



(11)

EP 2 169 327 A1

(12)

EUROPEAN PATENT APPLICATION
published in accordance with Art. 153(4) EPC

(43) Date of publication:
31.03.2010 Bulletin 2010/13

(51) Int Cl.:
F24F 5/00 (2006.01)

(21) Application number: **08791001.4**

(86) International application number:
PCT/JP2008/062414

(22) Date of filing: **09.07.2008**

(87) International publication number:
WO 2009/008453 (15.01.2009 Gazette 2009/03)

(84) Designated Contracting States:
**AT BE BG CH CY CZ DE DK EE ES FI FR GB GR
HR HU IE IS IT LI LT LU LV MC MT NL NO PL PT
RO SE SI SK TR**
Designated Extension States:
AL BA MK RS

- **YAMAMOTO, Jirou**
Osaka-shi
Osaka 530-8323 (JP)
- **SHIGEMORI, Masahiro**
Sakai-shi
Osaka 591-8511 (JP)

(30) Priority: **12.07.2007 JP 2007182874**

(71) Applicant: **Daikin Industries, Ltd.**
Osaka 530-8323 (JP)

(74) Representative: **HOFFMANN EITLE**
Patent- und Rechtsanwälte
Arabellastrasse 4
81925 München (DE)

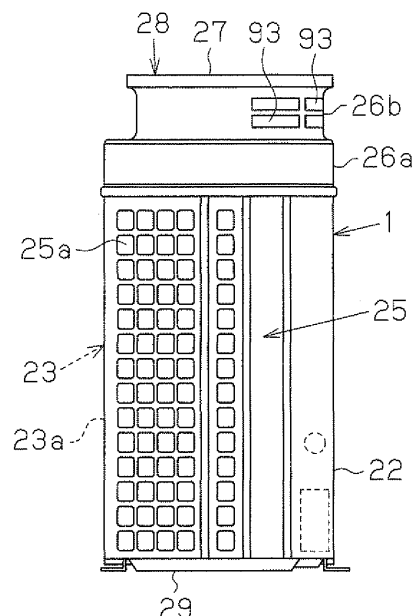
(72) Inventors:

- **NAKAGAWA, Suguru**
Sakai-shi
Osaka 591-8511 (JP)

(54) **AIR DELIVERY UNIT**

(57) An air delivery unit includes a casing, an air delivery device arranged in a fan passage in the casing, and a fan guard that is arranged at an air outlet of the casing and has an air blowing surface having a grill structure and a hollow frame wall portion. An air blowing opening is formed in the frame wall portion of the fan guard. This structure allows the air to be blown also from the opening of the frame wall portion of the fan guard. This reduces the amount and the speed of the air blown from the air blowing surface of the fan guard having the grill structure. As a result, rise of static pressure of the air delivery device is suppressed and noise caused by interference between bars of an air blowing grill and the air is reduced.

Fig.11



Description

TECHNICAL FIELD

[0001] The present invention relates to the structure of a fan guard arranged in an air delivery unit of an outdoor unit of an air conditioner or the like.

BACKGROUND ART

[0002] Typically, an air delivery unit, such as an outdoor unit of an air conditioner, has a fan guard having a grill structure, which covers an air outlet in order to ensure safety and protect blades of an air delivery device (see, for example, Patent Documents 1 to 3). However, the fan guard resists the stream of the air blown from the air outlet. In other words, the fan guard is one of the factors that raises the static pressure of the air delivery device. Also, interference between the air blown by the blades and the grill bars of the fan guard produces loud noise, which raises the level of the noise generated by the outdoor unit.

[0003] This problem is substantially negligible in, for example, a fan guard 9 having a grill structure formed only by steel wires a, b, c, d, which fan guard 9 employs a grill structure not only in an air blowing surface but also in side surfaces, as shown in Figs. 18 and 19 (see, for example, Patent Document 3). However, in a fan guard 9 that has a hollow frame wall portion and employs a grill structure only in an air blowing surface (see, for example, Patent Documents 1, 2), as shown in Figs. 13 to 17, the static pressure of the fan rises significantly, thus producing loud noise. The noise is represented by the sextuplicated value ($=V^6$) of the blowing speed V.

[0004] An outdoor unit illustrated in Figs. 13 to 15 has a laterally elongated casing 1 having a trunk-like shape, an opening 2a formed in a front plate 2 of the casing 1, a fan guard 9 that is formed of synthetic resin and attached to the front plate 2 in such a manner as to cover the opening 2a, side plates 4, 5 arranged in a machine chamber and a fan chamber, respectively, a top plate 8a and a bottom plate 8b of the casing 1, and a pair of leg portions 10 projecting downward from the bottom plate 8b.

[0005] When the air delivery device of the outdoor unit is activated and the fan (the impeller) of the air delivery device is rotated, air is drawn from an air inlet formed in the backside of the casing 1. The air introduced from the air inlet is then blown forward from the opening 2a of the casing 1. As illustrated in Figs. 14 and 15, the fan guard 9 is a rectangular body having a hollow frame member projecting by a predetermined length in a forward direction in which the air is blown (leftward as viewed in Fig. 15). An air blowing grill 91 having a grid-like structure is formed at the front surface of the fan guard 9. Four frame wall portions 92a, 92b, 92c, 92d, which form the fan guard 9, are each configured by a blind patch without an opening.

[0006] Since the fan guard 9 is configured in the above-described manner, the fan guard 9 resists the stream of air when the air is blown from the air blowing grill 91 of the fan guard 9 after having been introduced through the opening 2a of the casing 1, as illustrated in Fig. 15. This raises the static pressure of the air delivery device. As a result, the level of the noise caused by interference between the bars of the air blowing grill 91 and the air is also raised.

[0007] Figs. 16 and 17 each show an outdoor unit of an air conditioner of a type that draws air from sides and blows it upward. The outdoor unit has a vertically elongated casing 1 having a rectangular frame-like shape. The casing 1 has a front surface 23, a pair of side surfaces 24, 25, and a backside 22. An air inlet 23a having a grill structure is formed in the entire portion of the front surface 23 of the casing 1. Air inlets 24a, 25a each having a grill structure are formed in front portions of the corresponding side surfaces 24, 25. The backside 22 of the casing 1 as a whole and rear portions of the side surfaces 24, 25 are all formed by blind patches. A heat exchanger having a U shape as viewed from above is received in the casing 1 in correspondence with the air inlets 23a, 24a, 25a.

[0008] A bottom plate 29 is attached to the lower surface of the casing 1. A cylindrical fan guard 28 is arranged on top of the casing 1. The casing 1 receives a heat exchanger and an air delivery device (neither is shown), which is located above the heat exchanger. A base cap 26a shaped like a flat rectangular frame is arranged at the upper end of the casing 1. A non-illustrated circular opening is formed in the base cap 26a. A fan guard 28, which has been formed into a cylindrical shape through drawing, is attached to the opening of the base cap 26a. The fan guard 28 extends upward and the diameter of the fan guard 28 is decreased with respect to the diameter of the opening of the base cap 26a. An air blowing grill 27 having a grid-like structure is arranged at the upper surface of the fan guard 28.

