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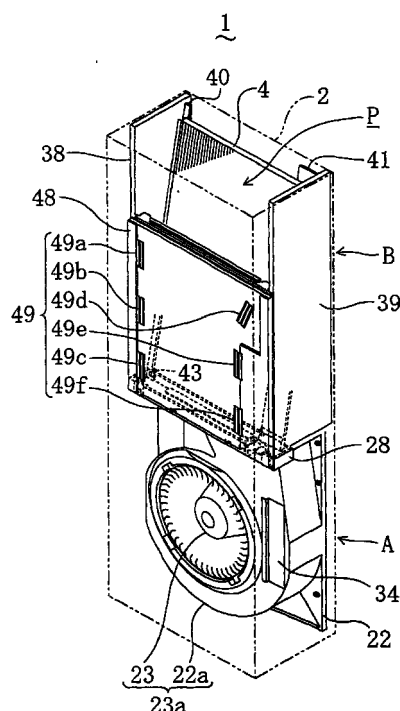
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(54) **AIR CONDITIONING UNIT**

(57) A digital broadcasting receiver is provided which can reproduce a carrier quickly and capture a desired signal at high speed. A carrier reproduction phase error detection circuit (6) detects a phase error voltage in accordance with a demodulation output obtained by demodulating a demodulated wave of a modulated wave during a predetermined section in a header section. A peak number calculation circuit (92) calculates an error frequency between a desired reception frequency and a reproduction carrier frequency in accordance with the phase error voltage. A differential coefficient calculation circuit (94) calculates the polarity of the error frequency. A step frequency control circuit (96) converts the calculated error frequency having the calculated polarity into a step frequency width for automatic frequency control. The reproduction carrier frequency is scanned at the converted step frequency width until a frame sync is established after the frame sync is detected. It is therefore possible to reproduce the carrier quickly and capture the desired signal at high speed.

Fig. 1



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Description

Technical Field

[0001] The present invention relates to an air conditioning unit.

Background Art

[0002] A so-called floorstanding air conditioning unit (hereinafter referred to as A floorstanding unit) has been used conventionally and frequently mainly as a package air conditioner or the like. As shown in Figure 19, a floorstanding unit (100) is composed of a fan (103) and a heat exchanger (104) held in a unit casing (102) configured as a vertically extended rectangular parallel-piped. The air conditioning unit (100) sucks in room air from an air suction port (106) formed in a lower portion of the front face of the casing (102), heats or cools the sucked air in the heat exchanger (104), and discharges the air from an air discharge port (101) formed in an upper portion of the front face of the casing (102), thereby conditioning the room air.

[0003] To prevent heat dissipation from a surface of the casing (102) of the conventional floorstanding unit (100), a sponge-like heat insulating material (111) has been laminated to an inner surface of the casing (102) via sealing materials (108) each composed of a double-coated tape or the like. In addition, a partition plate (105) partitioning the inner space of the casing (102) to define an air passage is provided anterior to the heat exchanger (104) to prevent the leakage of conditioned air from the casing (102) or for like purpose. A heat insulating material has also been laminated to the partition plate (105) via a sealing material to thermally insulate the conditioned air.

[0004] In the floorstanding unit (100), however, the air passage extending from the air suction port (106) to the air discharge port (101) via the fan (103) is formed primarily of steel plates. Accordingly, the problem is encountered that assembling and joining operations require time and labor.

[0005] Because of a large number of portions to be sealed, heat insulating materials should be provided separately. Since a large number of sealing materials and heat insulating materials are required, the unit has a large number of components, which leads to higher cost. Moreover, it has not been easy to recycle the foregoing structure in which the heat insulating materials are laminated via the sealing materials, though recycling has become an important issue in recent years.

[0006] The present invention has been achieved in view of the foregoing. It is therefore an object of the present invention to improve the assemblability and recyclability of an air conditioning unit.

Disclosure of Invention

[0007] To attain the foregoing object, the present invention has reduced the number of components of an air conditioning unit by effectively using a styrofoam material and causing molded styrofoam products to function as a heat insulating material and a structural material. The present invention has also facilitated assembling and disassembling operations for the unit by providing a structure in which the molded styrofoam products are interengaged.

