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

(11) EP 1 443 282 A1

(12) **EUROPEAN PATENT APPLICATION**
published in accordance with Art. 158(3) EPC

(43) Date of publication:
04.08.2004 Bulletin 2004/32

(21) Application number: **02799463.1**

(22) Date of filing: **06.09.2002**

(51) Int Cl.[7]: **F24F 5/00**

(86) International application number:
PCT/JP2002/009126

(87) International publication number:
WO 2003/027578 (03.04.2003 Gazette 2003/14)

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

(30) Priority: **21.09.2001 JP 2001289812**

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(54) OUTDOOR UNIT OF AIR CONDITIONER

(57) The inside of a main body of an outdoor unit (1) is partitioned by a partition plate (3) into two spaces, the one space is used as a heat exchange chamber (4) in which an outdoor heat exchanger (8), blowers (10a and 10b), and the like are disposed, and the other space is used as a machine chamber (5) in which a compressor (13), an electrical component package (16), and the like are disposed. The blowers each comprise a fan motor (11a, 11b) and a propeller fan (12a, 12b), there are disposed two units of the blowers arranged in vertical alignment with each other, and a diameter (ϕDa) of the propeller fan of the blower on the upper side is set larger than a diameter (ϕDb) of the propeller fan of the blower on the lower side.

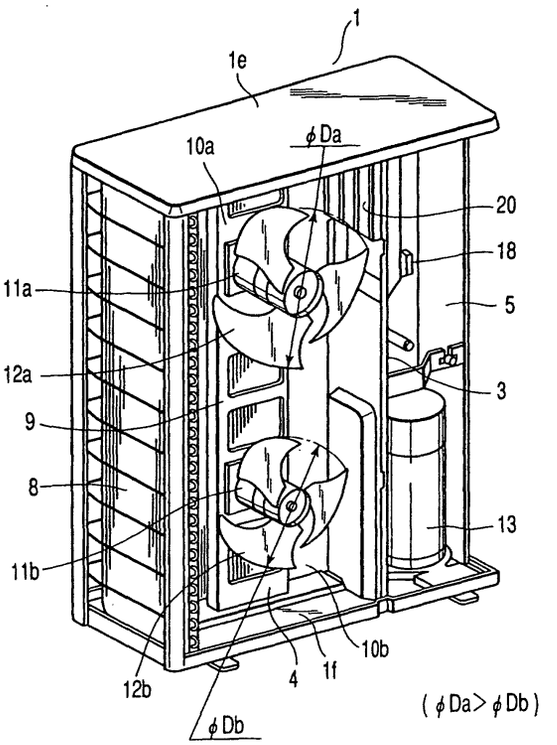

FIG. 2

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Description

Technical Field

[0001] The present invention relates to an air-conditioner outdoor unit having two blowers arranged in vertical alignment with each other.

Background Art

[0002] General-use air-conditioner outdoor units comprise of an indoor unit placed in a room to be air-conditioned and an outdoor unit placed outdoors, in which a refrigerant conduit and electric wiring are connected between the indoor and outdoor units.

[0003] In the outdoor unit, the inside of a main frame or housing of the outdoor unit is partitioned by a partition plate. One space formed therein is used as a heat exchange chamber in which an outdoor heat exchanger, blowers, and the like are disposed. The other space is used as a machine chamber in which, for example, a compressor, refrigerant conduit and associated components thereof, and an electrical component package are disposed.

[0004] In an intermediate-sized air conditioner, referred to as a business-use air conditioner, the height dimension of an outdoor heat exchanger provided in an outdoor unit has a vertically long shape having a dimension approximately equivalent to the height of a person. As such, two blowers need to be provided in the vertical direction to send outside air into an outdoor heat exchanger.

[0005] Each of the blowers has, for example, a propeller fan having a high air blow rate and high blowing efficiency and is fitted onto a rotation shaft of a fan motor. The diameters of the propeller fans are set identical to each other to be within the size of the housing, which is the main body of the outdoor unit.

[0006] Meanwhile, when heating operation is performed, frost is inevitably deposited in the outdoor heat exchanger to impair the heat exchange efficiency, so that a defrost operation is appropriately performed. During the defrost operation, frost-melted drain water falls from the outdoor heat exchanger and accumulate over a bottom board of the main body of the outdoor unit.

