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(54) **AIR CONDITIONER**

(57) An air conditioner comprises an outlet port (18) disposed in a cabinet (10) for guiding and discharging heat-exchanged air to the outside after it is supplied to an outdoor heat exchanger (14) and heat exchanged therein and a fan guard (20) attached to the outlet port (18) for preventing invasion of an object into the inside while securing a ventilation area for the heat-exchanged air. The fan guard (20) is molded integrally using a syn-

thetic resin material and is constituted of a plurality of circular slats (24) disposed concentrically at a predetermined pitch and a plurality of radial slats (25) intersecting the circular slats (24) and disposed radially from the center of the circular slats (24) to the outermost periphery thereof. The radial slats (25) are disposed alternately at every concentric pitch on the concentric circles between the circular slats (24).

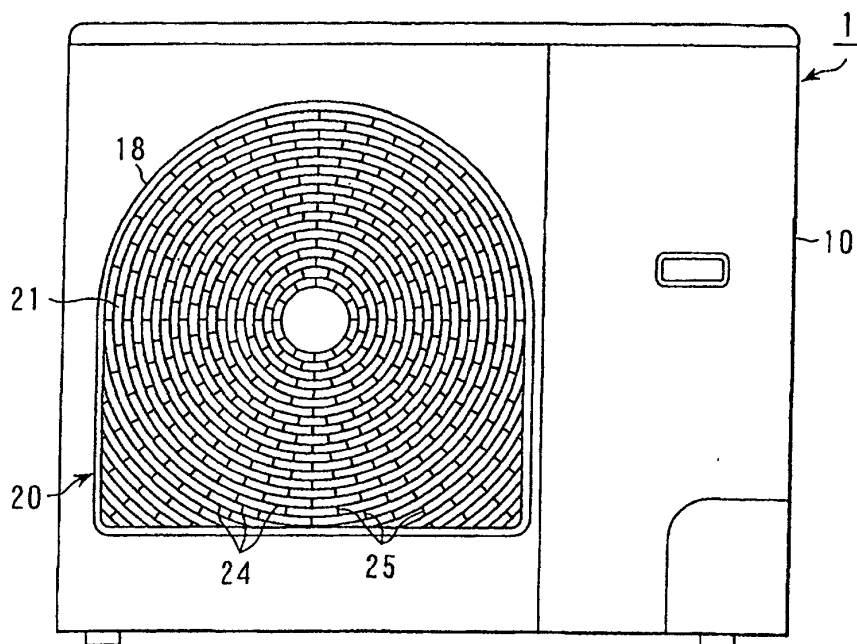


FIG. 3A

Description

Technical Field

5 **[0001]** The present invention relates to an air conditioner, and more particularly, to an improvement in a fan guard which is attached to an outlet port through which air having been heat-exchanged is guided and discharged to the outside after the air is sent to a heat exchanger and subjected to heat exchange and which is composed of concentric circular slats and radial slats.

10 Background Art

[0002] Separate type air conditioners, which are composed of an indoor unit disposed in a room to be air conditioned and an outdoor unit disposed in the open air and communicating with the indoor unit through refrigerant piping or the like, have been in heavy use.

15 **[0003]** In particular, the outdoor unit includes a heat exchanger and an outdoor blower disposed in a cabinet serving as a unit main body in confrontation with each other. Further, inlet ports are disposed on the back surface and side surfaces of the cabinet, and an outlet port is disposed on the front surface of the cabinet.

[0004] In particular, since the outlet port is disposed on the front surface of the cabinet, it is contemplated that a person might insert a finger into the cabinet by mistake or that an object might get into the cabinet. To cope with this problem, a fan guard for preventing invasion of a finger and an object is attached to the outlet port in such a degree as not to obstruct ventilation of heat-exchanged air.

[0005] Conventionally, a front surface of an outdoor unit is arranged as shown in, for example, FIG. 13. An outlet port 102 is opened through the front surface of a cabinet 101, and a fan guard 103 is fitted to the outlet port 102. The fan guard 103 is composed of a plurality of circular slats 104 disposed concentrically at a predetermined pitch and a plurality of radial slats 105 that intersect the circular slats 104 as well as extend radially from the center of the circular slats 104 to the outermost periphery thereof.

[0006] The circular slats 104 and the radial slats 105 are molded of, for example, a synthetic resin material. Further, from geometric characteristics, the intervals between the radial slats 105 are made smaller as they come nearer to the center of the circular slats 104. It is needless to say that the intervals between the radial slats 105 are designed such that necessary strength is maintained at the outermost periphery of the fan guard 103.

[0007] In the conventional fan guard 103, the intervals between the radial slats 105 are set based on design strength that is necessary at the outermost periphery. Thus, the intervals are set more densely than necessary intervals calculated from the strength of the fan guard as they come nearer to the center of the circular slats 104. This arrangement results in radial slats 105 having a large resistance against air flow.

35 **[0008]** Further, since the strength of the synthetic resin material, which constitutes the circular slats 104 and the radial slats 105, is insufficient, these slats are formed to have a large wall thickness to increase the strength thereof. As a result, a disadvantage arises in that actual ventilation areas are reduced and ventilation resistance is increased.

Disclosure of Invention

40 **[0009]** In an air conditioner according to an aspect of the present invention having a heat exchanger and a blower disposed in a cabinet, the blower supplying air to be heat exchanged to the heat exchanger so that the air is heat exchanged, the air conditioner comprises: an outlet port which is disposed in the cabinet, and guides and discharges heat-exchanged air to the outside after it is supplied to the heat exchanger and heat exchanged therein; and a fan guard which is attached to the outlet port, and prevents invasion of an object into the inside while securing a ventilation area for the heat-exchanged air, the fan guard being molded integrally using a synthetic resin material and being constituted of a plurality of circular slats disposed concentrically at a predetermined pitch and a plurality of radial slats intersecting the circular slats and disposed radially from the center of the circular slats to the outermost periphery thereof, and the radial slats being disposed alternately at every concentric pitch on the concentric circles between the circular slats.

Brief Description of Drawings

[0010]

55 FIG. 1 is a schematic lateral plan view of an outdoor unit constituting an air conditioner showing an embodiment of the present invention;
 FIGS. 2A to 2C are views explaining a structural shape and air blasting characteristics of a propeller fan constituting

an outdoor blower showing the embodiment of the present invention;

FIG. 3A is a front view of an outdoor unit having a fan guard of a first embodiment of the invention;

FIG. 3B is a front view explaining a feature of circular slats and radial slats constituting the fan guard;

FIG. 4 is a front view of an outdoor unit having a fan guard as a modification of the first embodiment;

FIG. 5 is a view showing the characteristics of operation noise of an outdoor blower to a quantity of supplied air when the outdoor blower is provided with the fan guard of the first embodiment and with a fan guard of a conventional structure;

FIGS. 6A and 6B are front views of outdoor units each having a fan guard as a different modification of the first embodiment;

FIG. 7A is a front view of an outdoor unit having a fan guard of a second embodiment of the invention;

FIG. 7B is a front view explaining a feature of circular slats and radial slats constituting the fan guard;

FIG. 8 is a front view of an outdoor unit having a fan guard as a modification of the second embodiment;

FIG. 9 is a front view showing a part of a fan guard as another modification of the second embodiment;

FIGS. 10A to 10D are views explaining a structural shape and a sectional shape of circular slats and radial slats which are applied to the first and second embodiments;

FIG. 11A is a front view of an outdoor unit having a fan guard according to a technical reference example;

FIG. 11B is a front view explaining a feature of circular slats and radial slats constituting the fan guard;

FIG. 12 is a front view of an outdoor unit having a fan guard; and

FIG. 13 is a front view showing an outdoor unit having a conventional fan guard.

Best Mode for Carrying Out the Invention

[0011] Embodiments of the present invention will be explained below with reference to the drawings. FIG. 1 is a lateral sectional view showing an outdoor unit 1 in a separate type air conditioner having an indoor unit and an outdoor unit.

[0012] In FIG. 1, reference numeral 10 denotes a cabinet serving as a unit main body, and the interior of the cabinet 10 is partitioned into a heat exchange chamber 12 and a machine chamber 13 by a partition plate 11. An outdoor heat exchanger 14, which is formed in an L-shape when viewed in a plan view, is disposed in the heat exchange chamber 12, and further an outdoor blower 15 is disposed in confrontation with the outdoor heat exchanger 14.

[0013] A compressor 16 is disposed in the machine chamber 13 and connected to the outdoor heat exchanger 14, an indoor heat exchanger and the like disposed in an indoor unit (not shown) through refrigerant piping so as to constitute a refrigerating cycle circuit.

[0014] The outdoor blower 15 is composed of a fan motor 15m and a propeller fan 15f to be fitted to a rotary shaft of the fan motor 15m. Since the propeller fan 15f is attached in confrontation with the front surface of the cabinet 10, the front surface of the cabinet 10 acts as an outlet side, and the back surface thereof acts as an inlet side. Since the outdoor heat exchanger 14 is interposed between the back surface of the cabinet 10 and the propeller fan 15f, it is positioned on the inlet side of the propeller fan 15f.

[0015] In contrast, inlet ports 17 are disposed on the back surface of the heat exchange chamber 12 and on a side surface of the cabinet 10, respectively. That is, external air is sucked into the cabinet 10 through the inlet ports 17 by driving the outdoor blower 15.

[0016] Further, an outlet port 18 is disposed in the cabinet 10 on the front surface side of the heat exchange chamber 12. External air sucked from the inlet ports 17 by driving the outdoor blower 15 passes through the outdoor heat exchanger 14, is heat exchanged therein, and blasted out from the outlet port 18.

[0017] A fan guard 20, which will be described later, is fitted to the outlet port 18 to reliably prevent insertion of a finger and an object thereinto. It is needless to say that the fan guard 20 is designed with such dimensions and shape that it does not act as a ventilation resistance against heat-exchanged air to be vented through the outlet port 18.

[0018] Note that, as shown in FIGS. 2A, 2B, and 2C, when the propeller fan 15f is driven in rotation clockwise (in the direction of an arrow ϕ) in FIG. 2B, the intensity of a blown-off stream of air from the propeller fan 15f is increased in the sequence of directions Va, Vb, and Vc from a center shaft K to an outer periphery as shown in FIG. 2C. Further, when a blowing-off angle α is set from a small angle (parallel to an axial center) to a large angle (large angle with respect to the axial angle) in the sequence of Wa, Wb, Wc as shown in FIG. 2A, the propeller fan 15f has such characteristics that the intensity of the blown-off stream of air increases in the above sequence.