[0008] Specifically, the present invention is an air conditioning unit comprising: a unit casing (2) disposed in a standing position on a floor surface, a front face of the unit casing (2) having an air suction port (73) and an air discharge port (74) formed in lower and upper sides thereof, respectively; a fan (23a) having a fan housing (22a) and an impeller (23), the fan housing (22a) being held in a lower portion of the unit casing (2) and having a volute portion (32) formed with a suction hole (29) opposing the air suction port (73) and a diffuser portion (33) adapted to upwardly discharge air, the impeller (23) being held in the volute portion (32) of the fan housing (22a); and a heat exchanger (4) disposed above the fan (23a) in the unit casing (2), at least a part of a peripheral wall of an air passage extending from the air suction port (73) to the air discharge port (74) in the unit casing (2) being formed of styrofoam (22, 38, 39, 48).

[0009] Since the present invention has thus formed a part of the peripheral wall of the air passage out of the styrofoam (38, 39, 48), a thermally insulated air passage can be formed easily at low cost.

[0010] In the air conditioning unit, a left heat insulating plate (38) and a right heat insulating plate (39) each formed of the styrofoam may be provided between left and right side faces of the heat exchanger (4) and left and right side faces of the unit casing (2), respectively.

[0011] In the arrangement, the left and right side faces of the heat exchanger (4) and the left and right side faces of the unit casing (2) are thermally insulated from each other by the left and right heat insulating plates (38) and (39) each formed of the styrofoam. This saves the labor of laminating heat insulating materials to the left and right side faces of the unit casing (2) via sealing materials.

[0012] The left and right heat insulating plates (38) and (39) may be fitted securely in the partition plate (48) or unit casing (2). The left and right heat insulating plates (38) and (39) which are fitted securely in the partition plate (48) or unit casing (2) obviate the necessity for the sealing materials and reduces the number of components. Therefore, assemblability and recyclability is improved.

[0013] A sheet metal (43) for supporting a bottom portion of the heat exchanger (4) may be inserted in a lower portion of each of the left and right heat insulating plates (38) and (39).

[0014] In the arrangement, the heat exchanger (4)

is supported by the metal sheets (43) inserted in the respective lower portions of the left and right heat insulating plates (38) and (39). This allows a fixing member for supporting the heat exchanger (4) to be formed integrally with the both heat insulating plates (38), (39) and reduces the number of components.

[0015] The air conditioning unit may further comprise: support pieces (40, 41) for supporting side edge portions of the heat exchanger (4) being tilted in a front-to-rear direction, the support pieces (40, 41) being formed integrally with the corresponding heat insulating plates (38, 39) to protrude inwardly from respective inner faces of the left and right heat insulating plates (38) and (39) and extend in a direction tilted from a perpendicular direction.

[0016] In the arrangement, the side edge portions of the heat exchanger (4) are supported by the support pieces (40), (41) of the both heat insulating plates (38) and (39), whereby the heat exchanger (4) is supported by the both heat insulating plates (38), (39). Since the support pieces (40),(41) are formed integrally with the both heat insulating plates (38) ,(39), it is unnecessary to separately provide a member for supporting the heat exchanger (4). This reduces the number of components and improves assemblability and recyclability.

[0017] The fan housing (22a) may comprise: a main body portion (22) covering a front side of the impeller (23); and a mounting board (25) secured to the main body portion (22) in such a manner as to hold the impeller (23) in a space between the mounting board (25) and the main body portion (22), the main body portion (22) being molded in one piece of the styrofoam.

[0018] In the arrangement, the main body portion (22) of the fan housing (22a) is molded integrally of the styrofoam and the main body portion (22) of the fan housing (22a) can be composed of a single member. This reduces the number of components and improves assemblability and recyclability.

[0019] An upper portion of the main body portion (22) of the fan housing (22a) may be provided with a drain pan (28) molded integrally with the main body portion (22).

[0020] In the arrangement, the drain pan (28) is molded integrally with the main body portion (22) of the fan housing (22a) so that it is no more necessary to separately form the drain pan (28) and join the formed drain pan (28) with other portions. This reduces the number of components and improves assemblability and recyclability.