[0007] Particularly, in a cold district where the outside temperature is low, a case can occur in which the water accumulatively staying on the bottom board is frozen depending on the temperature before the water is discharged. When the defrost operation is repeated, ice formed of the frozen water on the bottom board gradually grows higher.

[0008] When favored temperature rise does not occur to melt the ice, the ice is connected to a circumferential edge portion of the propeller fan of the blower on the lower side. As such, even when the operation is resumed, the propeller fan is restrained by the ice to be non-rotatable, thereby allowing overcurrent to flow to a fan motor and hence causing a malfunction. Even when the propeller fan rotates, the propeller fan would impinge on the ice, therefore potentially leading to deformation or damage of the fan per se.

[0009] In a cold district, no way is available to avoid the phenomenon in which the drain water accumulates over the bottom board. In this case, as a countermeasure, an idea occurs to design the configuration in which a propeller fan smaller than a standard type in diameter is used, and the propeller fan is positioned apart at a distance greater than an ice growing range.

[0010] In contrast, however, with the structure using propeller fans having such a smaller diameter on two sides, a necessary air blow rate cannot be secured at the time of air-cooling operation, for example. This consequently leads to reduction in heat exchange efficiency of the outdoor heat exchanger.

[0011] On the other hand, the electrical component package, which is provided in the machine chamber, therein accommodates various electrical components including, for example, a component such as a giant transistor of a high heating value. Therefore, an electrical-component cooling device, referred to as a "heat sink", is mounted near electrical components of high heating values.

[0012] The electrical-component cooling device has an endothermic plane and a radiating plane. The electrical components of high radiation values are mounted on the endothermic plane. The radiating plane is exposed to the side of a heat exchange chamber via an opening section of the partition plate. As such, the radiating plane is exposed to the airflow generated by the blower disposed in the heat exchange chamber, thereby being enabled to exhibit high radiation efficiency.

[0013] Nevertheless, the diameters of the two propeller fans are identical to each other. Accordingly, the propeller fans provides air blow rates identical to each other, so that the fans cannot draw efficiently cooling airflow to the electrical-component cooling device.

[0014] An object of the invention is to provide an air-conditioner outdoor unit comprising, as a prerequisite condition, two blowers arranged in vertical alignment, in which reduction in an air blow rate is suppressed as much as possible, occurrences of causing a fan of the blower on a lower side to be restrained by frozen drain water are reduced, reliability is thereby improved, and a sufficiently large diameter of a fan on the side proximity to an electrical-component cooling device is secured, whereby much air is drawn to flow to the side of the electrical-component cooling device, and radiation efficiency of the electrical-component cooling device is prevented from being reduced.

Disclosure of Invention

[0015] In an air-conditioner outdoor unit in which the inside of a main body of the outdoor unit is partitioned by a partition plate into two spaces, the one space is

used as a heat exchange chamber in which a outdoor heat exchanger, blowers, and the like are disposed, and the other space is used as a machine chamber in which a compressor, an electrical component package, and the like are disposed. The blowers each comprise a fan motor and a fan fitted onto a rotation shaft of the fan motor; and two units of the blowers are disposed in vertical alignment with each other at a predetermined spacing therebetween, wherein a diameter of the fan of the blower on the upper side is set larger than a diameter of the fan of the blower on the lower side.

[0016] Further, an electrical-component cooling device to cool electrical components to be accommodated in the electrical component package is provided in the vicinity of the blower on the upper side.

Brief Description of Drawings

[0017]

FIG. 1 is an exploded perspective view of components constituting an outdoor unit of an embodiment according to the invention.

FIG. 2 is a partly omitted appearance view of the outdoor unit.

Best Mode of Carrying Out the Invention

[0018] The drawing shows an outdoor unit constituting an air-conditioner. Specifically, FIG. 1 is an exploded perspective view of components constituting an outdoor unit of an embodiment according to the invention; and FIG. 2 is a partly omitted appearance view of the outdoor unit.

[0019] An outdoor unit main body 1 formed from a housing shaped as a vertically long rectangular box. In the outdoor-unit main body 1, there is used a lattice-shaped frame 1a formed such that portions of a left side wall and a rear wall, as viewed in the drawing, are rectangularly crosslinked, and the inside of the main body 1 can be visible therethrough. All walls of the frame 1a, except the left side wall and the rear wall, are formed of a plate.