[0019] Next, the fan guard 20 will be described in detail. FIG. 3A shows the front surface of the cabinet 10, and the fan guard 20 of the first embodiment is fitted to the outlet port 18. The fan guard 20 is composed of a plurality of slats 21 molded integrally using a synthetic resin material.

[0020] The slats 21 are composed of a plurality of circular slats 24 disposed concentrically at a predetermined pitch from a center to an outermost periphery and a plurality of radial slats 25 intersecting the circular slats 24 and disposed radially from the center of the circular slats 24 to the outermost periphery thereof. Note that the radial slats 25 are

composed of three kinds of radial slats 25a to 25c depending on their lengths.

[0021] Basically, an interval between the radial slats 25, which are located adjacent to each other in a peripheral direction, gradually increase from the center of the circular slats 24 to the outermost periphery thereof (gradually decreases from the outermost periphery of the circular slats 24 to the center thereof). However, the radial slats 25 are disposed here as described below.

[0022] That is, the radial slats 25, which are located on the same straight line from the outermost periphery of the circular slats 24 to the center thereof, are disposed on the concentric circles formed between the circular slats 24 at every other pitch. The radial slats 25, which are located adjacent to each other in the peripheral direction, are disposed on the concentric circles formed between the circular slats 24 at every other pitch from the concentric circles between circular slats 24 displaced at one pitch toward the center of the circular slats 24. From the above arrangement, the radial slats 25 are disposed alternately with respect to the concentric circles of the circular slats 24.

[0023] Then, as described later, when the interval between the radial slats 25 located adjacent to each other on a predetermined concentric circle between the circular slats 24 reaches a predetermined interval, an end of one of the radial slats 25 is lacking, and the portion of the radial slat 25 located forward of the end is thinned out.

[0024] This will be specifically described based on FIG. 3B. When the radial slats 25b, 25b are disposed on both the side of the radial slats 25a in a radial direction and the radial slats 25c, 25c are disposed on both the side of the radial slats 25b, 25b adjacent thereto in the radial direction, the radial slat 25a and radial slats 25c are disposed on the same concentric circle Ra between the circular slats 24 and no radial slat 25b is disposed on the concentric circle.

[0025] The radial slats 25b are disposed on a concentric circle Rb displaced at one pitch from the concentric circle Ra, on which the radial slat 25a and the radial slats 25c are disposed, between the circular slats 24. Further, the radial slat 25a and the radial slats 25c are disposed the concentric circle Ra displaced at one pitch from the concentric circle Rb. Thereafter, the radial slat 25a and radial slats 25c are disposed on each concentric circle Ra between the circular slats 24, and the radial slats 25b are disposed on each concentric circle Rb between the circular slats 24, that is, the radial slat 25a and radial slats 25c and the radial slats 25b are disposed at every other pitch. Accordingly, the radial slats 25a, 25c and the radial slats 25b are disposed alternately.

[0026] It is assumed here that the interval in the peripheral direction between adjacent radial slats 25a, 25c disposed on an outermost peripheral concentric circle Ra is shown by Q. Thus, the interval in the radial direction between adjacent radial slats 25b, 25b disposed on an outermost peripheral concentric circle Rb is slightly smaller than the interval Q. The interval in the peripheral direction between the adjacent radial slats 25a, 25c disposed on the concentric circle Ra located inward of the concentric circle Rb is more smaller than the interval Q. Then, ends of the radial slats 25b, 25b are lacking at a position at which the interval in the peripheral direction between the adjacent radial slats 25b, 25b finally reaches approximately Q/2. The remaining radial slats 25a, 25c are extended to the center of the circular slats 24 as they are. Thus, the intervals in the peripheral direction between the radial slats 25a, 25c are made sequentially smaller. Further, ends of the radial slats 25c are lacking at a position at which the interval in the peripheral direction between the adjacent radial slats 25a, 25c reaches approximately Q/2. In this manner, lacking portions are repeatedly formed under the condition described above until the remaining radial slat 25a is extended to the center of the circular slats 24.

[0027] That is, the radial slats 25b are disposed up to the position of a concentric circle R1 and ends thereof located forward of the position are lacking. Further, the radial slats 25c are disposed up to the position of a concentric circle R2 and ends thereof located forward of the position are lacking. Then, the radial slats 25a, 25a are disposed at the position of an innermost periphery at predetermined intervals and the ends thereof forward of the position are lacking.

[0028] Note that only radial slats 25a are disposed on an concentric circle R3 that is located one pitch inward of the ends of the radial slats 25b disposed on the concentric circle R1 and no radial slat 25c is disposed thereon. Radial slats 25c are disposed every other pitch from a concentric circle R4 located one pitch inward of the concentric circle R3.

[0029] That is, although the radial slats 25a, 25c and radial slats 25b are disposed alternately from the outermost periphery of the circular slats 24, the radial slats 25a and radial slats 25c are disposed alternately from the concentric circle R1 on which the radial slats 25b are lacking for the first time to the center of the circular slats 24.

[0030] As a result, although the intervals between the radial slats 25 on the same concentric circles are made gradually smaller from the outermost periphery of the circular slats 24 to the center thereof, the intervals between the radial slats 25a-25a on the concentric circle R3 located one pitch inwardly of the ends of the radial slats 25b where they are lacking for the first time are increased approximately equal to the intervals Q on the outermost periphery. Then, the intervals between the radial slats 25c and 25a disposed alternately from the concentric circle R4 located one pitch inward of the concentric circle R3 to the center are made sequentially smaller.

[0031] As described above, since the intervals between the radial slats 25 that secure necessary strength as the fan guard 20 can be set larger, the number of the radial slats 25 having a large resistance to an air flow can be reduced. Specifically, the number of the radial slats used in the fan guard 20 is set as shown in Table which will be described below.

[0032] Accordingly, the fan guard 20 is arranged in a mode which is in agreement with the intensity of an air flow blown off from the propeller fan 15f and corresponds to the blowing-off characteristics of the outdoor blower 15, thereby

the ventilation resistance of the fan guard 20 is reduced and the air blasting characteristics of the outdoor blower 15 are greatly improved, so that a heat exchange performance can be greatly improved.

[0033] FIG. 4 shows a fan guard 30 as a modification of the first embodiment described above. The fan guard 30 is simultaneously provided with two sets of the fan guards 20 explained above in FIG. 3A, and the fan guards 20 confront with each other so that they are disposed symmetrically with respect to an up/down direction.

[0034] The inner structure (not shown) of the fan guard 30 is basically similar to that of the fan guard 20 explained in FIG. 1. Since, however, the fan guard 30 is employed in an outdoor unit of a relatively large air conditioner, two sets of outdoor heat exchangers are disposed in confrontation with the upper and lower fan guards or one set of a large outdoor heat exchanger that extends to the upper and lower fan guards is disposed. Further since outdoor fans are disposed in confrontation with the upper and lower fan guards, an operation effect similar to that described above can be obtained.

[0035] FIG. 5 shows a result of measurement of change in operation noise to quantities of supplied air in the outdoor unit having the fan guard 20 shown in FIG. 3A and in the outdoor unit having the conventionally arranged fan guard 3 described previously in FIG. 13.

[0036] It can be found that when the same outdoor blower 15 is used, a degree of operation noise to the quantity of supplied air in the fan guard of the present invention N1 is lower than the fan guard of the conventional arrangement N2.

[0037] FIG. 6A shows a fan guard 40 as a modification of the first embodiment. Note that, in FIG. 6A, circular slats 44 are disposed in correspondence to the circular slats 24 in FIGS. 3A and 3B described above, and radial slats 45 are disposed in correspondence to the radial slats 25 in FIGS. 3A and 3B.

[0038] That is, the respective radial slats 45 are disposed with respect to the circular slats 44 formed concentrically under the same condition as that of the radial slats 25 described above. However, all the radial slats 45 are disposed in a state in which they are inclined a predetermined angle with respect to the center of the circular slats 44.

[0039] The fan guard 40 arranged as described above also has precisely the same effect as that of the fan guard 20 described above.

[0040] Further, although all the radial slats 45 are formed in a state in which they are inclined the predetermined angle with respect to the center of the circular slats 44, the present invention is not limited thereto, and they may be appropriately inclined in a different direction and formed in, for example, a spiral shape in its entirety.

[0041] FIG. 6B shows a fan guard 50 as another modification of the first embodiment. The fan guard 50 is composed of a first slat portion 51 and a second slat portion 52. The first slat portion 51 is separated from the second slat portion 52 by a predetermined pitch circle having a diameter approximately half that of the circle of an outermost periphery, and the first slat portion 51 is located on the outermost periphery side, and the second slat portion 52 is located on an inner periphery side. In the first slat portion 51, concentric circular slats 53 are disposed as well as radial slats 54 are disposed toward the center of the predetermined pitch circle from the outermost periphery of the circular slats 53 to the pitch circle at equally spaced intervals similar to conventional intervals. In the second slat portion 52, concentric circular slats 55 are disposed as well as radial slats 56 are disposed alternately to the concentric circles between the concentric circular slats 55 from the position of the pitch circle to the center thereof. The fan guard 50 has definitely the same effect as that of the fan guard 20 described above.

[0042] FIG. 7A shows a fan guard 60 as a second embodiment of the invention. The fan guard 60 is composed of a plurality of circular slats 64, which are disposed concentrically at entirely the same pitch from an outermost periphery to a center, and radial slats 65 disposed so as to intersect the circular slats 64. However, the radial slats 65 exhibits a modified radial state according to a condition under which the radial slats 65 are disposed as described later.

[0043] The radial slats 65 are disposed on the concentric circles between the circular slats 64 at equally spaced intervals. However, the number of the radial slats 65 on the concentric circles is gradually reduced one piece at every pitch of the concentric circles from the outermost periphery of the circular slats 64 to the center thereof.

[0044] With this arrangement, the radial slats 65 are composed of a straight line portion 65a formed straight from the outermost periphery of the circular slats 64 to the center thereof, parabolic portions 65b formed on both the sides of the straight line portion 65a in a parabolic state, and alternate portions 65c formed alternately on the concentric circles between the circular slats 64 in the portion other than the straight line portion 65a and the parabolic portions 65b.