[0009] As in the configurations shown in Figs. 13 to 15, a frame wall portion 26b of the fan guard 28, which has a cylindrical shape, is formed by a blind patch. This configuration also causes the fan guard 9 to resist the stream of the air blown from the air outlet, thus increasing the static pressure of the air delivery device.

[0010] To solve these problems, the structures described below have been proposed. For example, in a structure disclosed in Patent Document 4, a heat exchanger is arranged at the suction side of a propeller fan and an air blowing grill is mounted at the air blowing side of the propeller fan in the outdoor unit having a trunk-like shape. The outdoor unit has a first blowing passage extending from the propeller fan to the air blowing grill and a second blowing passage extending to the exterior without passing through the air blowing grill. The air flowing in the second air blowing passage moves between a fan guide and the propeller fan, and is blown to the exterior through the opening between the air blowing grill and the

fan guide. In this manner, the stream of the air blown by the propeller fan is divided into a stream of air flowing in the first blowing passage and a stream of air moving in the second blowing passage. This reduces the amount of air flowing in the first blowing passage by the amount corresponding to the amount of air traveling in the second blowing passage. Correspondingly, the amount of air blown from the first blowing passage to the air blowing grill is decreased.

[0011] To solve similar problems, the structure described below has also been proposed.

As disclosed in Patent Document 5, the outdoor unit also has a trunk-like shape and an outermost peripheral portion of a fan guard is extended along the axial direction of a fan motor by a predetermined dimension. A cutout is formed in the extended portion of the fan guard to form a narrow air passage between the fan guard and the casing. This air passage allows some of the air blown by the propeller fan to escape in a circumferential direction.

[0012] However, in the structure disclosed in Patent Document 4, it is necessary to form the second blowing passage in addition to the first blowing passage extending from the propeller fan to the air blowing grill. In this case, to provide the second blowing passage, a blowing side end of the fan guide (the bellmouth) must be subjected to special machining to form a round surface. This complicates the structure of the second blowing passage. Also, since a great amount of air flows in the second blowing passage, the noise caused in the second blowing passage must be regulated. Further, a large-sized opening, which is formed between the air blowing grill and the casing, degrades the outer appearance and makes it necessary to improve the attachment structure of the air blowing grill.

[0013] In the structure disclosed in Patent Document 5, the width of the circular frame forming the fan guard is increased, and the elongated cutout, which extends in a circumferential direction of the frame, is formed in the frame. However, rise of the static pressure of the air delivery device cannot be sufficiently reduced simply by forming the cutout in the frame. Also, since the cutout decreases the rigidity of the frame, the fan guard cannot be supported sufficiently and thus becomes easily deformed. Further, if the outdoor unit has an air outlet in a side wall of the casing and a cutout is formed in the entire outer peripheral portion of the frame, a short circuit may occur and decrease the heat exchange efficiency of the heat exchanger. The short circuit refers to the phenomenon in which, for example, when air conditioning is performed and heated air is blown from the outdoor unit, the blown air is blocked by an object and re-drawn to the outdoor unit. If the short circuit continues, heat cannot sufficiently escape from the outdoor unit, which disadvantageously lowers the air conditioning efficiency.

Patent Document 1: Japanese Laid-Open Utility Model Publication No. 6-67895

Patent Document 2: Japanese Laid-Open Patent

Publication No. 2002-195610

Patent Document 3: Japanese Laid-Open Patent Publication No. 5-248662

Patent Document 4: Japanese Laid-Open Patent Publication No. 8-189671

Patent Document 5: Japanese Laid-Open Patent Publication No. 2007-139242

SUMMARY OF THE INVENTION

[0014] Accordingly, it is an objective of the present invention to provide an outdoor unit of an air conditioner that reduces the amount and the speed of air blown from an air blowing surface of a fan guard having a grill structure, suppresses rise of the static pressure of an air delivery device, and reduces noise caused by interference between bars of the fan guard grill and the air.

[0015] To achieve the foregoing objective and in accordance with a first aspect of the present invention, an air delivery unit including a casing having an air inlet and an air outlet, an air delivery device arranged in a fan passage extending from the air inlet to the air outlet in the casing, an air blowing surface having a grill structure arranged at a position corresponding to the air outlet of the casing, and a fan guard that has a predetermined length along an air blowing direction and is formed by a hollow frame wall portion attached to a portion of the casing around the air outlet is provided. The air blowing surface and the frame wall portion of the fan guard are integrally formed of a synthetic resin. An air blowing opening is formed in the frame wall portion. A heat exchanger is arranged in the fan passage at a position upstream from the air delivery device. The heat exchanger is arranged in correspondence with the air inlet of the casing. The air blowing opening is arranged in the frame wall portion at a position spaced from the air inlet of the casing.

[0016] In the above-described structure, the frame wall portion of the fan guard is separate from the bars of the grill forming the air blowing surface. The frame wall portion functions as an air blowing frame and an attachment frame with respect to the casing.

[0017] Accordingly, an opening is easily formed in the frame wall portion of the fan guard.

Further, unlike conventional configurations, it is unnecessary to form a special passage configuration in the casing. It is also unnecessary to shape a bellmouth in such a manner as to guide a flow of air or machine a partition board into a predetermined shape. Further, since the fan guard is configured as the attachment frame with respect to the casing, the fan guard has high rigidity and is not easily deformed. Also, in order to prevent a short circuit, the air blowing opening is arranged in the frame wall portion of the fan guard only at the position spaced from the air outlet of the casing. The air is thus blown from an opening of the frame wall portion of the fan guard. This correspondingly decreases the amount and the speed of the air blown from the air blowing surface having the grill structure. As a result, rise of the static

pressure of the air delivery device is suppressed, and noise caused by interference between the bars of the air blowing grill and the air is reduced.

[0018] The short circuit, which is the phenomenon in which the blown air is drawn to the air inlet located close to the heat exchanger, is avoided. The heat exchange efficiency is thus maximally prevented from being lowered. This decreases excessive drive load acting on the fan motor and reduces the power consumption. Further, the heat exchange efficiency of the heat exchanger is prevented from decreasing.

[0019] In the above-described air delivery unit, it is preferable to form a plurality of openings in the frame wall portion of the fan guard. In this case, it is preferable that the size of each opening formed in the frame wall portion of the fan guard be not excessively large, from a viewpoint of safety and strength. It is also preferable that the multiple openings be formed in predetermined shapes and at predetermined positions so as to ensure an appropriate amount of air blow.

[0020] In the above-described air delivery unit, it is preferable to form a rib reinforcing the frame wall portion in the vicinity of the openings in the fan guard. This increases the rigidity of the frame wall portion having the openings, and allows sufficient reinforcement of the frame wall portion. Also, the amount of deformation of the frame wall portion with respect to pressing force is reduced to a low level.

[0021] In the air delivery unit described above, it is preferable that the fan guard have a rectangular shape, a recess having a threaded hole being formed in each of four corners of the fan guard, and that the fan guard be fixed to the casing by passing thread means through the threaded holes of the fan guard and fastening the thread means to the portion of the casing around the air outlet. In this case, when the thread means is passed through the threaded holes of the fan guard and fastened to the portion of the casing around the air outlet, the fan guard is fixed to the casing. The fan guard is thus stably attached to the casing.

