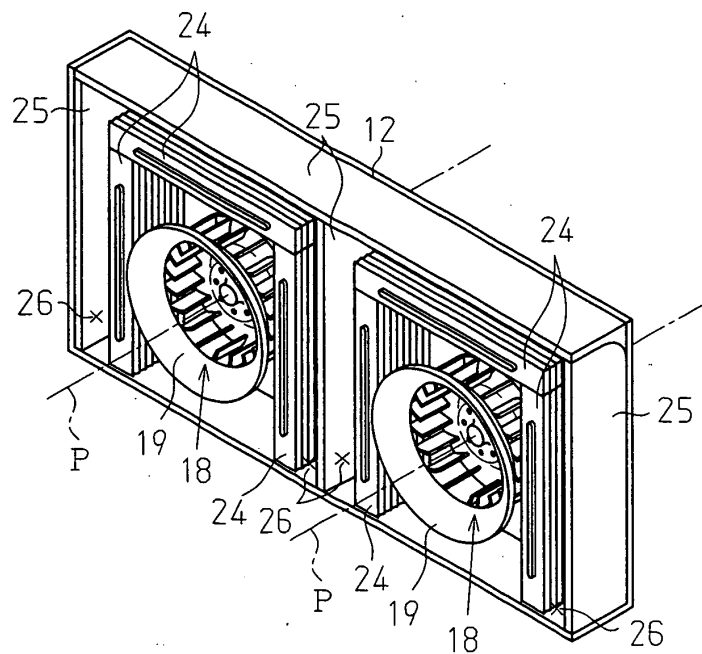


Fig. 7(a)

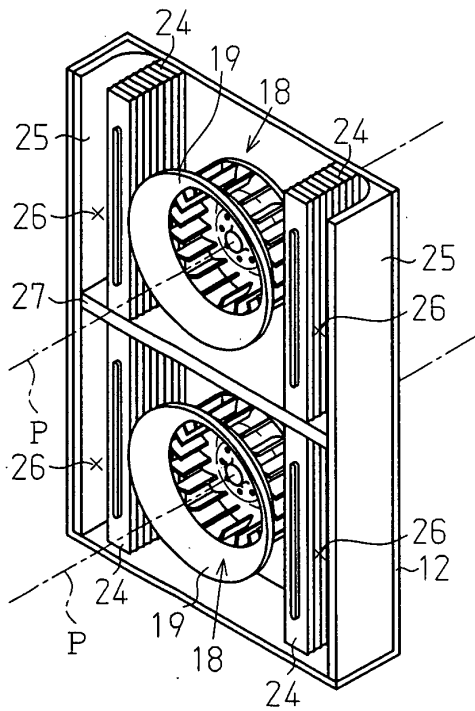


Fig. 7(b)