[0045] In FIG. 7B, it will be easier to specifically explain the number of the radial slats 65 in an outer peripheral direction from the center of the circular slats 64. One radial slat 65 is disposed straight from the center of the circular slats 64 to the outermost periphery thereof and acts as the straight line portion (reference radial slat) 65a. Seven radial slats 65 in total including the straight line portion 65a are disposed at equally spaced intervals on a concentric circle R7 between the circular slats 64 which is displaced one pitch in the outer peripheral direction from the center of the circular slats 64. Further, eight radial slats 65 in total including the straight line portion 65a are disposed at equally spaced intervals on a concentric circle R8 displaced one pitch in the outer peripheral direction from the concentric circle R7.

[0046] Further, nine radial slats 65 in total including the straight line portion 65a are disposed at equally spaced intervals on a concentric circle R9 displaced one pitch in the outer peripheral direction from the concentric circle R8,

and ten radial slats 65 in total including the straight line portion 65a are disposed at equally spaced intervals on a concentric circle R10 displaced one pitch in the outer peripheral direction from the concentric circle R9.

[0047] As described above, each time a concentric circle is displaced one pitch in the outer peripheral direction, one piece of a radial slat is added to the number of radial slats 65 disposed on the concentric circle. In FIG. 7B, 28 radial slats 65 in total including the straight line portion 65a are disposed at equally spaced intervals on a concentric circle R28 located on the outermost periphery side and formed in a perfect circular shape. Further, on concentric circles formed in an arc shape outward of the concentric circle R28, the radial slats 65 are disposed at intervals that are set at the same rate of change.

[0048] As a result, the radial slats 65 are composed of the straight line portion 65a formed straight from the outermost periphery of the circular slats 64 to the center thereof, the parabolic portions 65b disposed on both the sides of the straight line portion 65a, and the alternate portions 65c other than the straight line portion 65a and the parabolic portions 65b.

[0049] Accordingly, the fan guard 60 is arranged in a mode which is in agreement with the intensity of an air flow blown off from the propeller fan 15f and corresponds to the blow-off characteristics of the outdoor blower 15, thereby the ventilation resistance of the fan guard 60 is reduced and the blast characteristics of the outdoor blower 15 are greatly improved, so that heat exchange performance can be greatly improved.

[0050] FIG. 8 shows a fan guard 70 as a modification of the second embodiment described above. The fan guard 70 is simultaneously provided with two sets of the fan guards 60 described above in FIG. 7A, and the fan guards 60 confront with each other so that they are disposed symmetrically with respect to an up/down direction.

[0051] The inner structure (not shown) of the fan guard 60 is basically similar to that of the fan guard 20 explained in FIG. 1. Since, however, the fan guard 60 is employed in an outdoor unit of a relatively large air conditioner, two sets of heat exchangers are disposed in confrontation with the upper and lower fan guards or one set of a large outdoor heat exchanger that extends to the upper and lower fan guards is disposed. Further, since outdoor fans are disposed in confrontation with the upper and lower fan guards, an operation effect similar to that described above can be obtained.

[0052] FIG. 9 shows a fan guard 80 as another modification of the second embodiment. The fan guard 80 includes a straight portion 85a used as a reference similarly to the above reference radial slat, parabolic portions 85b, and alternate portions 85c, and only a part of the alternate portions 85c is modified.

[0053] Specifically, seven radial slats 85 in total including the reference radial slat 85a are disposed on a concentric circle R7 at equally spaced intervals, and radial slats 85 are disposed at enlarged intervals on a concentric circle R8 displaced one pitch externally of the concentric circle R7 at portions corresponding to alternate portions 85c.

[0054] Likewise, radial slats 85 are disposed at expanded intervals also on concentric circles R9 and R10 at portions corresponding to the alternate portions 85. In FIG. 9, hatched portions show the portions where the intervals of the radial slats 85 are enlarged.

[0055] Accordingly, since the fan guard 80 does not need the number of radial slats 85 whose strength exceeds the strength required to the fan guard 80, the number of radial slats 85 can be reduced to an ultimately necessary number, thereby the ventilation resistance of the fan guard 80 can be reduced and the air blasting characteristics of the outdoor blower 15 can be greatly improved, so that a heat exchange performance can be greatly enhanced.

[0056] Table 1 shows the number of radial slats on each concentric circle between circular slats when the radius of the outermost periphery of a circular slat is shown by, for example, La and the radii of circular slats are reduced in a sequence of Lb, Lc, Ld, ..., Lw to the center thereof. Accordingly, the number of radial slats in the arrangements of the fan guards described heretofore based on the drawings does not always correspond to the number of radial slats in Table 1.

Table 1

Radius	Fan guard 20	Fan guard 60	Fan guard 90	Conventional example
La	24	32	32	32
Lb	24	31	32	32
Lc	24	30	32	32
Ld	24	29	32	32
Le	24	28	32	32
Lf	24	27	32	32
Lg	24	26	32	32
Lh	24	25	32	32
Li	24	24	32	32
Lj	24	23	32	32
Lk	24	22	32	32
Ll	24	21	32	32
Lm	12	20	16	32
Ln	12	19	16	32
Lo	12	18	16	32
Lp	12	17	16	32
Lq	12	16	16	32
Lr	12	15	16	32
Ls	6	14	8	32
Lt	6	13	8	32
Lu	6	12	8	32
Lv	6	11	8	32
Lw	6	10	8	32
	390	483	520	736

[0057] In the column of conventional example in Table 1, since 32 pieces, for example, of radial slats are necessary on all the concentric circles between circular slats from the outermost periphery La to the center Lw, the number of radial slats amounts to 736 pieces.

[0058] In contrast, the number of radial slats 25 shown in the column of the fan guard 20 is set by alternately disposing the radial slats 25 as described above in FIG. 3A. The number of radial slats 25 from the outermost periphery La of the circular slats 24 to the center Lw thereof is divided into, for example, three kinds of groups, that is, a group of 24 pieces, a group of 12 pieces, and a group of 6 pieces. Thus, the number of radial slats 25 amounts to 390 pieces in total, and the ratio of the number of radial slats 25 to the number of radial slats in the conventional structure of 736 pieces is 0.54.

[0059] The number of radial slats 65 shown in the column of the fan guard 60 is reduced one piece on every concentric circle between circular slats 64 from the outermost periphery La to the center Lw, as explained in FIG. 7A previously.

[0060] Although 32 pieces of radial slats are necessary on the outermost periphery La, since the number of radial

slats is reduced one piece at every one pitch, the number of them is reduced to 10 pieces on a concentric circle on which the number of radial slats is minimized. Thus, the total number of radial slats amounts to 483 pieces that are greatly smaller than those of the conventional example, although the total number is larger than that of the first embodiment.

[0061] FIGS. 10A to 10D are views showing an example of specific shapes of the circular slats and the radial slats. Note that although these shapes can be applied to all the circular slats 24, 44, 54, 64, 84 and to all the radial slats 25, 45, 55, 65, 85 of the fan guards 20 to 80 described above, explanation will be made here as to the circular slats 24 and the radial slats 25 of the fan guard 20.

[0062] That is, the circular slats 24 are disposed in parallel with each other at predetermined intervals, the radial slats 25 are disposed in a direction where they are perpendicular to the circular slats 24. The circular slats 24 have a sectional shape formed in a substantially flat shape or in a substantially blade shape. Thus, ventilation resistance is reduced between the circular slats 24 as well as an increase in noise due to exfoliation of air flow is suppressed, thereby the air blasting characteristics can be greatly improved.

[0063] Further, the radial slats 25 have a sectional shape formed in a circular, substantially flat or substantially blade shape. Therefore, the strength of the fan guard 20 can be increased without almost increasing the ventilation resistance thereof, and the sectional dimension of the circular slats 24 can be suppressed thereby.

[0064] FIGS. 11A and 11B are views showing examples of a technical reference. FIG. 11A shows a front surface side of a cabinet 10, wherein a fan guard 90 is fitted to an outlet port 18. The fan guard 90 is composed of a plurality of slats molded integrally using a synthetic resin material.

[0065] Specifically, the slats are composed of a plurality of circular slats 94, which are disposed concentrically at a predetermined pitch from a center to an outermost periphery, and a plurality of radial slats 95, which intersect the circular slats 94 and are disposed radially from the center of the circular slats 94 to the outermost periphery thereof.

[0066] Although it is needless to say that the intervals between the radial slats 95, which are located adjacent to each other, are gradually increased from the center of the circular slats 94 to the outermost periphery thereof (gradually reduced from the outermost periphery of the circular slats 94 to the center thereof), these radial slats 95 are lacking at the ends thereof which confront the center of the circular slats 94 at predetermined positions.

[0067] Next, an arrangement of the lacking end portions of the radial slats 95 will be described in detail. It is assumed that the interval between adjacent radial slats 95 is shown by m which are located on the perfectly circular outermost periphery P_s of the circular slats 94. When the radial slats 95 are extended toward a center Z from the outermost periphery P_s of the circular slats 94 acting as a reference, the interval between the adjacent radial slats 95 is made gradually smaller than the interval m .

[0068] Then, there is a position where the interval between the adjacent radial slats 95 is set to $m/2$ on the circular slat 94 at a predetermined position. At this position, an end of one of the radial slats 95 is lacking, and the portion of the radial slat 95 located forward of the lacking end is thinned out.

[0069] The other radial slat 95 is extended as it is to the center of the circular slats 94. Thus, since the other radial slat 95 is located adjacent to the radial slat 95 extended previously without lacking, the interval therebetween is made sequentially smaller.

[0070] Finally, the interval between the adjacent radial slats 95 is set to $m/2$ at a predetermined position of the circular slats 94. Then, an end of one of the radial slats 95 is lacking at the predetermined position, and the portion of the radial slat 95 located forward of the lacking end is thinned out. In this manner, lacking portions are repeatedly formed under the condition described above until the remaining radial slats 95 are extended to the center of the circular slats 94.

[0071] Further, this will be specifically described based on FIG. 11B. Reference radial slats 95s, which extend from the center of the circular slats 94 to the outermost periphery thereof and intersect with each other vertically and-horizontally, are disposed, and a radial slat located at an intermediate portion between the reference radial slats 95s (that is, located at a position displaced 45° from the reference radial slats S) is denoted by reference numeral 95a.