BRIEF DESCRIPTION OF THE DRAWINGS

[0022]

Fig. 1 is a front view showing an air delivery unit according to a first embodiment of the present invention;

Fig. 2 is a side cross-sectional view showing the air delivery unit;

Fig. 3 is a perspective view showing the fan guard of the air delivery unit as viewed from diagonally above and the right;

Fig. 4 is a perspective view showing the fan guard of the air delivery unit as viewed from diagonally above and the left;

Fig. 5 is an enlarged side view showing an opening formed in a frame wall portion of the fan guard;

Fig. 6 is a partial cross-sectional view taken along line 6-6 of Fig. 1;

Fig. 7 is a partial cross-sectional view taken along line 7-7 of Fig. 1;

Fig. 8 is a front view showing an opening of a modification;

Fig. 9 is a front view showing the opening of the modification as viewed from the backside of the frame wall portion;

Figs. 10(a), 10(b), and 10(c) are diagrams schematically illustrating an operation of the modification;

Fig. 11 is a front view showing an air delivery unit according to a second embodiment of the present invention;

Fig. 12 is a plan view showing the air delivery unit;

Fig. 13 is a front view showing a conventional air delivery unit;

Fig. 14 is a perspective view showing a fan guard of the air delivery unit as viewed from diagonally above and the right;

Fig. 15 is an enlarged side cross-sectional view showing a portion of the fan guard of the air delivery unit;

Fig. 16 is a front view showing a conventional air delivery unit;

Fig. 17 is a plan view showing the air delivery unit;

Fig. 18 is a front view showing a conventional air delivery unit having a fan guard having a steel wire type grill structure; and

Fig. 19 is an exploded perspective view showing the conventional air delivery unit having the fan guard having the steel wire type grill structure.

BEST MODE FOR CARRYING OUT THE INVENTION

(First Embodiment)

[0023] Figs. 1 to 7 show the structure of an air delivery unit according to a first embodiment of the present invention as a whole and a main portion of the air delivery unit. In the present embodiment, the air delivery unit is embodied as an outdoor unit of an air conditioner.

[0024] As shown in Figs. 1 and 2, the outdoor unit includes a heat exchanger 11, an air delivery device 12, and a casing 1. The casing 1 has a front plate 2, a rear plate 3, a pair of side plates 4, 5, a top plate 8a, and a bottom plate 8b. The heat exchanger 11 has an L shape as viewed from above. The heat exchanger 11 has an elongated portion 11a corresponding to the backside of the casing 1 and a short portion 11b corresponding to a side surface of the casing 1. The air delivery device 12 includes a fan motor 12a and a fan (a impeller) 12b. The casing 1 has a laterally elongated trunk-like shape. A compressor 13, which compresses refrigerant, is received in the casing 1. The fan motor 12a of the air delivery device 12 is supported by the front plate 2. An opening 2a, which is an air outlet, is formed in the front plate 2 at a position spaced from a machine chamber M. A

cylindrical bellmouth B is formed inside the opening 2a in the casing 1. A fan guard 9 formed of synthetic resin is attached to the front plate 2 in such a manner as to cover the opening 2a.

An air inlet 3a is formed in the rear plate 3 at a position spaced from the machine chamber M. The side plate 5 is located in the proximity of a fan chamber F in the casing 1. An air inlet 5a is formed in the side plate 5. A pair of leg portions 10 project downward from the bottom plate 8b.

[0025] The heat exchanger 11 is arranged in correspondence with both of the air inlet 3a, which is formed in the rear plate 3 of the casing 1, and the air inlet 5a, which is formed in the side plate 5. The heat exchanger 11 is supported in the casing 1 by means of a pair of channel-like plates 6.

[0026] The fan chamber F, in which the air delivery device 12 and the heat exchanger 11 are arranged, and the machine chamber M, in which the compressor 13 is accommodated, are provided in the casing 1. The interior of the casing 1 is divided into the fan chamber F and the machine chamber M by a partition plate 7.

[0027] When the fan motor 12a of the air delivery device 12 is activated and the fan (the impeller) 12b is rotated, air (the ambient air) is drawn through the air inlets 3a, 5a, sent through the bellmouth B, and blown forward from the opening 2a of the casing 1.

[0028] The fan guard 9 is attached to the front plate 2 of the casing 1 and extends along the outer periphery of the opening 2a. As illustrated in Figs. 3 and 4, the fan guard 9 is a rectangular hollow frame structure extended by a predetermined width (length) W along the direction in which the air is blown.

[0029] A grid-like air blowing grill 91 is formed in the front surface of the fan guard 9 as an air blowing surface. The fan guard 9 has four frame wall portions 92a, 92b, 92c, 92d. Out of the frame wall portions, the frame wall portion 92b located close to the side plate 5 of the casing 1, which is the left side frame wall portion 92b as viewed in Fig. 1, is formed by a blind patch without an opening. In contrast, the frame wall portion 92a located opposite to the frame wall portion 92b, which is the right frame wall portion 92a as viewed in the drawing, and a pair of upper and lower frame wall portions 92c, 92d each have a plurality of slit-like openings 93. In each of the frame wall portions 92a, 92c, 92d, the corresponding openings 93 are arranged in two parallel rows along the direction of the width of the frame wall portion 92a, 92c, 92d. Pairs of openings 93, which are aligned in the direction of the width, are arranged with a predetermined interval in the longitudinal direction of each frame wall portion 92a, 92c, 92d. Accordingly, a predetermined amount of air is blown out from the casing 1 not only in the forward direction but also in sideward directions.

[0030] With reference to Figs. 6 and 7, in the fan guard 9, the air sent forward from the opening 2a of the casing 1 is blown from the air blowing grill 91 of the fan guard 9 as a mainstream. Simultaneously, a predetermined

amount of air is blown from the openings 93 of the right frame wall portion 92a and the upper and lower frame wall portions 92c, 92d as sub streams. The fan guard 9, which has the above-described grill structure, thus reduces the amount and the speed of the air blown from the air blowing grill 91. This suppresses rise of the static pressure of the air delivery device 12 and decreases the noise caused by interference between the bars of the air blowing grill 91 and the air. As a result, the excessive drive load acting on the fan motor 12a is reduced, and the power consumption is decreased. Accordingly, a low-noise and energy-saving air delivery unit is provided.

[0031] Further, in the above-described configuration, the L-shaped heat exchanger 11 is arranged in an upstream portion of an air blowing passage in the fan chamber F of the casing 1. The openings 93 are arranged at the positions spaced from the left frame wall portion 92b, at which the short circuit easily occurs due to the shape of the heat exchanger 11. Accordingly, the short circuit in which the blown air is drawn to the air inlet 5a located close to the heat exchanger 11 is avoided. The heat exchange efficiency of the heat exchanger 11 is thus prevented from decreasing. If it is unnecessary to take the short circuit into consideration, the openings 93 may be formed in all of the frame wall portions 91 a to 92d.

[0032] A triangular corner rib 95 is formed in each of the four corner portions of the fan guard 9. The corner ribs 95 reinforce the frame wall portions as a whole. Each of the corner ribs 95 has a screw securing recess 96 having a screw hole (a threaded hole). By passing screws 97 through the screw holes of the fan guard 9 and fastening the screws 97 to the portion of the casing 1 around the opening 2a, the fan guard 9 is fixed to the casing 1.