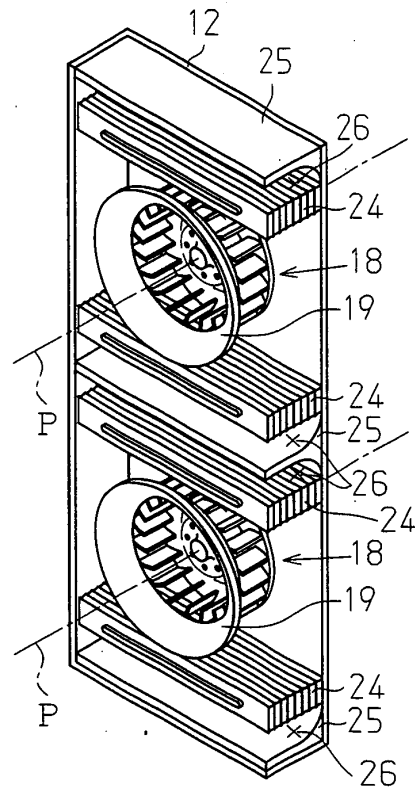


Fig. 8

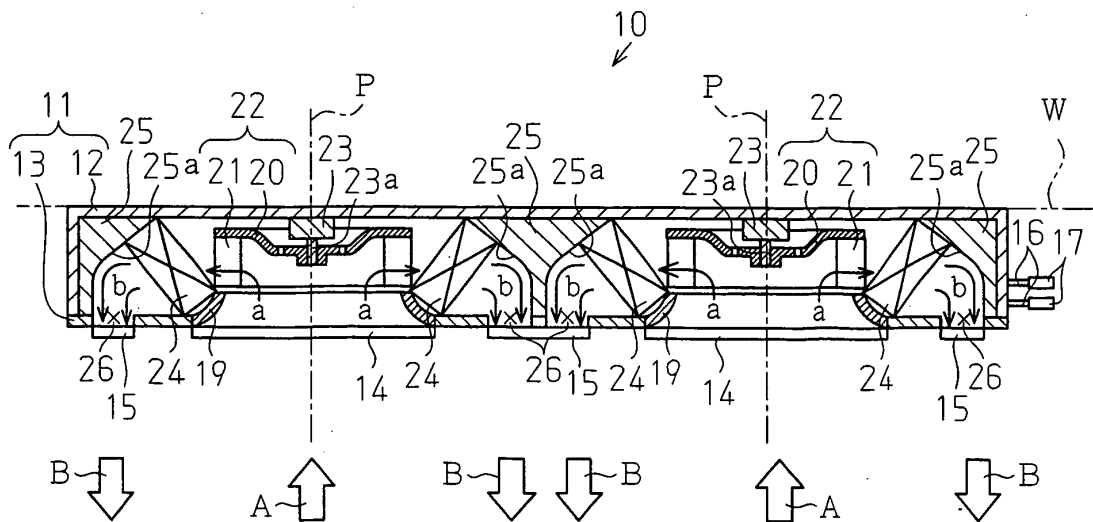
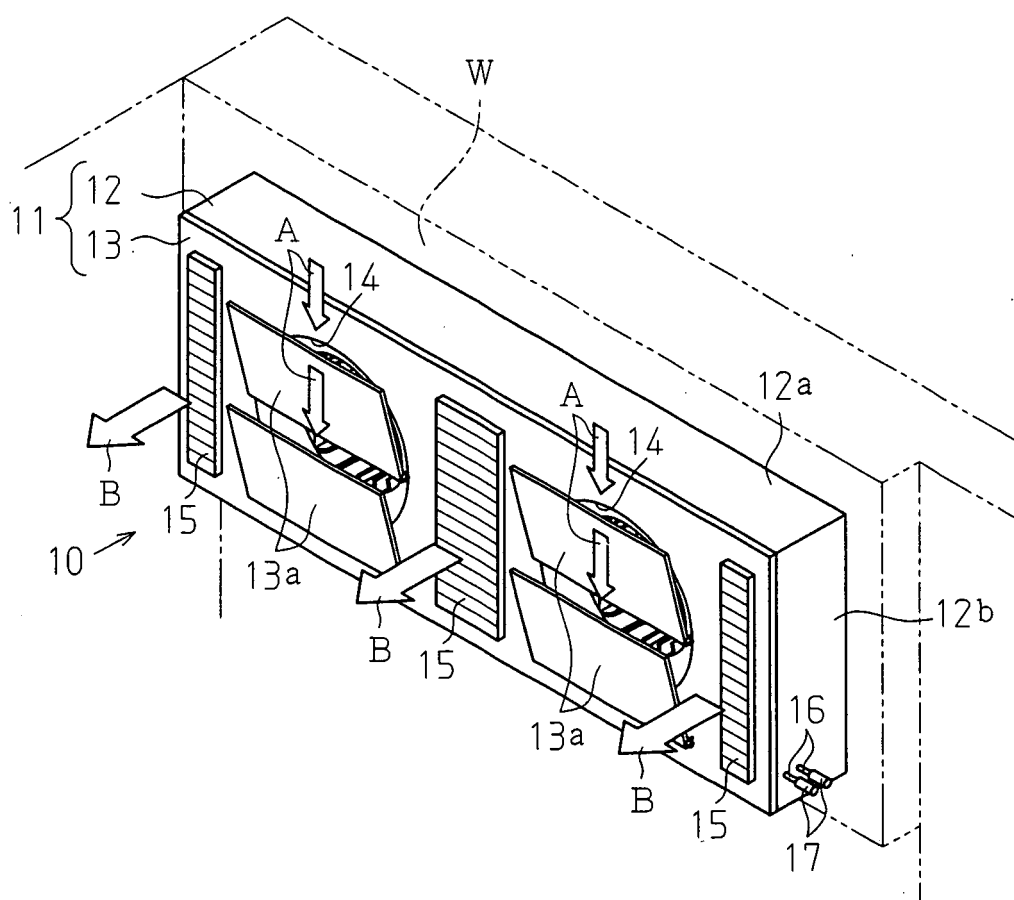


Fig. 9



INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2005/012961

A. CLASSIFICATION OF SUBJECT MATTER Int.Cl. ⁷ F24F13/30, 1/00		
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 F24F13/30, 1/00		
Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched Jitsuyo Shinan Koho 1922-1996 Jitsuyo Shinan Toroku Koho 1996-2005 Kokai Jitsuyo Shinan Koho 1971-2005 Toroku Jitsuyo Shinan Koho 1994-2005		
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.
X Y	JP 2002-195642 A (Mitsubishi Heavy Industries, Ltd.), 10 July, 2002 (10.07.02), Par. Nos. [0016] to [0022]; Figs. 1 to 2 (Family: none)	1-4, 7, 8 5, 6, 9, 10
Y	JP 2-136628 A (Mitsubishi Electric Corp.), 25 May, 1990 (25.05.90), Page 2, upper right column, line 7 to lower right column, line 18; Figs. 1 to 2 (Family: none)	5, 9, 10
Y	JP 3161979 B2 (Daikin Industries, Ltd.), 25 April, 2001 (25.04.01), Par. No. [0017]; Fig. 2 (Family: none)	6
☒ Further documents are listed in the continuation of Box C. ☐ See patent family annex.		
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Date of the actual completion of the international search 18 August, 2005 (18.08.05)		Date of mailing of the international search report 06 September, 2005 (06.09.05)
Name and mailing address of the ISA/ Japanese Patent Office		Authorized officer
Facsimile No.		Telephone No.

INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2005/012961

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	JP 63-4897 Y2 (Mitsubishi Heavy Industries, Ltd.), 09 February, 1988 (09.02.88), Column 1, lines 8 to 18; Fig. 1 (Family: none)	9, 10
Y	JP 11-141968 A (Sanyo Electric Co., Ltd.), 28 May, 1999 (28.05.99), Par. Nos. [0010] to [0025]; Figs. 1 to 7 (Family: none)	10

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REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- JP 10122589 A [0003]
- JP 9217942 A [0003]