[0021] The air conditioning unit may further comprise: a left heat insulating plate (38) and a right heat insulating plate (39) each formed of the styrofoam, the left and right heat insulating plates (38) and (39) being disposed between left and right side faces of the heat exchanger (4) and left and side faces of the unit casing (2), respectively; and a partition plate (48) molded in one piece of the styrofoam, the partition plate (48) being disposed between the heat exchanger (4) and the front

face (62) of the unit casing (2), the main body portion (22) of the fan housing (22a) and the drain pan (28) being formed of the styrofoam having an expansion ratio lower than an expansion ratio of the styrofoam composing the left and right heat insulating plates (38) and (39) and the partition plate (48).

[0022] In the arrangement, the styrofoam having a higher expansion ratio than the styrofoam forming the drain pan (28) is used to form the left or right heat insulating plate (38), (39) or the partition plate (48) which presents no problem even if it has water permeability. This provides a unit at lower cost.

[0023] A pipe pressing plate (34) for fixing a pipe of the heat exchanger (4) may be inserted in a front face of the main body portion (22) of the fan housing (22a).

[0024] In the arrangement, the pipe of the heat exchanger (4) is fixed by the pipe pressing plate (34) inserted in the main body portion (22) of the fan housing (22a). This obviates the necessity to separately provide an additional member for fixing the pipe and reduces the number of components.

[0025] A groove (36) for permitting a pipe of the heat exchanger (4) to vertically extend therethrough may be formed in the drain pan (28).

[0026] In the arrangement, the pipe of the heat exchanger (4) is inserted through the groove (36) formed in the drain pan (28) so that a piping operation in the unit casing (2) is performed easily.

[0027] In the air conditioning unit, a partition plate (48) molded in one piece of the styrofoam may be disposed between the heat exchanger (4) and the front face (62) of the unit casing (2).

[0028] In the arrangement, the partition plate (48) is formed of the styrofoam. This obviates the necessity to separately provide a heat insulating material on the partition plate (48) and reduces the number of components. Moreover, assemblability and recyclability is improved.

[0029] A front face of the partition plate (48) may have projecting and depressed portions (49) each for fixing a wire held therebetween, the projecting and depressed portions (49) being molded integrally with the partition plate (48).

[0030] In the arrangement, the wire of electric equipment or the like is fixed by the depressed and projecting portions (49) formed integrally with the partition plate (48). This obviates the necessity to separately provide a member for fixing the wire and reduces the number of components.

[0031] A partition plate (48) molded in one piece of the styrofoam may be disposed between the heat exchanger (4) and the front face (62) of the unit casing (2), a projecting portion (58) may be formed on either one of a left edge portion of the partition plate (48) and a front edge portion of the left heat insulating plate (38), while a depressed portion (67) is formed in the other thereof, the partition plate (48) and the left heat insulating plate (35) being assembled with the projecting portion (58) fitted in the depressed portion (67), and the

projecting portion (58) may be formed on either one of a right edge portion of the partition plate (48) and a front edge portion of the right heat insulating plate (39), while the depressed portion (67) is formed in the other thereof, the partition plate (48) and the right heat insulating plate (39) being assembled with the projecting portion (58) fitted in the depressed portion (67).

[0032] In the arrangement, the partition plate (48) and the left and right heat insulating plates (38), (39) are assembled with the projecting portion fitted in the depressed portion. This obviates the necessity for a fixing member for assembly and reduces the number of components. Moreover, an assembling operation becomes easy.

[0033] A partition plate (48) molded in one piece of the styrofoam may be disposed between the heat exchanger (4) and the front face (62) of the unit casing (2) and each of upper and lower portions of the partition plate (48) may be formed with a fitting portion (57) composed of a depressed or projecting portion to be engaged with a receiving portion (71) of the unit casing (2) which is composed of a depressed or projecting portion, the partition plate (48) being assembled with the fitting portion (57) engaged with the receiving portion (71).

[0034] In the arrangement, the partition plate (48) is assembled with the fitting portion fitted in the receiving portion of the unit casing (2). This obviates the necessity for a fixing member for assembly and reduces the number of components. Moreover, an assembling operation becomes easy.