[0072] Radial slats 95b, 95b are disposed on both the sides of the radial slat 95a, and further radial slats 95c, 95c are disposed on both the sides of the radial slats 95b, 95b. The radial slats 95a, 95b, and 95c are disposed on the perfectly circular outermost periphery P_s of the circular slats 94 at intervals m .

[0073] Although these radial slats 95a, 95b, and 95c are extended from the outermost periphery of the circular slats 94 to the center thereof, the intervals between the radial slat 95a and the radial slats 95b and the interval between the radial slat 95b and the radial slats 95 are set to $m/2$, respectively at the position P_a of a predetermined pitch circle of the circular slats 94

[0074] At this position, the radial slat 95a and the radial slats 95c remain as they are, ends of the radial slats 95b on both the sides of the radial slat 95a are lacking, and the portions of the radial slats 95b located forward of the lacking ends are thinned out. Since the radial slats 95a and 95c are further extended, the radial slat 95a is located adjacent to the radial slats 95c, and the interval therebetween is made gradually smaller.

[0075] At the position P_b of a predetermined pitch circle of the circular slats 94, the interval between the radial slat 95a and the radial slats 95c and the interval between the radial slats 95c and the radial slats 95s are set to $m/2$, respec-

tively. Thus, an end of the radial slat 95c is lacking at this time, and the radial slats 95a and 95s are further extended.

[0076] Accordingly, the radial slat 95a is located adjacent to the reference radial slats 95s at the portion forward of the position Pb, thereby the interval therebetween is made gradually smaller. At the position Pc of a predetermined pitch circle of the circular slats 94, the interval between the radial slats 95a and 95s is set to $m/2$. At this time, an end of the radial slat 95a is lacking, and only the reference radial slats 95s exist on the center side forward of the lacking end.

[0077] With the above arrangement, the fan guard 90 is arranged in a fan guard mode which is in agreement with the intensity of air flow blown off from the propeller fan 15f and corresponds to the blowing-off characteristics of the outdoor blower 15 by lacking and thinning off of the radial slats 95 which are not necessary in strength, thereby the ventilation resistance of the fan guard 90 is reduced and the air blasting characteristics of the outdoor blower 15 are greatly improved, so that heat exchange performance can be greatly improved.

[0078] Note that the number of radial slats 95 described in the column of the fan guard 90 of Table 1 is as described below. That is, the number of radial slats 25 on the outermost periphery La is 32 pieces that is as many as that of the conventional example. However, since ends of the radial slats are lacking on predetermined pitch circles, the number of radial slats 25 is reduced to 16 pieces at some mid point that is half the 16 pieces, and further reduced to 8 pieces in the vicinity of the center that is half the 16 pieces, thereby only 520 pieces in total of the radial slats 25 are necessary. Accordingly, the number of radial slats can be greatly reduced as compared with that of the conventional example.

[0079] FIG. 12 shows a fan guard 99 as a modification of the first embodiment described above. The fan guard 99 is simultaneously provided with two sets of the fan guard 90 explained above in FIG. 11A, and the fan guards 90 confront with each other so that they are disposed symmetrically with respect to an up/down direction.

[0080] The inner structure (not shown) of the fan guards 90 is basically similar to that of the fan guard 20 explained in FIG. 1. Since, however, the fan guard 99 is employed in an outdoor unit of a relatively large air conditioner, two sets of heat exchangers are disposed in confrontation with the upper and lower fan guards or one set of a large outdoor heat exchanger that extends to the upper and lower fan guards is disposed. Further since outdoor fans are disposed in confrontation with the upper and lower fan guards, an operation effect similar to that described above can be obtained.

Industrial Applicability

[0081] As explained above, the present invention is advantageous in the technical field of an air conditioner because the invention achieves such effects that a ventilation area can be increased in an outlet port of a cabinet while increasing the strength of a fan guard attached to the outlet port and that air blasting performance can be greatly improved by suppressing ventilation resistance.

Claims

1. An air conditioner having a heat exchanger and a blower disposed in a cabinet, the blower supplying air to be heat exchanged to the heat exchanger so that the air is heat exchanged, comprising:

an outlet port which is disposed in the cabinet, and guides and discharges heat-exchanged air to the outside after it is supplied to the heat exchanger and heat exchanged therein; and
a fan guard which is attached to the outlet port, and prevents invasion of an object into the inside while securing a ventilation area for the heat-exchanged air,

wherein the fan guard is constituted of a plurality of circular slats disposed concentrically at a predetermined pitch and a plurality of radial slats intersecting the circular slats and disposed radially from the center of the circular slats to the outermost periphery thereof, and

the radial slats are disposed alternately at every concentric pitch on the concentric circles between the circular slats.

2. An air conditioner according to claim 1, wherein the ends of the radial slats which confront the center of the circular slats are lacking at predetermined positions.

3. An air conditioner according to claim 1, wherein the fan guard is molded integrally using a synthetic resin material.

4. An air conditioner according to claim 1, wherein the sectional shape of the circular slats is formed in a substantially flat shape or in a substantially blade shape.

5. An air conditioner according to claim 1, wherein the sectional shape of the radial slats is formed in a substantially

circular shape, in a substantially flat shape, or in a substantially blade shape.

6. An air conditioner having a heat exchanger and a blower disposed in a cabinet, the blower supplying air to be heat exchanged to the heat exchanger so that the air is heat exchanged, comprising:

an outlet port which is disposed in the cabinet, and guides and discharges heat-exchanged air to the outside after it is supplied to the heat exchanger and heat exchanged therein; and
a fan guard which is attached to the outlet port, and prevents invasion of an object into the inside while securing a ventilation area for the heat-exchanged air,

wherein the fan guard is constituted of a plurality of circular slats disposed concentrically at a predetermined pitch and a plurality of radial slats intersecting the circular slats and disposed radially from the center of the circular slats to the outermost periphery thereof, and

the radial slats are disposed on the concentric circles between the circular slats at equally spaced intervals as well as the number of the radial slats being reduced one piece at every one pitch of the concentric circles from the outermost periphery of the circular slats to the center thereof.

7. An air conditioner according to claim 6, wherein the radial slats are constituted of a straight light portion serving as a reference radial slat formed straight from the center of the circular slats to the outermost periphery thereof, parabolic portions formed in a parabolic shape on both the sides of the straight portion, and alternate portions formed alternately on the adjacent concentric circles between the circular slats on both sides of parabolic portions.

8. An air conditioner according to claim 7, wherein a part of the alternate portions is disposed such that radial slats are disposed at increased intervals on the concentric circles of the circular slats.

9. An air conditioner according to claim 6, wherein the fan guard is molded integrally using a synthetic resin material.

10. An air conditioner according to claim 6, wherein the sectional shape of the circular slats is formed in a substantially flat shape or in a substantially blade shape.

11. An air conditioner according to claim 6, wherein the sectional shape of the radial slats is formed in a substantially circular shape, in a substantially flat shape, or in a substantially blade shape.