[0020] A front wall of the outdoor unit main body 1 is divided into a first front wall plate 1b and a second front wall plate 1c that is situated adjacent the first front wall plate 1b and that is partly bent in the sidewall direction. Together with the lattice-shaped frame 1a, a circumferential wall frame is formed to include a bent plate 1d that partly constitutes a right side wall and a rear side wall. An upper portion and a lower portion of the circumferential wall frame are closed by a top plate 1e and a bottom plate 1f, respectively. Thereby, the outdoor unit main body 1 is constituted.

[0021] The inside of the outdoor unit main body 1 is partitioned by a partition plate 3. A front-wall side edge of the partition plate 3 matches an engagement edge between the first front wall plate 1b and the second front wall plate 1c. A rear wall portion of the partition plate 3 is diagonally bent near an edge thereof. This edge matches an engagement edge between a rear wall edge of the bent plate 1d and an edge of the lattice-shaped frame 1a. An upper edge of the partition plate 3 is brought in contact with the top plate 1e, and a lower edge of the partition plate is brought into contact with the bottom plate 1f, whereby the inside of the main body 1 is partitioned.

[0022] Fan guards 2a and 2b are mounted in vertical alignment with each other in one front side portion of the outdoor unit main body 1. The fan guards 2a and 2b are mounted to oppose below-described blowers disposed in the outdoor unit main body 1, thereby preventing entrance of a human finger and other foreign matter in the manner of not impairing ventilation of the heat exchange air.

[0023] A heat exchange chamber 4 herein refers to the one partitioned spacing opposite a mounting position of the fan guard 2a in the outdoor unit main body 1. A machine chamber 5 herein refers to the other spacing not opposing the fan guard 2a.

[0024] The heat exchange chamber 4 communicates with the outside through a portion partly surrounded by the lattice-shaped frame 1a. The machine chamber 5 is circumferentially surrounded by plates such as the second front wall plate 1c and the bent plate 1d to be substantially in a hermetic state.

[0025] In the first front wall plate 1b, circular blowoff openings 7a and 7b individually circumferentially surrounded by circular bell mouths 6a and 6b are opened in vertical alignment with each other. The fan guards 2a and 2b are mounted in such a manner as to cover the blowoff openings.

[0026] For reasons described below, the diameters of the lower bell mouth 6b and the lower blowoff opening 7b are designed smaller, in comparison with the diameters of the upper bell mouth 6a and the upper blowoff opening 7a.

[0027] In the heat exchange chamber 4, an outdoor heat exchanger 8 is disposed, and in addition, a blower support 9 is disposed. In the blower support 9, the first blower 10a and the second blower 10b are mounted in vertical alignment with each other and supported.

[0028] The outdoor heat exchanger 8 is mounted over the bottom plate 1f, and the height dimension thereof is designed substantially identical to that of the first front wall plate 1b. The heat exchanger is formed substantially in the form of the letter "L" in a plan view along the lattice-shaped frame 1a that constitutes the left side wall and the back side wall of the main body 1.

[0029] The blower support 9 is formed vertically long in such a manner that a lower end portion thereof is fixedly mounted onto the mounted on the bottom plate 1f, and an upper end portion thereof is engageably placed on an upper end portion of the outdoor heat exchanger 8. The first and second blowers 10a and 10b thus supported by the blower support 9 are constituted of respec-

tive fan motors 11a and 11b and respective propeller fans 12a and 12b that are fixedly fitted onto rotation shafts of the respective fan motors.

[0030] In an assembled state, the first and second blowers 10a and 10b are positioned opposite the respective blowoff openings 7a and 7b. The propeller fans 12a and 12b are partly inserted into the respective bell mouths 6a and 6b mounted to the respective blowoff openings 7a and 7b, thereby providing rotational blowing in the bell mouths.

[0031] In this particular case, by way of one characteristic, a diameter ϕDa of the propeller fan 12a of the first blower 10a is set larger than a diameter ϕDb of the propeller fan 12b of the second blower 10b (ϕDa > ϕDb).