Brief Description of Drawings

[0035]

Figure 1 is a perspective view of an air conditioning unit;

Figure 2 is an exploded perspective view of a part of a unit casing;

Figure 3 is a perspective view of a mounting portion of the unit casing;

Figure 4 is an exploded perspective view of a blowing portion;

Figure 5 is a front view of a fan housing;

Figure 6 is a rear view of the fan housing;

Figure 7 is a right side view of the fan housing;

Figure 8 is an exploded perspective view of a heat exchanging portion;

Figure 9 is a front view of a left heat insulating plate;

Figure 10 is a top view of the left heat insulating plate;

Figure 11 is a front view of a partition plate;

Figure 12 is a cross-sectional view of a wire groove;

Figure 13 is a rear view of the partition plate;

Figure 14 is a side view of the partition plate;

Figure 15 is a bottom view of the partition plate;

Figure 16 is an exploded perspective view of the

front face of the unit casing;

Figure 17 is a transverse cross-sectional view of the air conditioning unit;

Figure 18 is a vertical cross-sectional view of the air conditioning unit; and

Figure 19 is a perspective view of a conventional air conditioning unit.

Best Mode for Carrying Out the Invention

[0036] Referring now to the drawings, the embodiments of the present invention will be described.

EMBODIMENT 1

[0037] As shown in Figure 1, an air conditioning unit (1) according to an embodiment of the present invention is a so-called floorstanding indoor unit which is connected to an outdoor unit (not shown) via a coolant pipe (not shown). In a unit casing (2) configured as a vertically extended generally rectangular parallelepiped, there are held an impeller (23) of a multi-vane fan (23a), a plate-fin-tube heat exchanger (4), a main body portion (22) of a fan housing (22a), a left heat insulating plate (38), a right heat insulating plate (39), a partition plate (48), and the like. In the unit casing (2), a blowing portion (A) and a heat exchanging portion (B) are formed upwardly in this order. An air passage is defined to extend from an air suction port (73) to an air discharge port (74) (see Figure 16). An insulated air passage (P) thermally insulated from the ambient is particularly defined between the heat exchanger (4) and the air discharge port (74) since conditioned air which has been either heated or cooled by the heat exchanger (4) passes therebetween.

[0038] As shown in Figure 2, the rear face, left side face, right side face, top face, and bottom face of the unit casing (2) are formed of a rear panel (10), a left side panel (11), a right side panel (12), a top panel (13), and a bottom panel (14), respectively. As shown in Figure 3, the edge portions of the rear panel (10) and the left and right panels (11) and (12) which extend vertically are formed with respective abutment surfaces (16) each having a generally L-shaped horizontal cross section. Each of the abutment surfaces (16) is formed with a plurality of screw holes (17) which are aligned vertically with a specified pitch. A screw (15) is inserted through each of the screw holes (17) with the respective abutment surfaces (16) of the rear panel (10) and the both side panels (11) and (12) in abutment with each other, thereby securing the rear panel (10) to the both side panels (11) and (12). Likewise, the rear panel (10) is screwed to each of the top panel (13) and the bottom panel (14). Pipe through holes (37) which permit a coolant pipe (not shown) connected to the heat exchanger (4) to pass therethrough are formed in the lower portions of the rear panel (10) and the left and right panels (11) and (12). By permitting the coolant pipe to pass

through any of the pipe through holes (37) depending on the place where the air conditioning unit (1) is installed, placement flexibility and ease of installation is increased.

[0039] As shown in Figure 4, a fan motor (24) is mounted on a mounting board (25) secured to the rear panel (10). A receiving groove (27) for receiving a motor lead wire (not shown) is formed centrally in the lower side of the mounting board (25) to extend vertically. A pressing plate (26) for covering the receiving groove (27) with the motor lead wire held in the receiving groove (27) is mounted on the mounting board (25) from the front side thereof. The impeller (23) of the multi-vane fan (23a) is coupled to the rotation axis of the fan motor (24). The impeller (23) is formed of a synthetic resin material.

[0040] The main body portion (22) of the fan housing (22a), which is a characteristic of the present embodiment, is secured to the mounting board (25) by using push nut pins made of a resin in such a manner as to cover the periphery of the impeller (23) from the front side thereof. The main body portion (22) may also be secured to the mounting board (25) by using a hook-and-loop fastener. Thus, the impeller (23) is held in the space defined by the main body portion (22) of the fan housing (22a) and the mounting board (25). The main body portion (22) of the fan housing (22a) is formed of styrofoam (foam polystyrene) having an expansion ratio of about 1:15. As shown in Figures 5 to 7, the main body portion (22) of the fan housing (22a) comprises a basal portion (31) abutting the mounting board (25) and a volute portion (32) protruding forwardly from the basal portion (31) to cover the impeller (23). A circular suction hole (29) opposing the air suction port (73) is formed centrally in the front face of the volute portion (32). A diffuser portion (33) for upwardly guiding the air sucked in from the suction hole (29) is formed above the suction hole (29) of the volute portion (32).