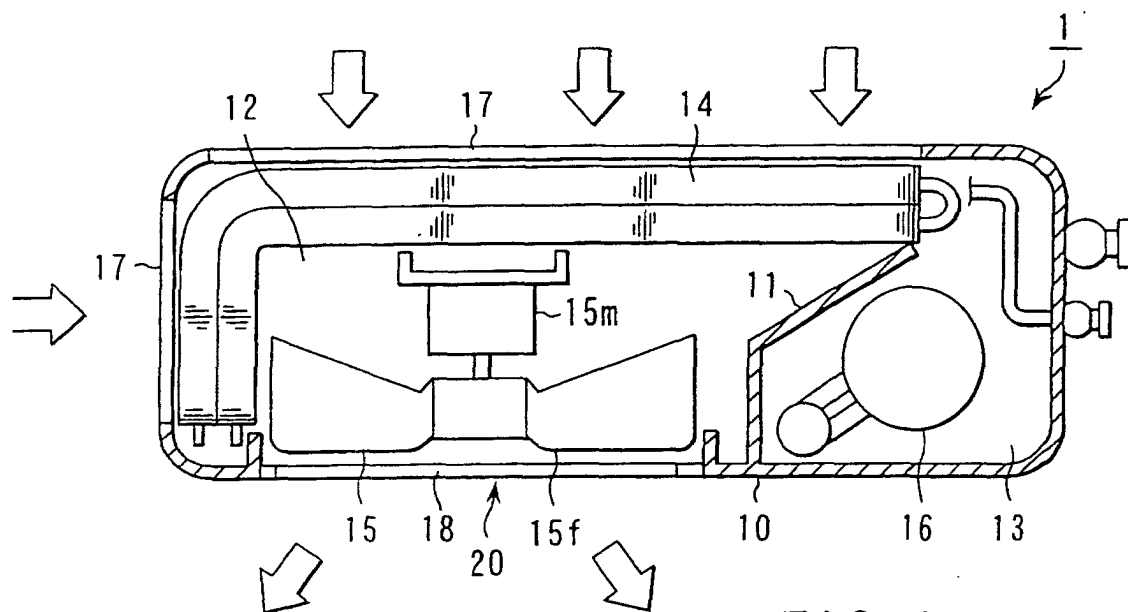


FIG. 1

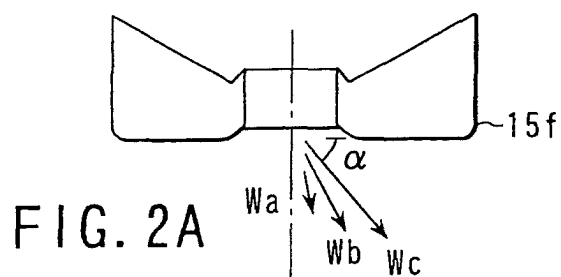


FIG. 2A

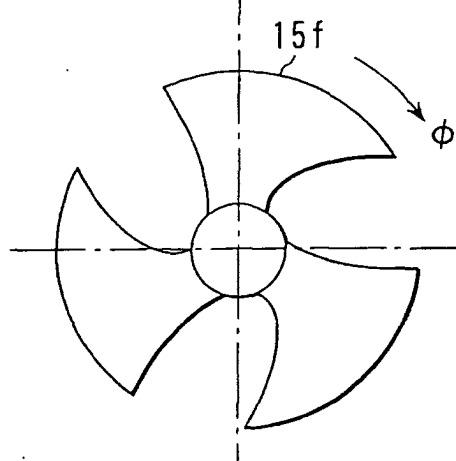


FIG. 2B

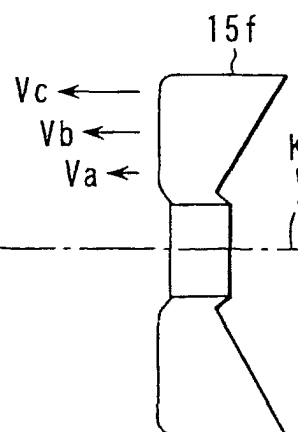


FIG. 2C

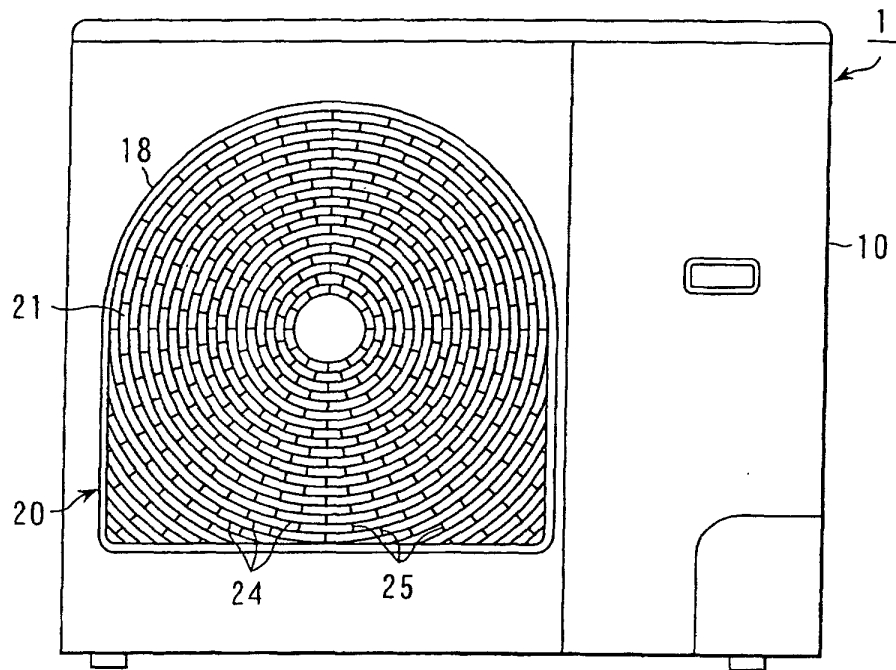


FIG. 3A

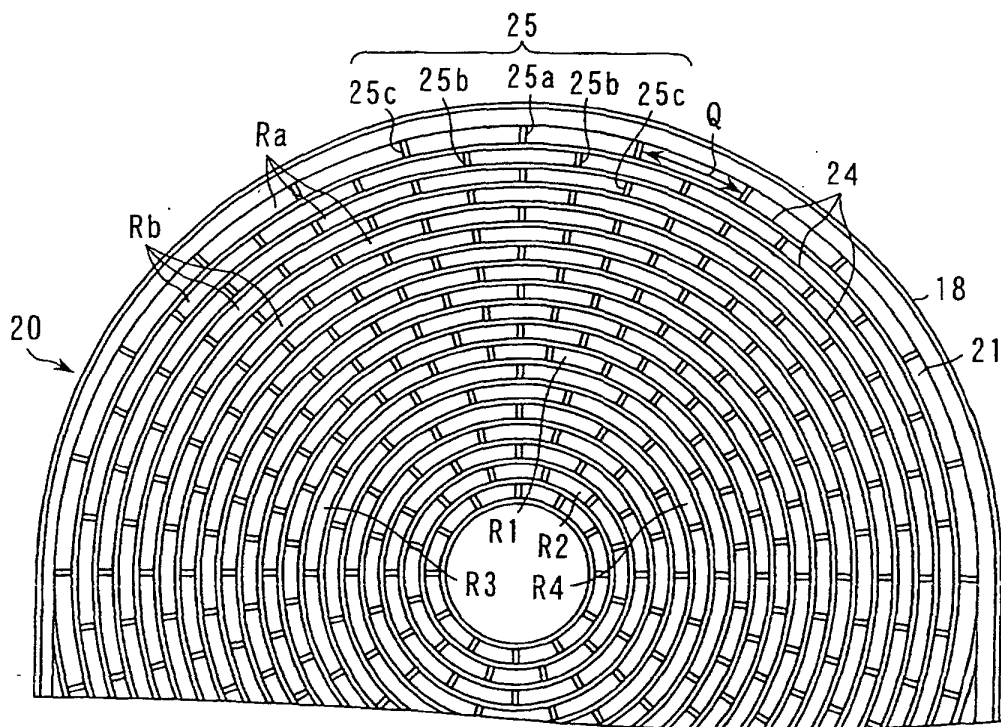