[0032] More specifically, the diameter ϕDa of the propeller fan 12a of the first blower 10a is set to be as large as possible in terms of, for example, space-wise conditions. However, the diameter ϕDb of the propeller fan 12b of the second blower 10b is set to be as small as possible to accomplish that, by way of the totality with the first blower 10a, a sufficient air blow rate is secured for the outdoor heat exchanger 8, and reduction in cooling efficiency is minimized.

[0033] Of course, selection is made such that, relative to the output of the fan motor 11a of the first blower 10a, the output of the fan motor 11b of the second blower 10b is smaller.

[0034] Suppose that, as in the conventional case, the first blower 10a is mounted on the upper side and the second blower 10b is mounted on the lower side without changing the mounting center position of the blower on the lower side. In this case, the distance between the bottom plate 1f and the circumferential edge of the propeller fan 12b is increased by a difference in radius of the propeller fan 12b of the second blower 10b miniaturized smaller than in the conventional case.

[0035] Alternatively, suppose that the mounted position of the second blower 10b is shifted to the upper side without changing the mounted position of the first blower 10a to secure a constant distance between the circumferential edge of the propeller fan 12a of the first blower 10a and the circumferential edge of the propeller fan 12b of the second blower 10b. In this case, the distance between the circumferential edge of the propeller fan 12b of the second blower 10b and the bottom plate 1f is further increased.

[0036] In either of the cases, the distance between the circumferential edge of the propeller fan 12b of the second blower 10b and the bottom plate 1f is increased by the difference in that the diameter ϕDb of the propeller fan 12b of the second blower 10b is set smaller than the diameter ϕDa of the propeller fan 12a of the first blower 10a.

[0037] On the other hand, in the machine chamber 5, the compressor 13 is disposed, and an accumulator 14 is disposed near the compressor 13. A four-way valve 15 is disposed on an upper position of the compressor 13. The compressor 13, the accumulator 14, and the four-way valve 15 are connected to one another via a refrigerant conduit (not shown). In addition, the compressor 13 and the outdoor heat exchanger 8 are connected together via a refrigerant conduit (not shown), whereby a refrigeration cycle with an indoor heat exchanger of the indoor unit is configured.

[0038] An electrical component package 16 is mounted to an upper portion of the machine chamber 5. The electrical component package 16 is comprised of a front-wall package member 16a in which inverters, terminals, and other electrical components of low radiation values are mounted, and a sidewall package member 16b in which control electrical components, giant transistors, and other electrical components of high radiation values are mounted.

[0039] The sidewall package member 16b is mounted on an endothermic plane formed on the side of one wall of an electrical-component cooling device 20 (which is also called a "heat sink") disposed in an upper portion of the partition plate 3. A radiating plane is formed on the side of the other wall of the electrical-component cooling device 20, and is disposed on the side of the heat exchange chamber 4 via the partition plate 3.

[0040] As described above, the electrical component package 16 is disposed on the upper portion of the machine chamber 5. As such, the electrical-component cooling device 20 is mounted in the upper portion of the partition plate 3 to be positioned very close to the first blower 10a disposed in an upper portion of the heat exchange chamber 4.

[0041] Although not shown in this particular case, an outside-air receiving opening is provided in an upper portion of the rear wall side of the bent plate 1d. In addition, a conducting opening for conducting between the machine chamber 5 and the heat exchange chamber 4 is provided in a portion near the electrical-component cooling device 20 on the partition plate 3.

[0042] The air-conditioner outdoor unit is configured as described above. Upon issuance of an instruction to start a refrigeration cycle operation, the compressor 13 is driven, and the first and second blowers 10a and 10b are then driven.

[0043] The outside air is drawn into the outdoor unit main body 1 via the lattice-shaped frame 1a and is then led to travel through the outdoor heat exchanger 8, whereby a heat exchange function is performed. The air is then guided into the bell mouths 6a and 6b and is discharged to the outside from the blowoff openings 7a and 7b.

[0044] When an air-heating operation is performed, frost is inevitably caused to stick to the outdoor heat exchanger 8. As such, the defrost operation is appropriately performed to remove frost by interrupting the air-heating operation. During the defrost operation, frost-melted drain water falls from the outdoor heat exchanger 8 and accumulates on the bottom plate 1f.

[0045] Particularly, in a cold district where the outside temperature is low, the water accumulatively staying on

the bottom plate 1f is frozen depending on the temperature before the water is discharged. When the defrost operation is repeated, ice formed from the frozen water on the bottom plate 1f gradually grows higher.