[0033] Accordingly, the frame wall portions 92a to 92d of the fan guard 9 have sufficient strength and rigidity as attachment frames. This allows stable attachment of the fan guard 9 to the front surface of the casing 1.

[0034] The fan guard 9 is a rectangular hollow frame structure extended by the predetermined width (length) W along the air blowing direction. Two rows of the openings 93 are formed in the frame wall portions of the fan guard 9 and arranged in the circumferential direction. This facilitates installation of the outdoor unit and improves the outer appearance of the outdoor unit. In addition, the air is smoothly blown from inside the casing 1 and the level of the noise produced by the air blowing is lowered.

[0035] Unlike conventional outdoor units, the outdoor unit of the present invention does not need a special passage configuration. Specifically, it is unnecessary to shape the bellmouth in such a manner as to guide an airstream or machine the partition plate into a predetermined shape. Also, since the frame wall portions of the fan guard 9 are formed as the attachment frame attached to the casing 1 and have enhanced rigidity, the frame wall portions cannot be deformed easily.

(Modification)

[0036] The openings 93, which are formed in the frame wall portions 92b to 92d of the fan guard 9, are shaped like elongated slits so that the fingers cannot enter the openings 93.

Also, the openings 93 are aligned along the direction of the width of each frame wall portion and spaced apart at the predetermined intervals in the longitudinal direction of the frame wall portion. However, by increasing the length of each of the openings 93, the number of the openings 93 may be decreased correspondingly. For example, as illustrated in Fig. 8, a total of four openings 93 may be arranged in each frame wall portion while divided in two pairs.

[0037] However, as the length of each opening 93 becomes greater, the rigidity of the wall portions of the air blowing grill 91 becomes lower. Specifically, as illustrated in Figs. 10(a) and 10(b), the amount of deformation of the frame wall portions of the fan guard 9 with respect to pressing force P increases. In this case, the rigidity of the walls of the air blowing grill 91 may be improved by increasing the thickness of each frame wall portion. However, this increases the weight of the fan guard 9 as a whole and raises the costs, too. If the width of a portion A (see Fig. 9) between the openings 93 increases, the length of each opening 93 decreases.

[0038] To solve this problem, as shown in Fig. 9, reinforcement ribs L may be arranged in middle portions of the openings 93 of each frame wall portion 92b to 92d. Specifically, each of the reinforcement ribs L is arranged at the backside of the frame wall portion 92b to 92d in such a manner as to cross the corresponding pair of the openings 93. This suppresses decrease of rigidity of the frame wall portions of the fan guard 9 despite the increased lengths of the openings 93. Accordingly, as illustrated in Fig. 10(c), the amount of deformation of each frame wall portion of the fan guard 9 with respect to the pressing force P is decreased. Although the reinforcement ribs L may be separate members from the fan guard 9, it is preferable to form the reinforcement ribs L together with the openings 93 when the fan guard 9 is molded. Further, the arrangement of the reinforcement ribs L is not restricted to the arrangement shown in Fig. 8. Specifically, as illustrated in Fig. 5, the reinforcement ribs L may be employed for the three pairs of openings arranged along the longitudinal direction of each frame wall portion.

(Second Embodiment)

[0039] Figs. 11 and 12 show the structure of an air delivery unit according to a second embodiment of the present invention as a whole and a main portion of the air delivery unit. In the present embodiment, the air delivery unit is embodied as an outdoor unit of an air conditioner of a type that draws air from sides through three surfaces and blows the air upward.

[0040] The outdoor unit has a frame-like casing 1 with a rectangular cross section extending in the vertical direction. An air inlet 23a having a grill structure is formed in the entire portion of a front surface 23 of the casing 1. Air inlets 24a, 25a are each formed in the front surface of the corresponding one of two side surfaces 24, 25. A backside 22 of the casing 1 as a whole and rear portions of the side surfaces 24, 25 are formed by blind patches. A heat exchanger, which has a U shape as viewed from above, is received in the casing 1 in correspondence with the air inlet 23a of the front surface 23 and the air inlets 24a, 25a of the side surfaces.

[0041] A bottom plate 29 is arranged at the lower surface of the casing 1. A cylindrical fan guard 28 is provided on top of the casing 1. An air delivery device (not shown) is received in the casing 1 and arranged below the fan guard 28. A flat rectangular frame-like base cap 26a is engaged with the upper end of the casing 1. A fan guard 28, which has been formed into a cylindrical shape through drawing, is attached to an opening of the base cap 26a. The fan guard 28 projects upward and the diameter of the fan guard 28 is decreased with respect to the diameter of the base cap 26a. A circular air blowing grill 27 having a grid-like structure is arranged at the upper surface of the fan guard 28.

[0042] In a frame wall portion 26b of the fan guard 28, which has a cylindrical shape, elongated openings 93 are arranged in two parallel rows along the direction of the width of the frame wall portion. Pairs of the openings 93, which are aligned in the width direction, are arranged with a predetermined interval in a circumferential direction of the fan guard 28. Accordingly, a predetermined amount of air is blown from inside the casing 1 through the openings 93 of the frame wall portion 26b of the fan guard 28, in addition to the air blowing grill 27 at the upper surface of the fan guard 28.

[0043] As a result, this fan guard 28 allows the air blown upward by the air delivery device arranged in the casing 1 to be blown through the air blowing grill 27 at the top surface of the fan guard 28 and through the multiple openings 93 of the frame wall portion 26b. This decreases the amount and the speed of the air blown from the air blowing grill 27, thus suppressing rise of the static pressure of the air delivery device and decreasing the noise caused by interference between the bars of the air blowing grill 27 and the air. As a result, excessive drive load acting on the fan motor is decreased and the power consumption is lowered. Accordingly, a low-noise and energy-saving air delivery unit is provided.

[0044] Additionally, in the above-described configuration, the openings 93 are arranged at the positions spaced from the front surface and the front portions of both side surfaces, at which a short circuit easily occurs due to the shape of the heat exchanger 11. Accordingly, the short circuit in which the blown air is drawn to air inlets 23a, 24a, 25a located close to the heat exchanger 11 is avoided. The heat exchange efficiency of the heat exchanger 11 is thus prevented from decreasing.

[0045] Also, in the above-described structure, the frame wall portion of the fan guard 28 functions as an air blowing frame and an attachment frame attached to the casing 1. This facilitates formation of the openings 93 in the frame wall portion of the fan guard 28. Accordingly, it is unnecessary to employ a special passage configuration. Specifically, it is unnecessary to shape the bellmouth in such a manner as to guide an airstream or machine a partition plate into a predetermined shape. Also, since the frame wall portion of the fan guard 28 is configured as an attachment frame attached to the base cap 26a and has enhanced rigidity, the frame wall portion of the fan guard 28 cannot be deformed easily.

(Modification)

[0046] The present embodiment may be modified by forming reinforcement ribs L as illustrated in Fig. 9 for each of the openings 93.