FIG. 3B

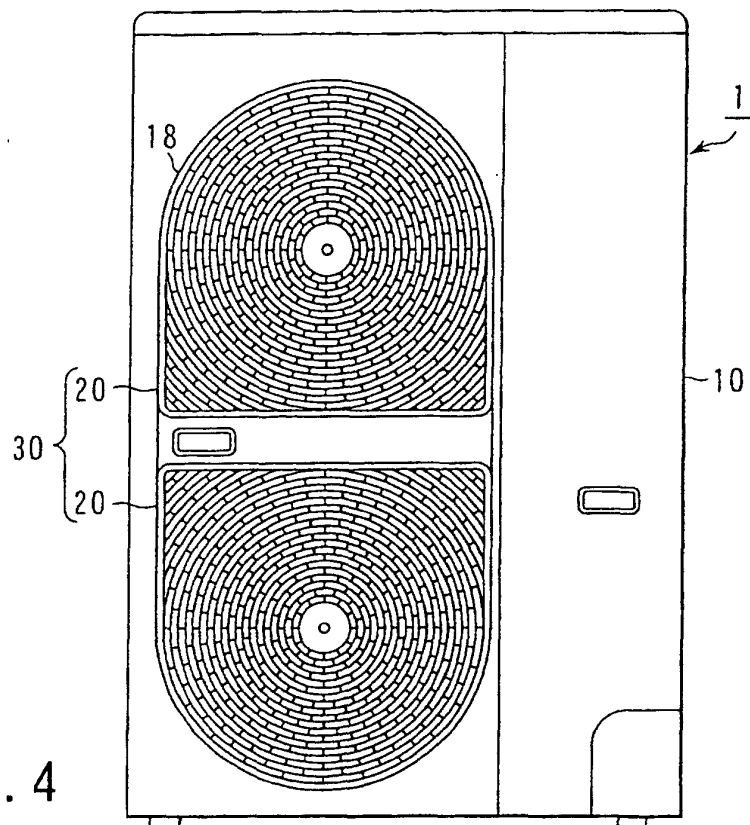


FIG. 4

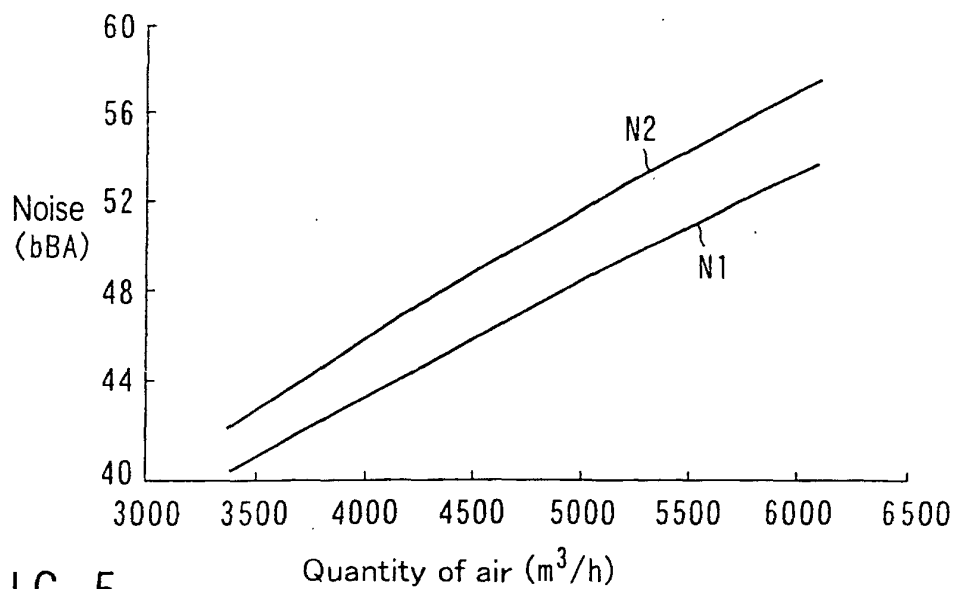


FIG. 5

FIG. 6A

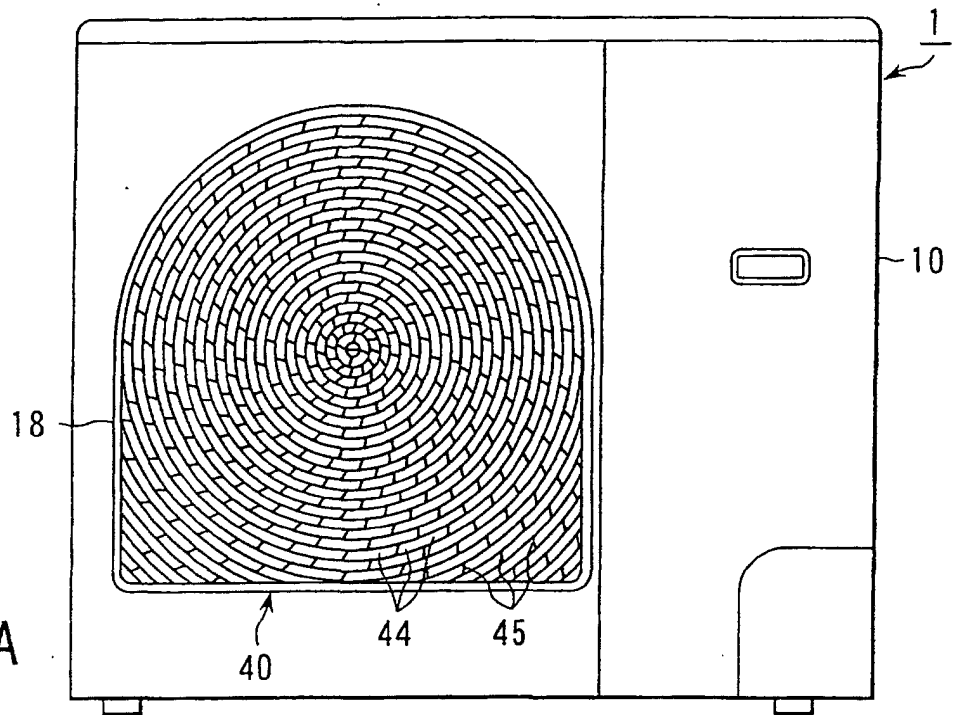
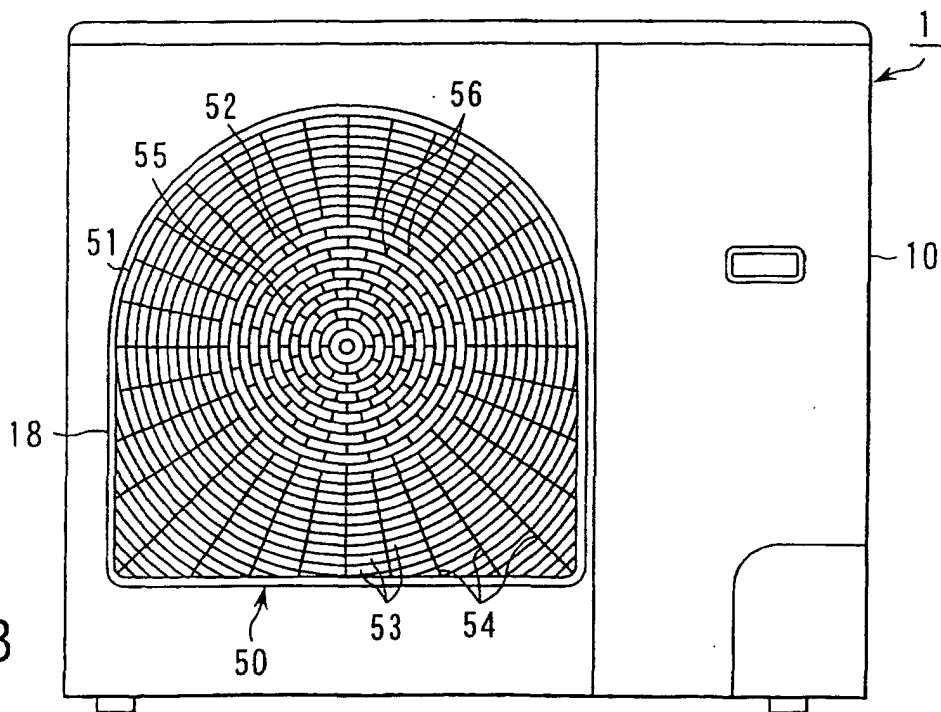
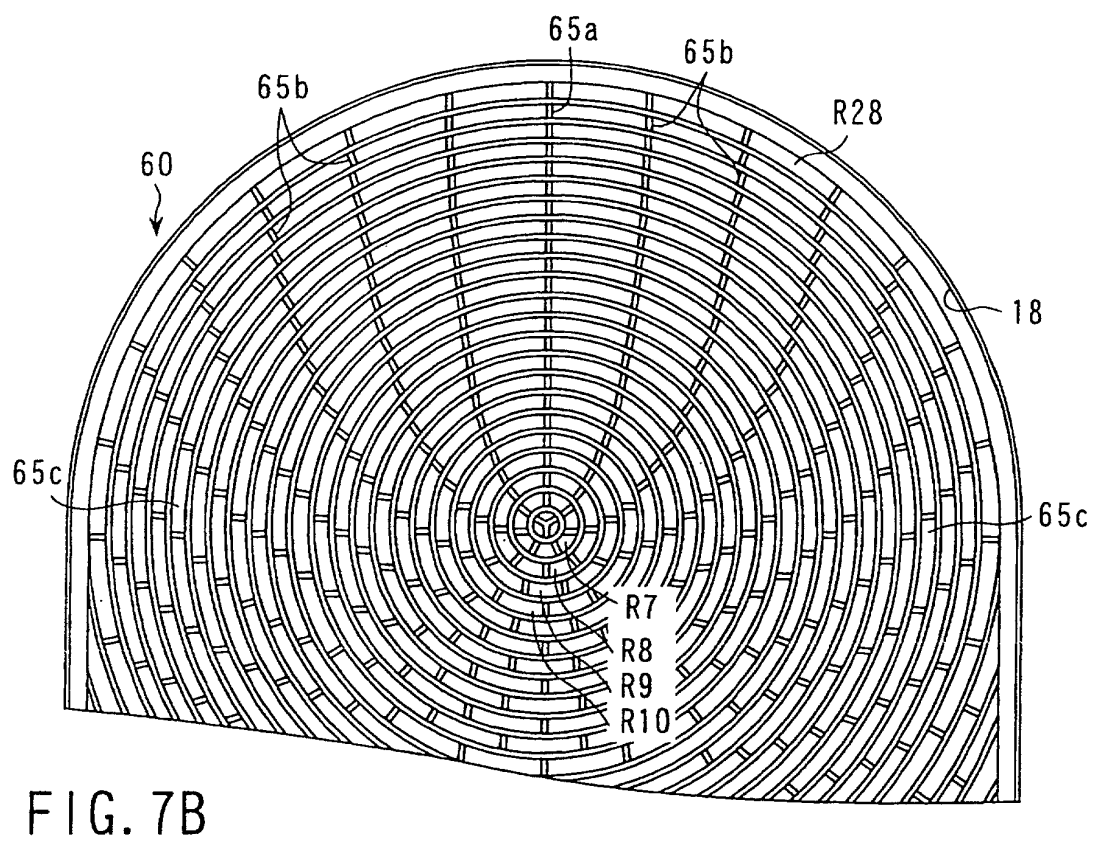
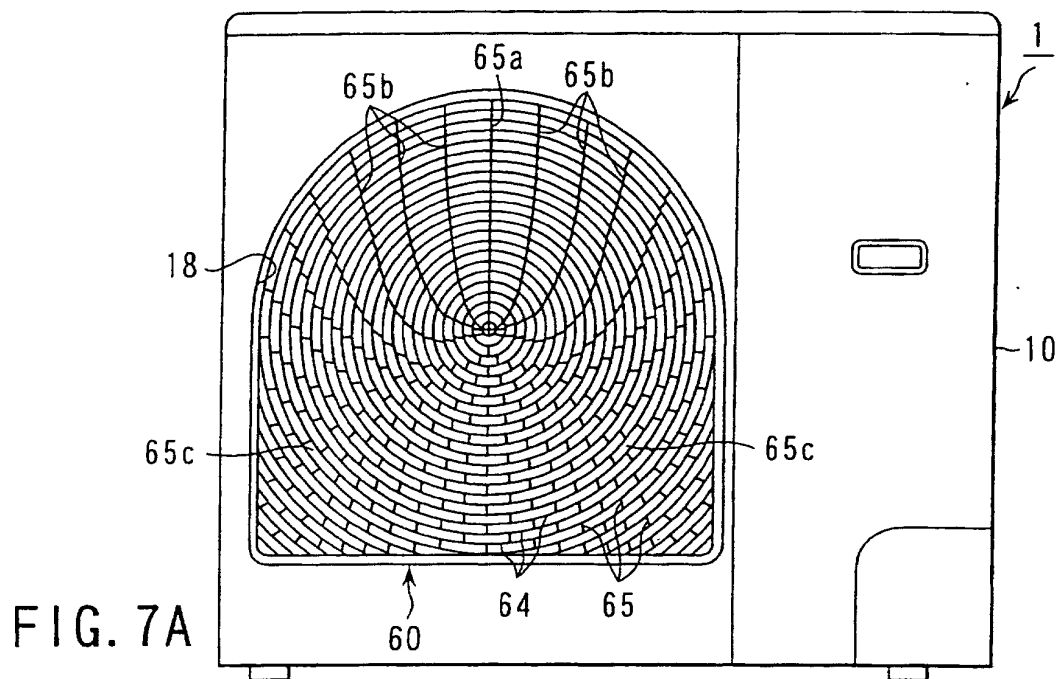