[0046] However, in the above-described outdoor unit, the diameter ϕDb of the propeller fan 12b of the second blower 10b on the lower side is set smaller than the diameter ϕDa of the propeller fan 12a of the first blower 10a on the upper side. Thereby, the sufficient distance is secured between the circumferential edge of the propeller fan 12b and the bottom plate 1f.

[0047] Because of the above arrangement, even when a favored temperature rise does not occur to melt ice, almost no cases take place in which the ice formed of frozen drain water grows to the extent of reaching the circumferential edge of the propeller fan 12b of the second blower 10b on the lower side.

[0048] Accordingly, the propeller fan 12b is not restrained by the ice, and is hence always maintained in a readily rotatable state. Consequently, no events take place in which, for example, overcurrent flows to the fan motor 11b, and the propeller fan 12b impinges on ice and hence causes the fan to be deformed or damaged, therefore enabling reliability to be secured.

[0049] As described above, different from the case where the diameters of the propeller fans of the two blowers are designed small and hence a necessary air blow rate cannot be obtained, the highest possible air blow rate of the first blower 10a is secured, and the lowest necessary air blow rate of the second blower 10b is secured. Consequently, no such an event as that causing reduction in the heat exchange efficiency of the outdoor heat exchanger 8 takes place.

[0050] Additionally, the electrical output of the fan motor 11b of the second blower 10b is lower than the electrical output of the fan motor 11a of the first blower 10a, so that the total electrical output has a tendency to decrease. This enables running costs to be reduced.

[0051] In addition, the outside-air receiving opening is provided in the bent plate 1d, and the conducting opening is provided in the portion near the electrical-component cooling device 20 on the partition plate 3. Thereby, with the blowing function being performed, outside air is guided from the outside-air receiving opening into the machine chamber 5, and is further guided into the heat exchange chamber 4 via the conducting opening.

[0052] In the machine chamber 5, in the operational driving of the compressor 13, heat radiation occurs, and very high heat generation takes place from electrical components such as giant transistors in the electrical component package 16.

[0053] Together with the heated air transferred into the machine chamber, the outside air guided into the machine chamber 5 from the outside-air receiving opening is discharged into the heat exchange chamber 4 via the conducting opening. Consequently, the inside of the machine chamber 5 is cooled.

[0054] On the other hand, in line with the electrical-component cooling device 20, the endothermic plane on the side of the machine chamber 5 absorbs heat from the electrical components such as the giant transistors of high heating values. In addition, the heat is radiated from the radiating plane on the side of the machine chamber 5, whereby the electrical components are cooled.

[0055] The conducting opening is thus provided in the portion near the electrical-component cooling device 20. Consequently, when the outside air introduced into the machine chamber 5 is guided from the conducting opening to the heat exchange chamber 4, the electrical-component cooling device 20 is cooled.

[0056] Further, the radiating plane of the electrical-component cooling device 20 is exposed to the side of the heat exchange chamber 4 via the partition plate 3 and is positioned very near the first blower 10a situated on the upper side. More specifically, the airflow velocity near the propeller fan 12a of the first blower 10a for the electrical-component cooling device 20 is increased, whereby enhancement in the radiation efficiency can be implemented.