Claims

1. An air delivery unit comprising a casing having an air inlet and an air outlet, an air delivery device arranged in a fan passage extending from the air inlet to the air outlet in the casing, an air blowing surface having a grill structure arranged at a position corresponding to the air outlet of the casing, and a fan guard that has a predetermined length along an air blowing direction and is formed by a hollow frame wall portion attached to a portion of the casing around the air outlet, the air blowing surface and the frame wall portion of the fan guard being integrally formed of a synthetic resin, an air blowing opening being formed in the frame wall portion, the air delivery unit being **characterized in that**:
 - a heat exchanger is arranged in the fan passage at a position upstream from the air delivery device;
 - the heat exchanger is arranged in correspondence with the air inlet of the casing; and
 - the air blowing opening is arranged in the frame wall portion at a position spaced from the air inlet of the casing.
2. The air delivery unit according to claim 1, **characterized in that** a plurality of openings are formed in the frame wall portion of the fan guard.
3. The air delivery unit according to claim 1 or 2, **characterized in that** a rib reinforcing the frame wall portion in the vicinity of the opening is arranged in the fan guard.
4. The air delivery unit according to any one of claims 1, 2, and 3, **characterized in that** the fan guard has

a rectangular shape, a recess having a threaded hole being formed in each of four corners of the fan guard, wherein the fan guard is fixed to the casing by passing thread means through the threaded holes of the fan guard and fastening the thread means to the portion of the casing around the air outlet.