FIG. 6B





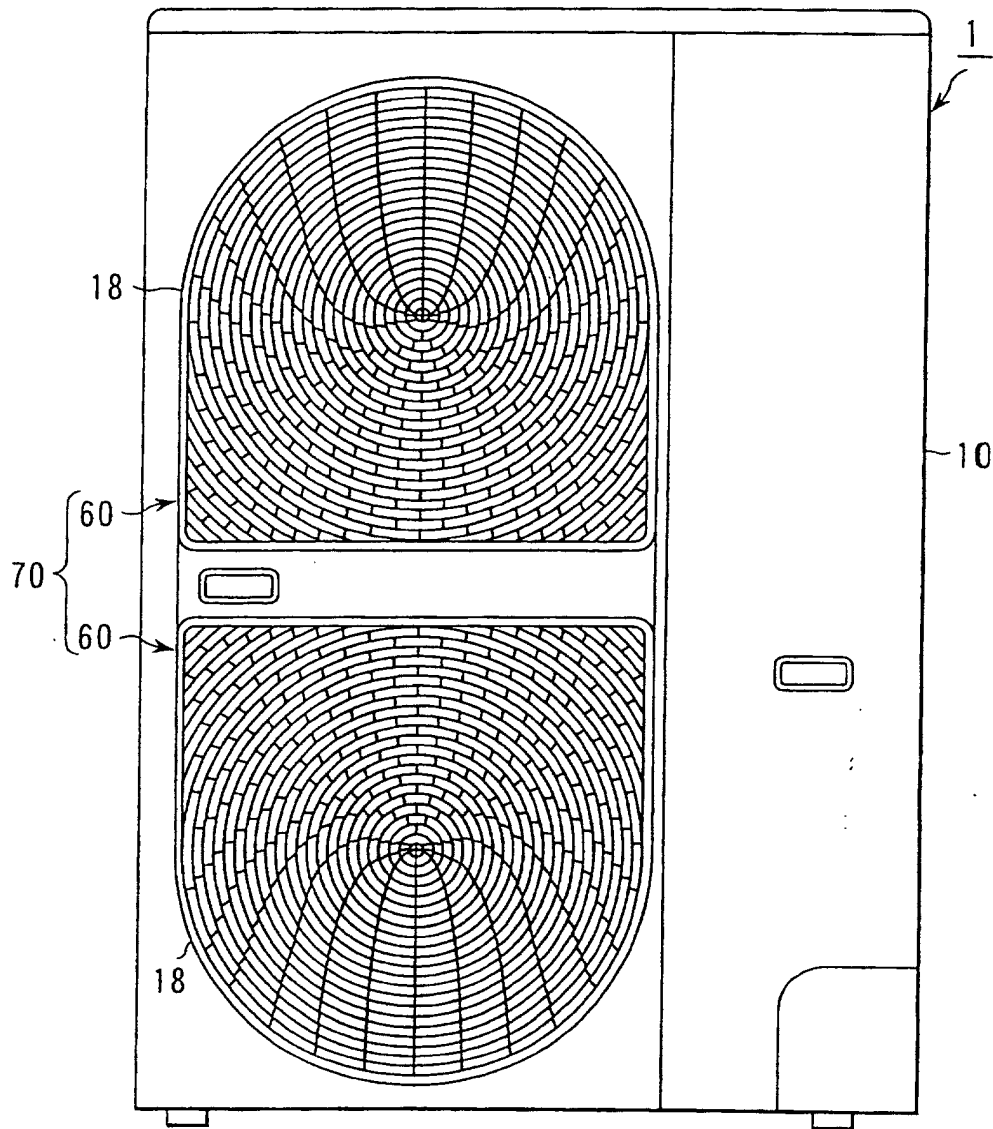


FIG. 8

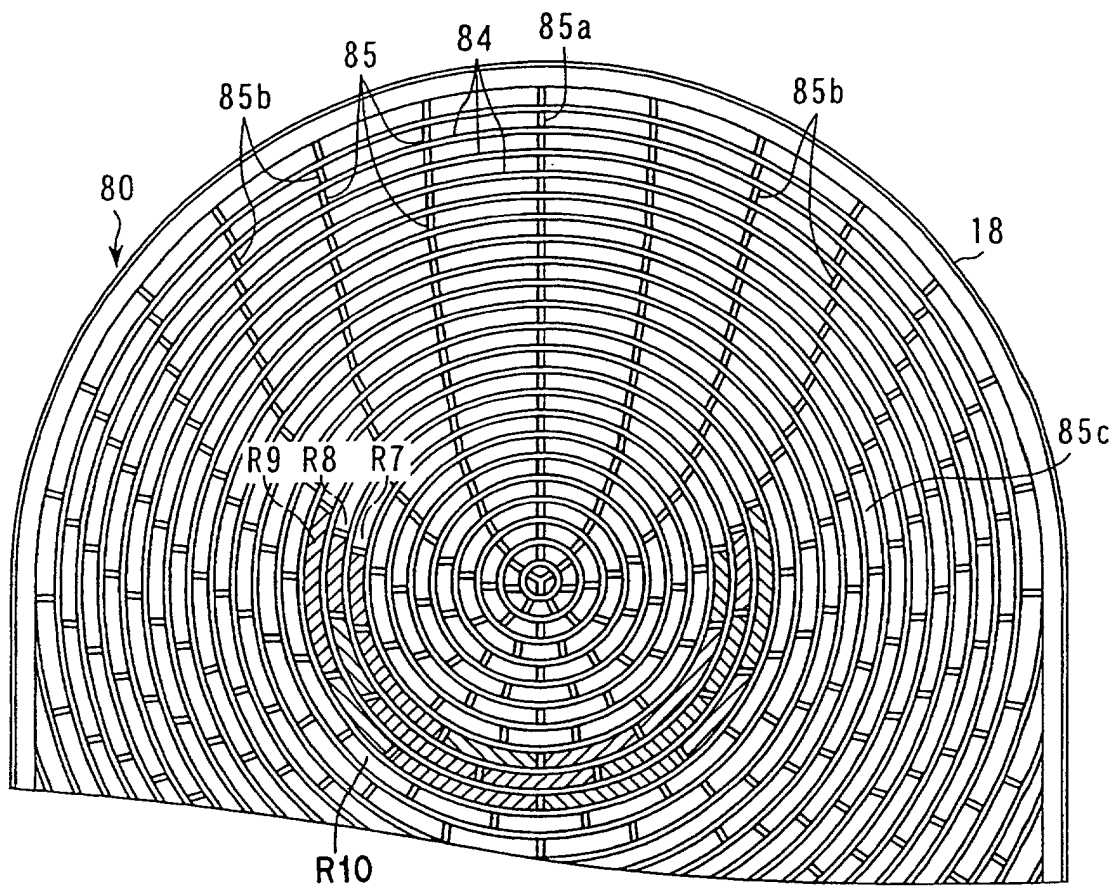


FIG. 9

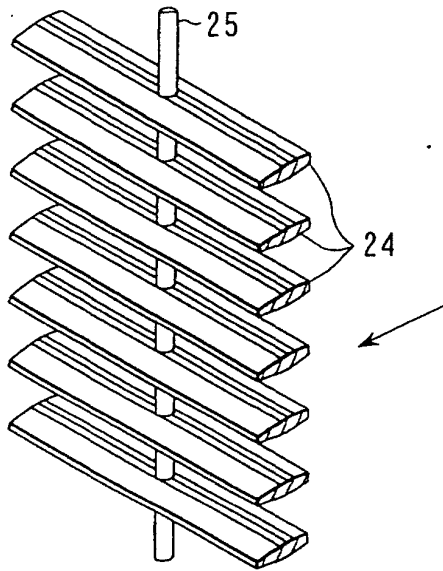


FIG. 10A

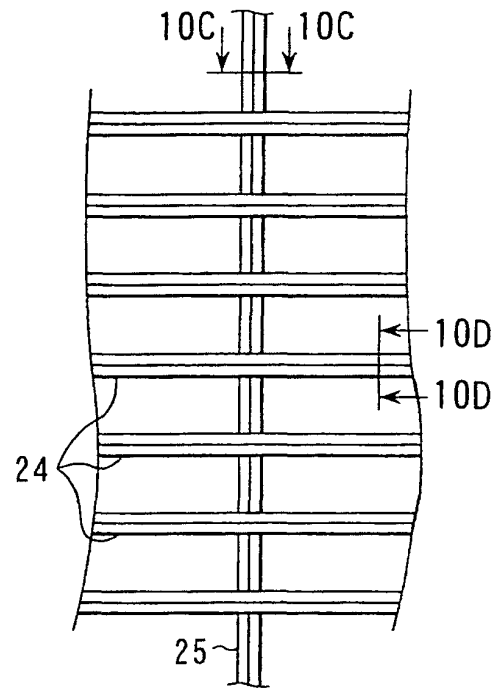


FIG. 10B

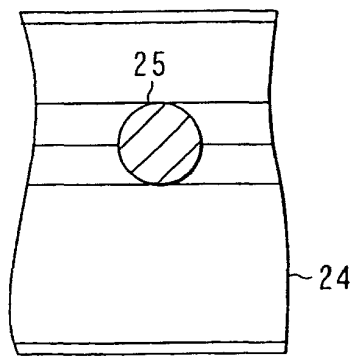


FIG. 10C

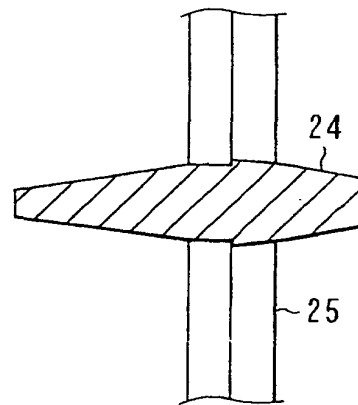
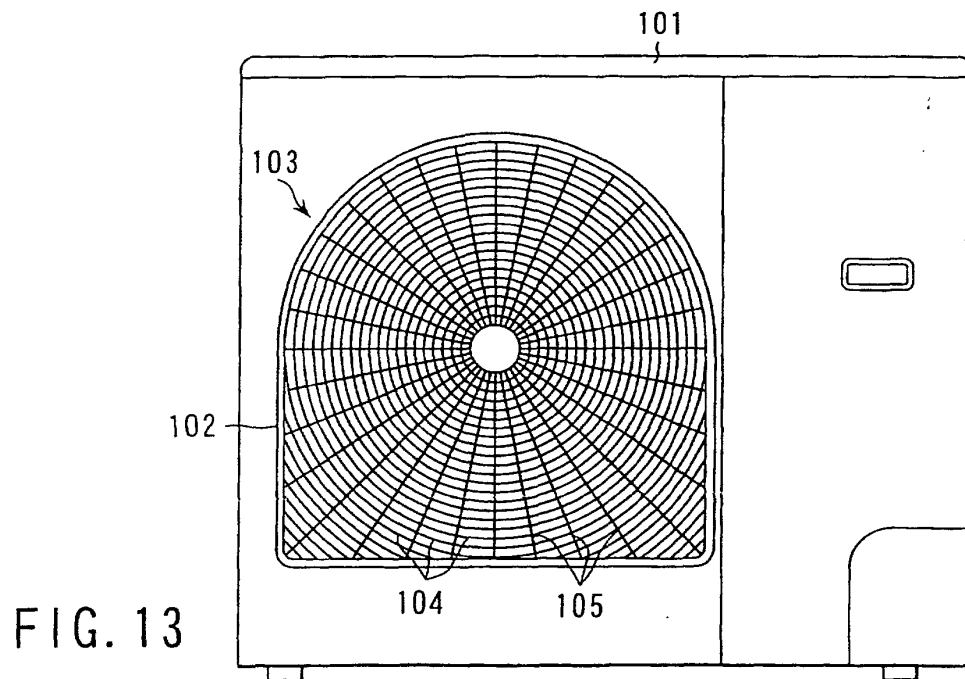
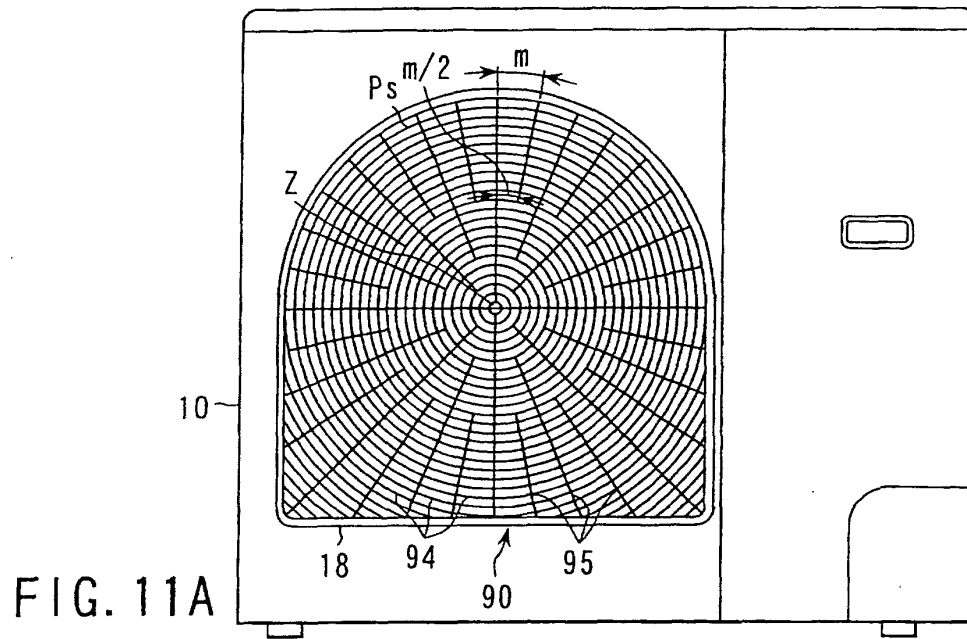