Industrial Applicability

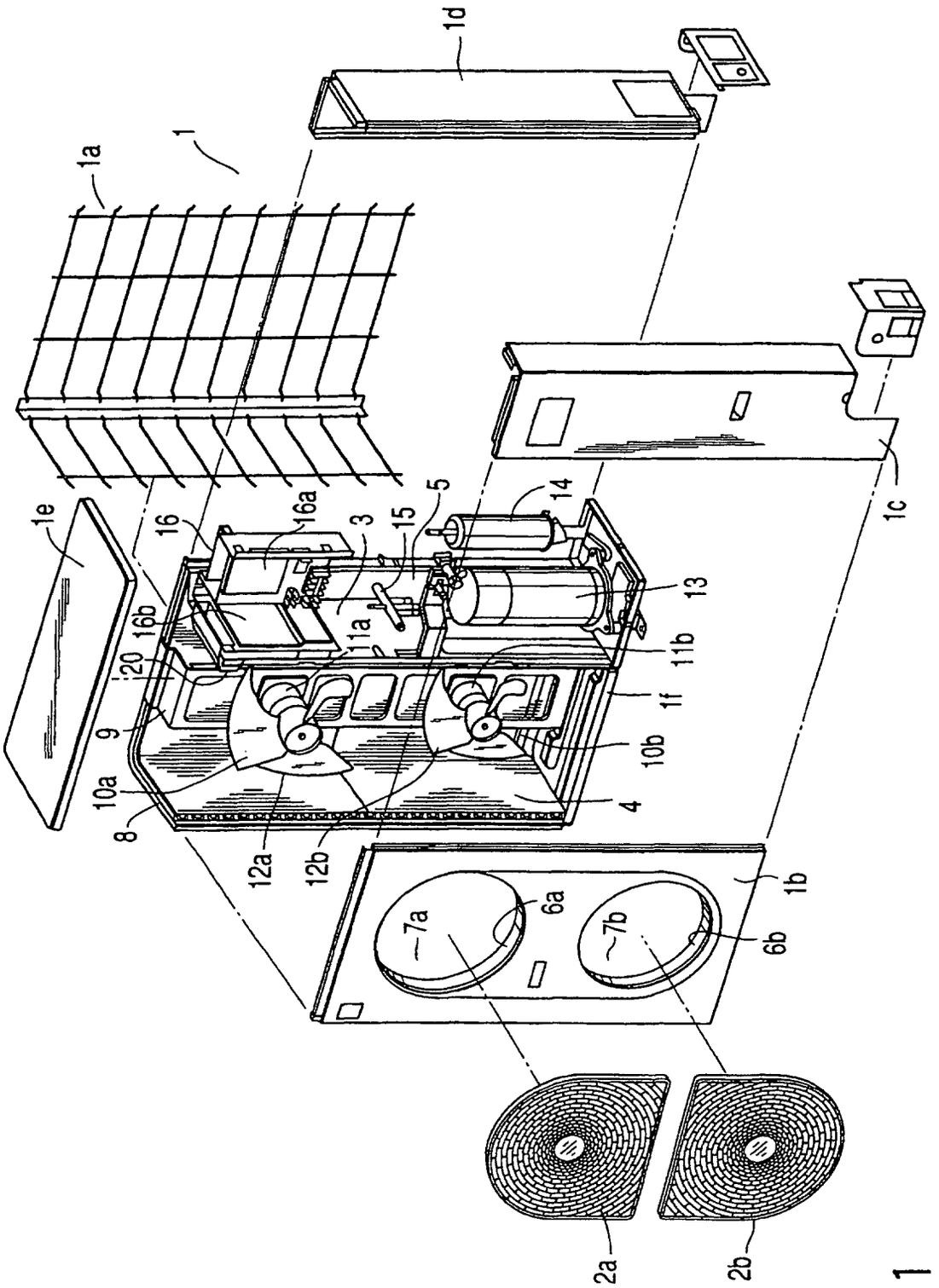
[0057] According to the present invention, an air-conditioner outdoor unit can be obtained in which the reduction in the air blow rate is restrained as much as possible, the reduction in the occurrences of causing the fan of the blower on the lower side to be restrained by ice is achieved, and the radiation efficiency of the electrical-component cooling device can be prevented from being reduced.

Claims

1. An air-conditioner outdoor unit in which the inside of a main body of the outdoor unit is partitioned by a partition plate into two spaces, the one space is used as a heat exchange chamber in which an outdoor heat exchanger, blowers, and the like are disposed, and the other space is used as a machine chamber in which a compressor, an electrical component package, and the like are disposed, **characterized in that** the blowers each comprise a fan motor and a fan fitted onto a rotation shaft of the fan motor; and two units of the blowers are disposed in vertical alignment with each other at a predetermined spacing therebetween, and a diameter of the fan of the blower on the upper side is set larger than a diameter of the fan of the blower on the lower side.

2. An air-conditioner outdoor unit according to claim 1, **characterized in that** an electrical-component cooling device to cool electrical components to be accommodated in the electrical component pack-

age is provided in the vicinity of the blower on the upper side.