Fig.1

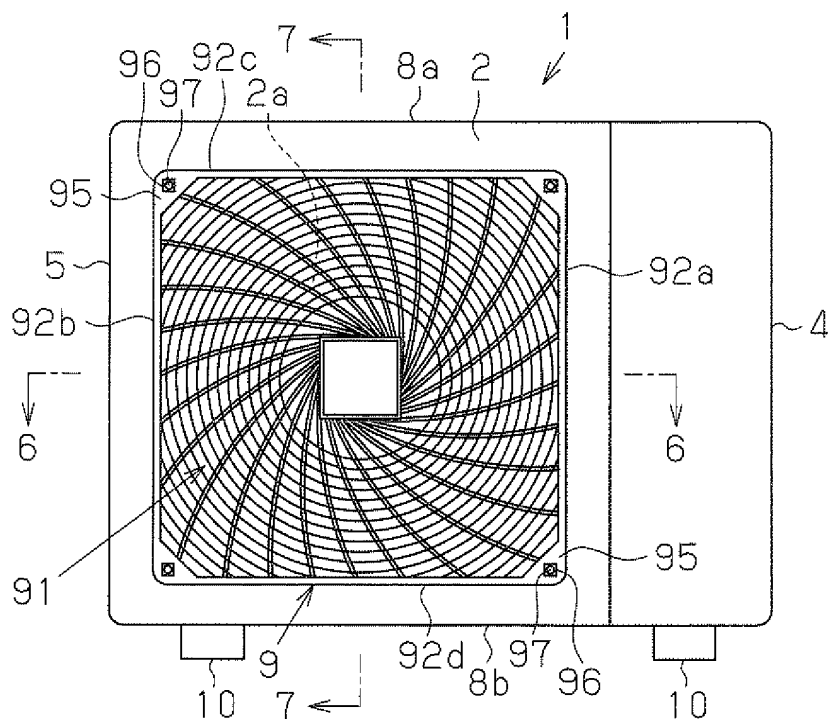


Fig.2

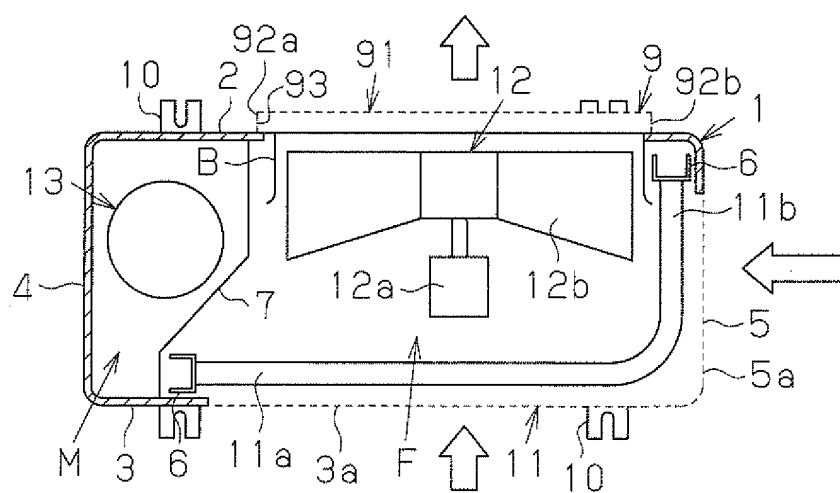


Fig.3

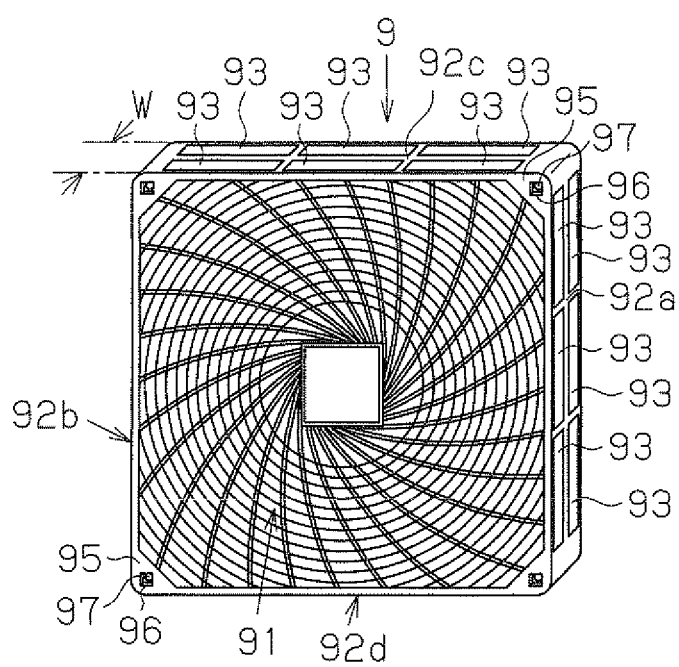


Fig.4

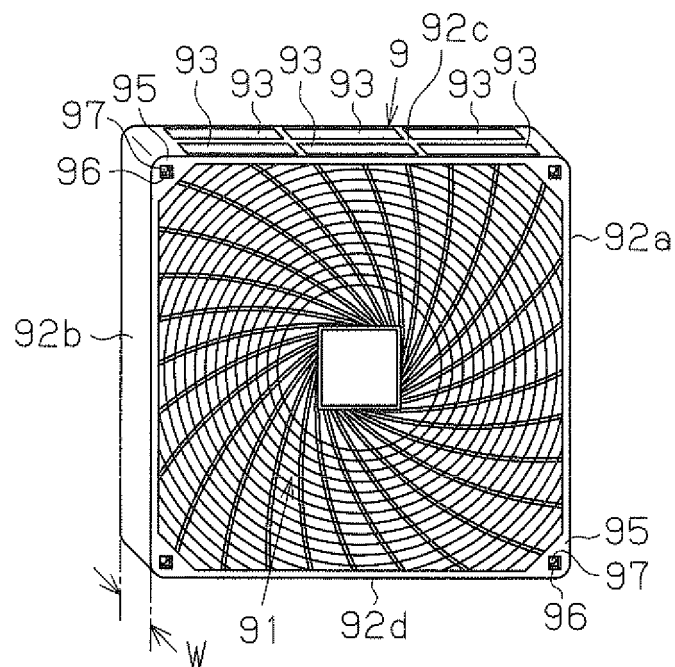


Fig.5

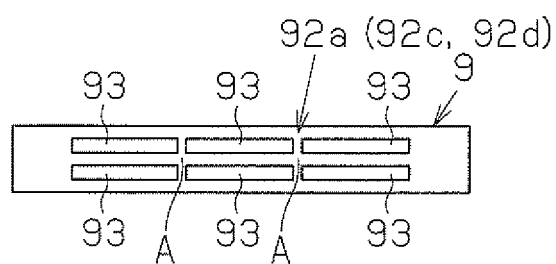


Fig.6

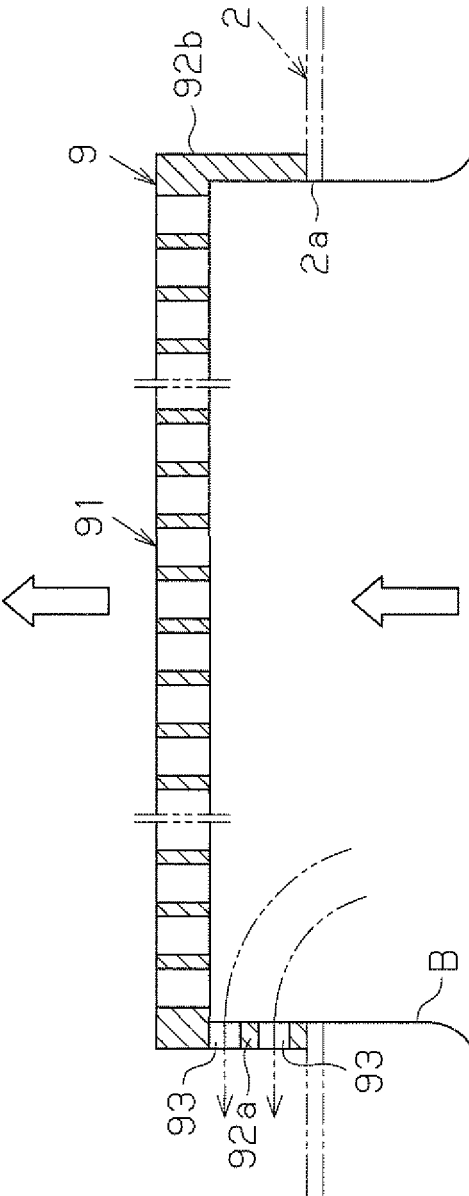


Fig.7

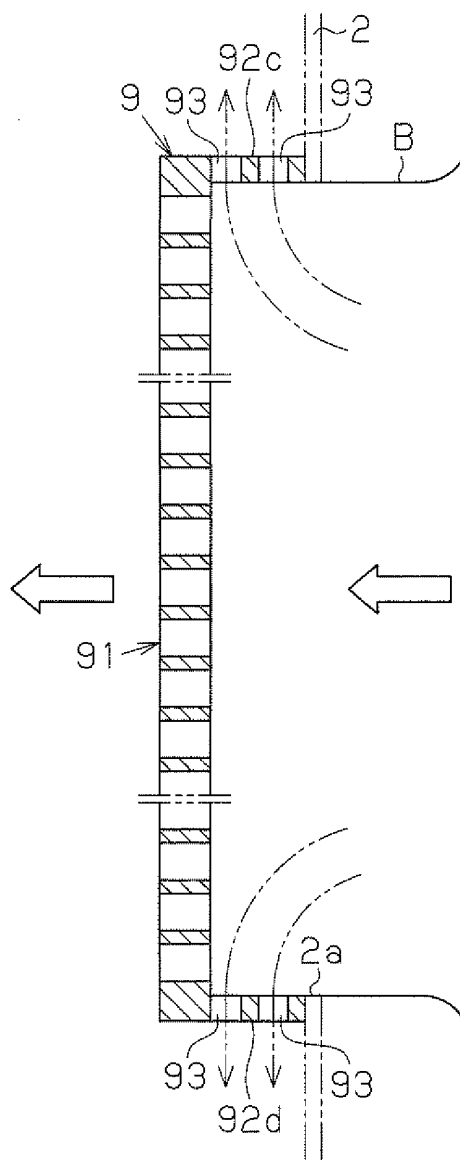


Fig.8

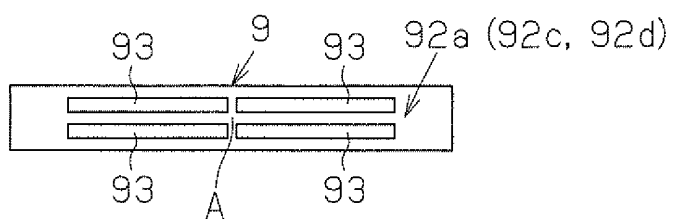


Fig.9

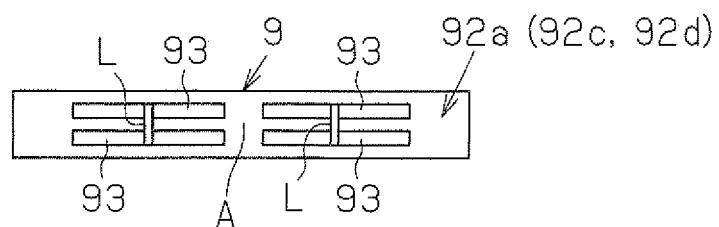


Fig.10

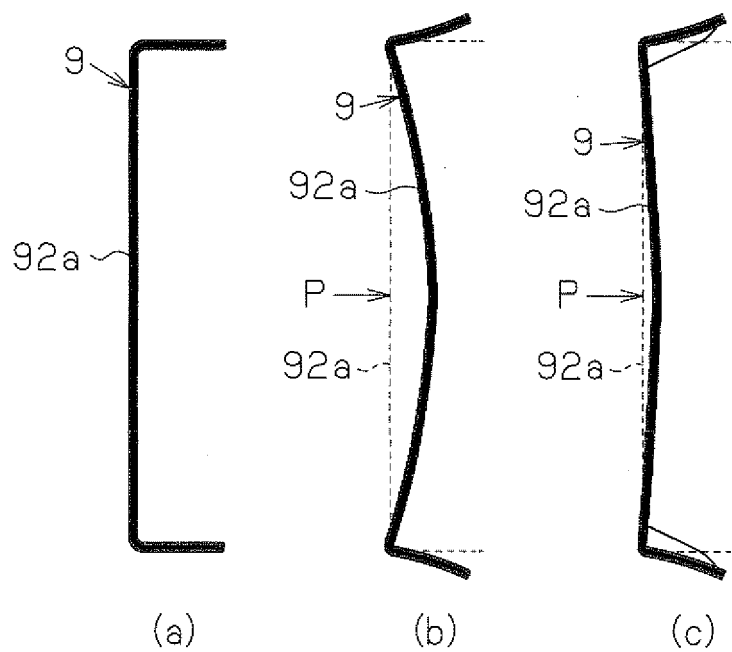


Fig.11

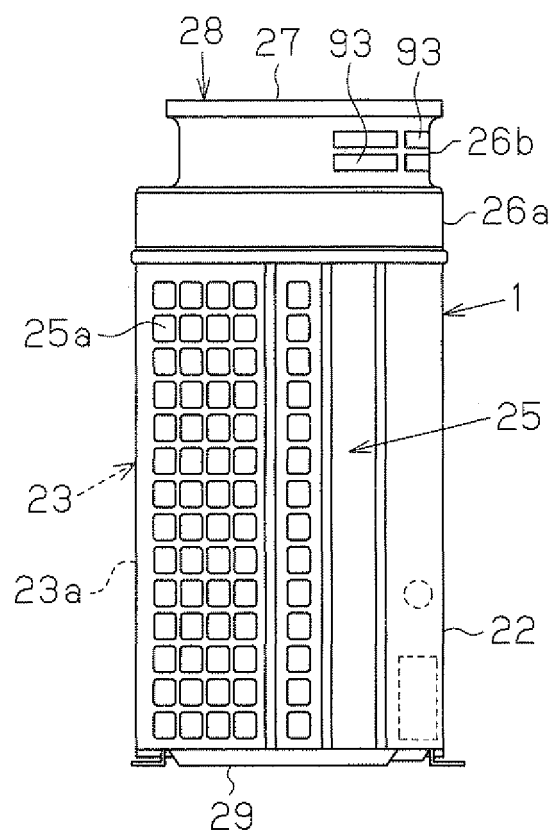


Fig.12

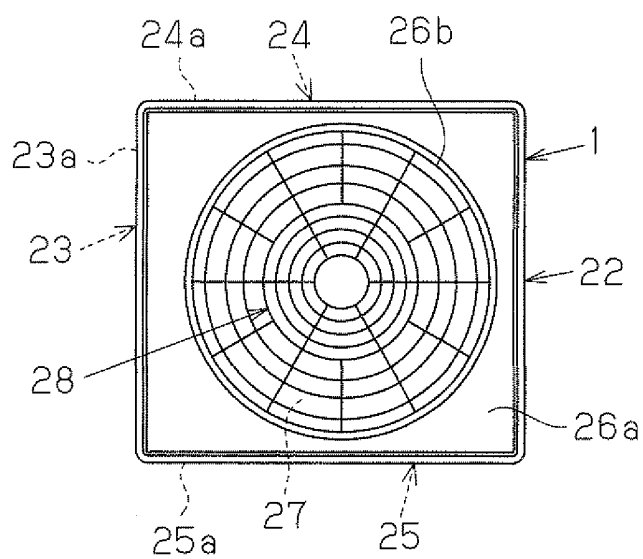


Fig.13

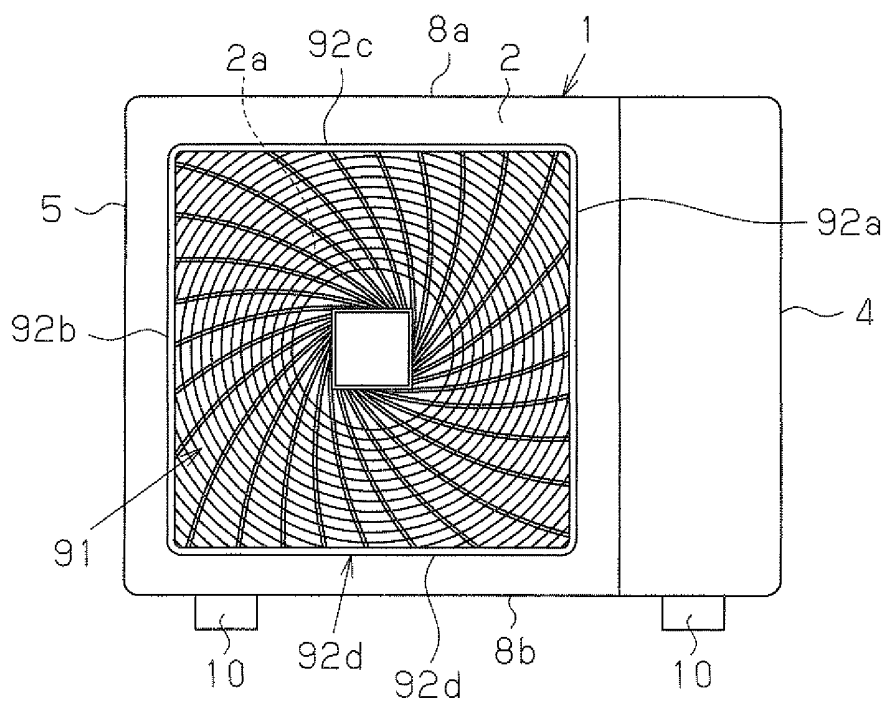


Fig.14

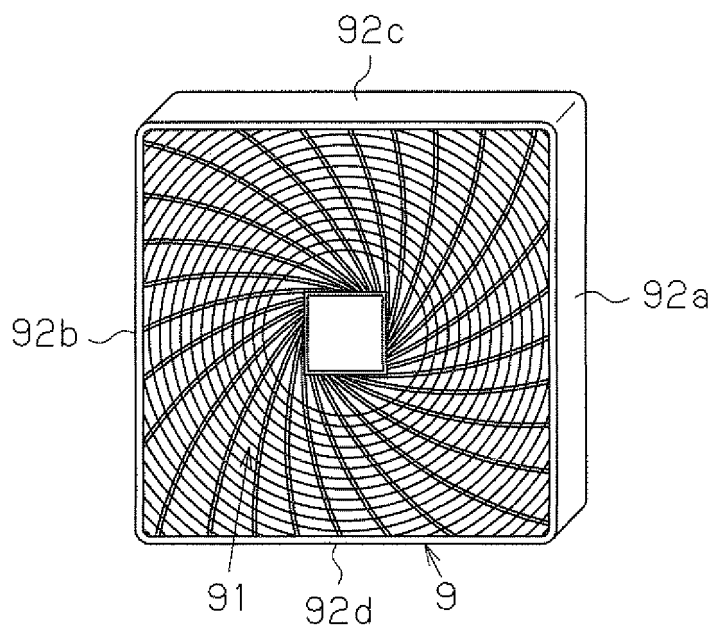


Fig.15

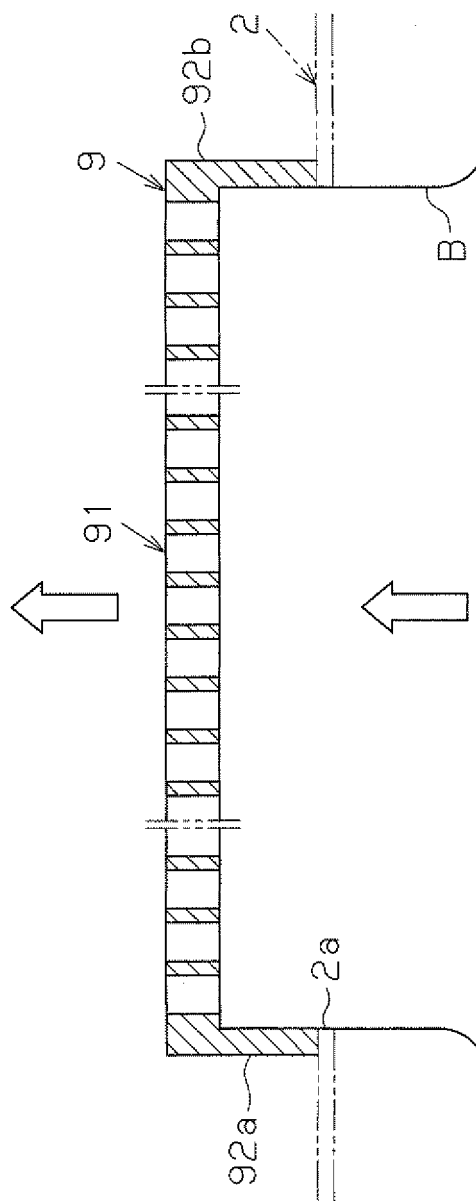


Fig.16

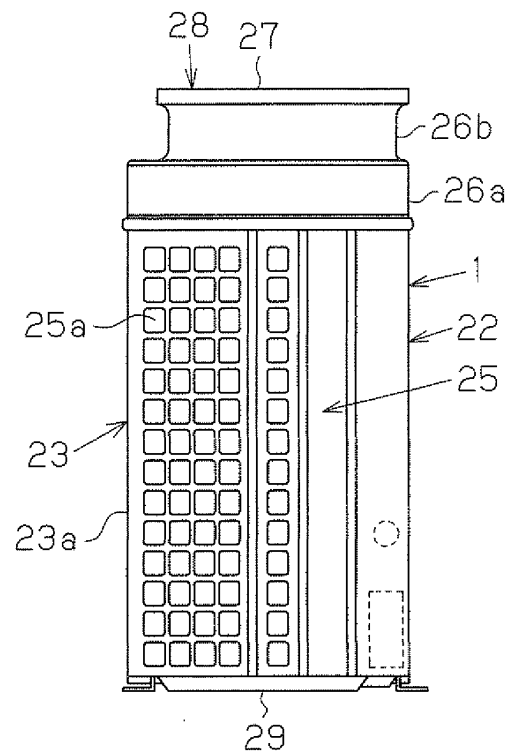


Fig.17

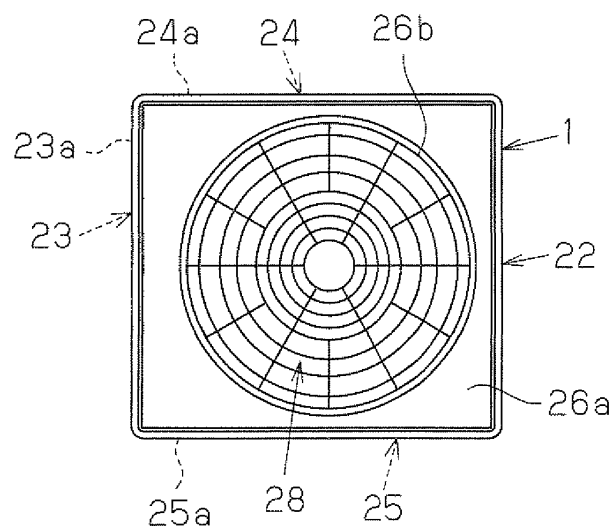


Fig.18

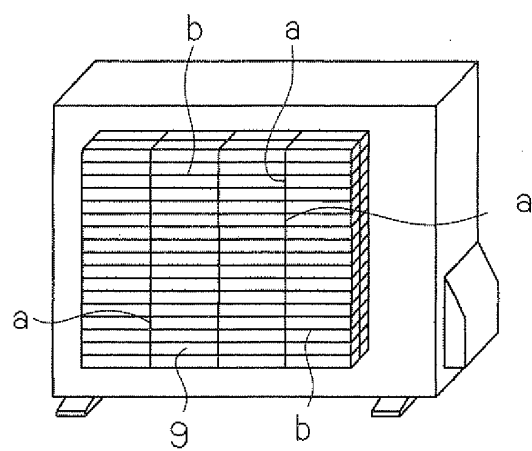
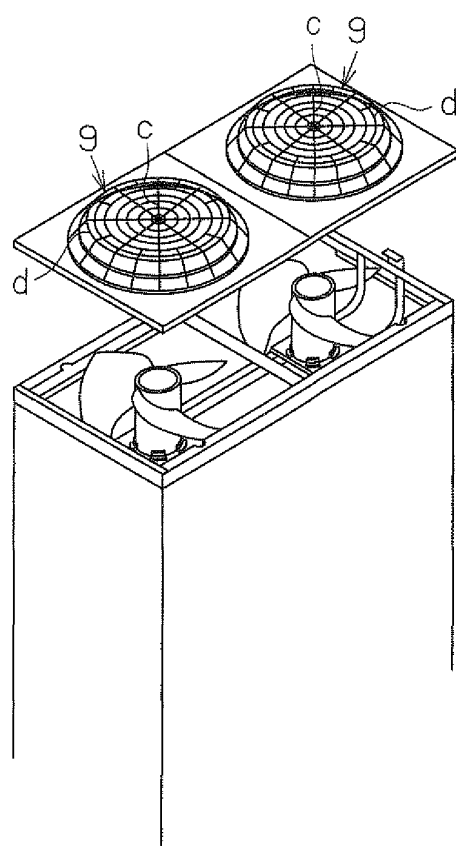