FIG. 10D



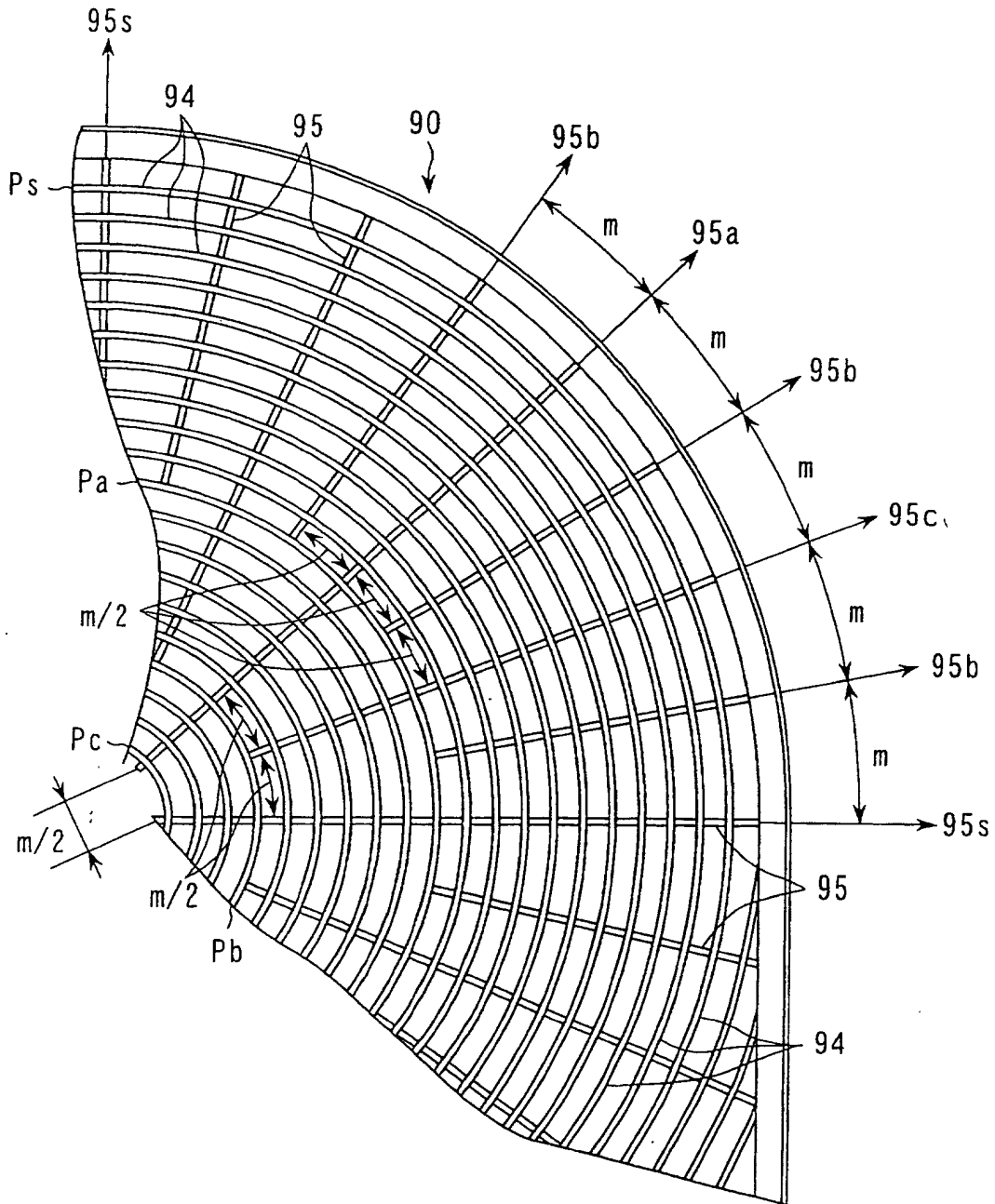


FIG. 11B

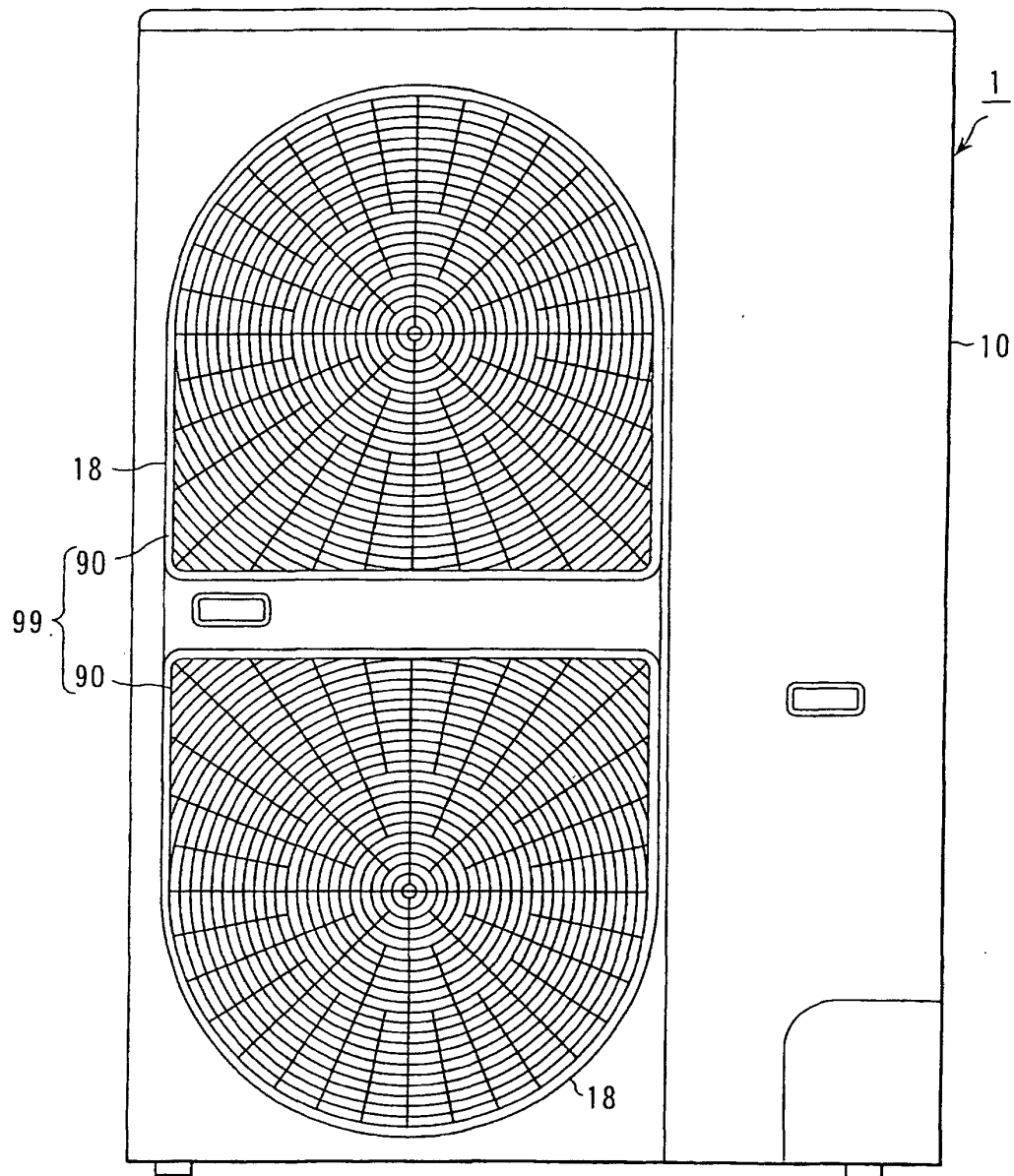


FIG. 12

INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP01/11470

A. CLASSIFICATION OF SUBJECT MATTER Int.Cl ⁷ F24F 5/00		
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 F24F 5/00		
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 1996-2002 Kokai Jitsuyo Shinan Koho 1971-2002 Toroku Jitsuyo Shinan Koho 1994-2002		
Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)		
C. DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	JP 8-247097 A (Toshiba AVE Corporation, Toshiba Corporation), 24 September, 1996 (24.09.1996), page 2, right column, Par. No. [0005] (Family: none)	1-11
Y	JP 11-237083 A (Sanyo Electric Co., Ltd.), 31 August, 1999 (31.08.1999), page 3, left column, Par. No. [0009] (Family: none)	1-11
Y	JP 2000-65418 A (Hitachi, Ltd.), 03 March, 2000 (03.03.2000), page 2, Par. Nos. [0007] to [0010] (Family: none)	4, 5, 10, 11
☐ 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 document 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 25 January, 2002 (25.01.02)		Date of mailing of the international search report 05 February, 2002 (05.02.02)
Name and mailing address of the ISA/ Japanese Patent Office		Authorized officer
Facsimile No.		Telephone No.

Form PCT/ISA/210 (second sheet) (July 1992)