1d
1
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1e
16
16a
3
15
5
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13
16b
11a
11b
20
1f
9
10b
10a
8
4
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6a
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6b
1c
2a
2b

FIG. 1

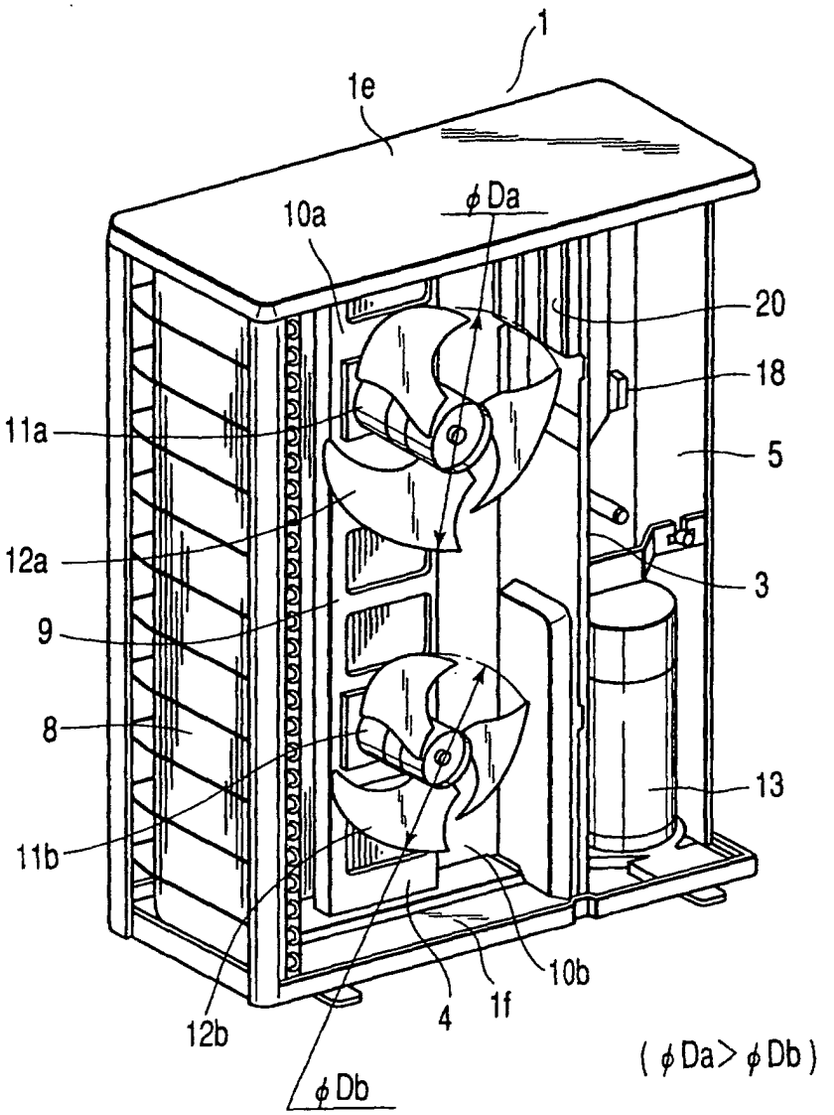

FIG. 2

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP02/09126

A. CLASSIFICATION OF SUBJECT MATTER
Int.Cl[7] F24F5/00

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] F24F5/00

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

Jitsuyo Shinan Koho	1926-1996	Toroku Jitsuyo Shinan Koho	1994-2002
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.
X	JP 9-292142 A (Mitsubishi Heavy Industries, Ltd.), 11 November, 1997 (11.11.97), Full text; all drawings (Family: none)	1
X	JP 9-280608 A (Mitsubishi Heavy Industries, Ltd.), 31 October, 1997 (31.10.97), Full text; all drawings (Family: none)	1
X	Microfilm of the specification and drawings annexed to the request of Japanese Utility Model Application No. 196626/1983 (Laid-open No. 104682/1985) (Mitsubishi Electric Corp.), 17 July, 1985 (17.07.85), Full text; all drawings (Family: none)	1

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

* Special categories of cited documents:
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"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
09 October, 2002 (09.10.02)	29 October, 2002 (29.10.02)
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/JP02/09126

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	Microfilm of the specification and drawings annexed to the request of Japanese Utility Model Application No. 184718/1983 (Laid-open No. 92070/1985) (Mitsubishi Electric Corp.), 24 June, 1985 (24.06.85), Full text; all drawings (Family: none)	1

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