[0041] As shown in Figures 4 and 7, a drain pan (28) slightly protruding forward from the volute portion (32) is provided on the upper end of the volute portion (32). The present embodiment is characterized in that the drain pan (28) and the main body portion (22) of the fan housing (22a) are molded integrally. That is, the drain pan (28) and the main body portion (22) of the fan housing (22a) are formed in one piece. Accordingly, the drain pan (28) is also formed of styrofoam having an expansion ratio of about 1:15. To thoroughly recover a drain from the heat exchanger (4), the drain pan (28) extends over the entire region in the lateral direction of the heat exchanger (4), i.e. over the entire region in the lateral direction of the main body portion (22) of the fan housing (22a). A through groove (36) which permits the coolant pipe (not shown) connected to the heat exchanger (4) to vertically extend therethrough is formed in a right end portion of the front side of the drain pan (28). The through groove (36) is composed of two large and small grooves (36a) and (36b) each having a

semicircular horizontal cross section.

[0042] A first pipe pressing plate (34) is inserted in the right side of the front face of the volute portion (32) of the main body portion (22) of the fan housing (22a). A second pipe pressing plate (35) having a generally L-shaped horizontal cross section is disposed anterior and in opposing relation to the first pipe pressing plate (34). The coolant pipe (not shown) is held in the space between the first and second pipe pressing plates (34) and (35) to extend vertically through the through hole (36). As shown in Figure 4, a bellmouth (21) is fitted in the peripheral portion of the suction hole (29) of the main body portion (22) of the fan housing (22a) from the front side thereof.

[0043] As shown in Figure 8, the heat insulating plates (38), (39) which are a characteristic of the present embodiment are provided on the both sides of the heat exchanger (4). The heat insulating plates (38), (39) thermally insulate the air that has passed through the heat exchanger (4) and heated or cooled therein from air outside the air conditioning unit (1), prevent vapor condensation on a front panel (62) (see Figure 16), and support the heat exchanger (4), while sealing the heat exchanger (4). Although the left and right heat insulating plates (38) and (39) are formed to have roughly the same configuration, their support pieces (40), (41) for supporting the side portions of the heat exchanger (4) are different in size. Specifically, the support piece (40) of the left heat insulating plate (38) is formed to have a horizontal length (protrusion length) shorter than that of the support piece (41) of the right heat insulating plate (39). The both heat insulating plates (38), (39) are formed of styrofoam plates each having an expansion ratio of about 1:25. In the present embodiment, a description will be given only to the structure of the left heat insulating plate (38) with reference to Figures 9 and 10, while omitting the detailed description of the right heat insulating plate (39).

[0044] The left heat insulating plate (38) comprises a flat panel portion (42) having a vertically extended generally rectangular configuration and the support piece (40) protruding from the flat panel portion (42) toward the heat exchanger (4), i.e., inwardly of the unit casing (2). The flat panel portion (42) and the support piece (40) are formed in one piece. That is, the flat panel portion (42) and the support piece (40) are molded integrally. The support piece (40) is tilted rearwardly from the lower side of the flat panel portion (42) toward the upper side thereof so as to support the heat exchanger (4) in a rearwardly tilted position. The front side of the support piece (40) is configured as a flat surface to securely fix the heat exchanger (4). A metal sheet (43) for fixing a heat exchanger mounting board (44), which is generally configured as a flat panel, is made of iron and inserted in the lower portion of the support piece (40) of the left heat insulating plate (38). The heat exchanger mounting board (44) is screwed to the metal sheets (43), (43) inserted in the respective

heat insulating plates (38), (39) to support the bottom portion of the heat exchanger (4). It follows therefore that the two heat insulating plates (38), (39) support the heat exchanger (4) via the metal sheets (43) and the heat exchanger mounting board (44).