Fig.19



INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2008/062414

A. CLASSIFICATION OF SUBJECT MATTER

F24F5/00 (2006.01) i

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)

F24F5/00

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 1996-2008

Kokai Jitsuyo Shinan Koho 1971-2008 Toroku Jitsuyo Shinan Koho 1994-2008

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	Microfilm of the specification and drawings annexed to the request of Japanese Utility Model Application No. 055601/1985 (Laid-open No. 172973/1986) (Mitsubishi Electric Corp.), 27 October, 1986 (27.10.86), Page 5, line 20 to page 6, line 3; page 8, lines 1 to 17; Figs. 4, 5 (Family: none)	1-4

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

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"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
18 August, 2008 (18.08.08)Date of mailing of the international search report
02 September, 2008 (02.09.08)Name and mailing address of the ISA/
Japanese Patent Office

Authorized officer

Facsimile No.

Telephone No.

INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2008/062414

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	CD-ROM of the specification and drawings annexed to the request of Japanese Utility Model Application No. 039957/1991 (Laid-open No. 132337/1992) (Daikin Industries, Ltd.), 08 December, 1992 (08.12.92), Par. Nos. [0010] to [0012]; Figs. 2, 4 (Family: none)	1-4
Y	JP 10-238814 A (Sharp Corp.), 08 September, 1998 (08.09.98), Par. No. [0018]; Fig. 1 (Family: none)	4

Form PCT/ISA/210 (continuation of second sheet) (April 2007)

REFERENCES CITED IN THE DESCRIPTION

This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.

Patent documents cited in the description

- JP 6067895 A [0013]
- JP 2002195610 A [0013]
- JP 5248662 A [0013]
- JP 8189671 A [0013]
- JP 2007139242 A [0013]