[0045] The heat exchanger (4) is composed of a pair of plate-fin-tube heat exchangers (4a), (4b) disposed in upper and lower positions. A draining plate (45) for receiving a drain from the upper heat exchanger (4a) and discharging the received drain from a side thereof into the drain pan (28) is disposed between the pair of heat exchangers (4a), (4b). A pipe cover (46) covering the coolant pipe (not shown) connected to the heat exchanger (4) is provided on the right side of the heat exchanger (4), i.e., anterior to the support piece (41) of the right heat insulating plate (39). The upper portion of the upper heat exchanger (4a) is secured to the heat exchanger mounting board (47).

[0046] A switch box (50) for accommodating electric equipment (not shown) such as a control circuit is provided below the heat exchanger (4). The front side of the switch box (50) is covered with a switch box lid (51). The switch box lid (51) is securely screwed to the switch box (50). A wire hole (52) for guiding the wire of the electric equipment (not shown) to the outside of the switch box (50) is formed in the upper right portion of the switch box lid (51).

[0047] A partition plate (48) for thermally insulating the air that has passed through the heat exchanger (4) and partitioning the inner space of the casing (2) to define the insulated air passage (P) is provided anterior to the heat exchanger (4) (specifically, between the heat exchanger (4) and the front panel (62)). As shown in Figures 11 to 15, the partition plate (48) is formed of a styrofoam plate having a generally plate-like configuration and an expansion ratio of about 1:25. The front face of the partition plate (48) is provided with six wire grooves (49a) to (49f). The wire grooves (49a) to (49f) are grooves for fixing the wires of the electric equipment accommodated in the switch box (50) which have been fitted therein. Specifically, wire grooves (49) are composed of the three wire grooves (49a) to (49c) arranged in a vertical line on the left side of the front face of the partition plate (48) and the three wire grooves (49d) to (49f) arranged vertically on the right side of the front face of the partition plate (48). The wire groove (49d) in the upper right position is formed to be inclined upwardly to the right. As shown in Figure 12, each of the wire grooves (49) is composed of a depressed portion (54) formed between left and right projecting portions (53a), (53b) such that a wire is fitted from above in the depressed portion (54). The wire grooves (49a) to (49f) are molded integrally in the partition plate (48).

[0048] A through groove (55) which permits the wire of the heat exchanger (4) to extend therethrough is formed in the back face of the partition plate (48). The through groove (55) defines a through hole having a circular cross section in combination with the through

groove (36) of the main body portion (22) of the fan housing (22a) (specifically, the drain pan (28)), which is for permitting the wire to extend therethrough. That is, the lower portion of the back face of the partition plate (48) abuts the front face (72) of the drain pan (28) during assembly and the two half-split grooves of each of the through grooves (55) and (36) are combined with each other to compose the through hole having a circular cross section.

[0049] As shown in Figure 14, a projecting portion (57) for the fitting of the partition plate (48) in a discharge grille (56) is formed on the upper portion of the partition plate (48) to extend in the lateral direction. A projecting portion (59) for causing the partition plate (48) to abut the front face of the drain pan (28) and fixing the partition plate (48) thereto is formed on the lower portion of the partition plate (48) to extend in the lateral direction. As shown in Figure 17, projecting portions (58), (58) for the fitting of the partition plate (48) in the left and right heat insulating plates (38), (39) are formed on the left and right end portions of the partition plate (48) to protrude rearwardly and extend vertically.

[0050] As shown in Figure 16, a suction grille (60), the front panel (62), and the discharge grill (56) are formed upwardly in this order on the front face of the unit casing (2). The suction grille (60) formed with the air suction port (73) is provided anterior to the blowing portion (A). An air filter (61) is provided posterior to the suction grille (60). The front panel (62) is disposed above the suction grille (60) and anterior to the partition plate (48). A control panel (63) is provided on the front face of the front panel (62). A first heat insulating frame (64) is provided on the front panel (62). The discharge grille (56) formed with the air discharge port (74) is disposed on the first heat insulating frame (64). Second and third heat insulating frames (65), (66) are disposed over the left side, upper side, and right side of the discharge grille (56). Accordingly, the first to third heat insulating frames (64) to (66) cover the entire periphery of the discharge grille (56) and thermally insulate the periphery of the discharge grill (56).

[0051] Next, a description will be given to the assembly of the air conditioning unit (1) with reference to Figures 17 and 18. As shown in Figure 17, the fear panel (10) is securely screwed to the left and right side panels (11), (12) with the respective abutment surfaces (16) thereof in abutment with each other, as described above. The rear edge portions of the left and right side panels (11), (12) are formed with forwardly depressed portions (70), (70). The rear edge portions of the left and right heat insulating plates (38), (39) are formed with rearwardly projecting portions (69), (69). The projecting portions (69), (69) are fitted in the depressed portions (70) of the left and right side panels (11), (12). The front edge portions of the left and right heat insulating plates (38), (39) are formed with depressed portions (67), (67). The depressed portions (67), (67) and the left and right projecting portions (58), (58) of the partition

plate (48) are interengaged, while the front edges (68), (68) of the left and right heat insulating plates (38), (39) are held in the spaces between the projecting portions (58), (58) of the partition plate (48) and the inner surfaces of the left and right side panels (11), (12). The left and right edges of the heat exchanger (4) are supported by the support pieces (40), (41) of the left and right heat insulating plates (38), (39).

[0052] As shown in Figure 18, the projecting portion (57) provided as a fitting portion on the upper end of the partition plate (48) is fitted in a depressed portion (71) formed as a receiving portion in the first heat insulating frame (64), whereby the partition plate (48) and the first heat insulating frame (64) are assembled. The lower end portion of the back face of the partition plate (48) is in abutment with the front face (72) of the drain pan (28), while the lower end of the partition plate (48) is held in the space between the drain pan (28) and the suction grille (60) and supported thereby.

Effects of the Present Embodiment

[0053] Thus, in the air conditioning unit (1) of the present embodiment, the left and right heat insulating plates (38) and (39) are provided between the side portions of the heat exchanger (4) and the side panels (11), (12) of the unit casing (2), so that it is no more necessary to laminate the heat insulating material to each of the side panels (11), (12) of the unit casing (2) via the sealing material.

[0054] Since the support pieces (40), (41) for supporting the side portions of the heat exchanger (4) are molded integrally with the left and right heat insulating plates (38) and (39), it is unnecessary to separately provide a member for supporting the side portions of the heat exchanger (4). Moreover, since the metal sheets (43) for supporting the bottom portion of the heat exchanger (4) are inserted in the lower portions of the left and right heat insulating plates (38) and (39), it is unnecessary to separately provide a member for supporting the bottom portion of the heat exchanger (4). Since the member for supporting the heat exchanger (4) can thus be formed integrally with the both heat insulating plates (38), (39), the number of components can be reduced.

[0055] Since the partition plate (48) provided between the heat exchanger (4) and the front panel (62) is formed of styrofoam, the partition plate (48) itself has a heat insulating effect, so that it is no more necessary to separately laminate the heat insulating material to the partition plate (48).

[0056] Since the wire grooves (49) are molded integrally with the partition plate (48), it is unnecessary to separately provide a member for fixing the wire of electric equipment.

[0057] Since the main body portion (22) of the fan housing (22a) composing the volute portion (32) and diffuser portion (33) of the fan (23a) is molded integrally

of styrofoam, the number of components of the fan housing (22a) can be reduced.

[0058] Since the drain pan (28) is formed integrally with the main body portion (22) of the fan housing (22a), it is unnecessary to separately form the drain pan (28) and the number of components can be reduced.

[0059] Since the pipe pressing plate (34) is inserted in the front face of the main body portion (22) of the fan housing (22a), a member for fixing the pipe of the heat exchanger (4) can be integrated in the fan housing (22a).

[0060] Since the partition plate (48) and the main body portion (22) of the fan housing (22a) are formed with the respective through grooves (36), (55), the pipe of the heat exchanger (4) can be disposed easily and piping workability is improved.

[0061] Since the fit portions composed of projecting and depressed portions are provided on the respective edge portions of the left heat insulating plate (38), the right heat insulating plate (39), and the partition plate (48) such that the two heat insulating plates (38), (39) and the partition plate (48) are assembled by interengaging the fit portions, a fixing tool such as a screw is no more necessary, so that the number of components is reduced and assemblability is improved.

[0062] Since the upper and lower end portions of the partition plate (48) are provided with the fitting portions (57) which are fitted in the receiving portions (71) of the unit casing (2), the number of components is similarly reduced and assemblability is improved.

[0063] Thus, according to the air conditioning unit (1) of the present embodiment, the number of components is reduced. In addition, assemblability is improved and assembling time can be reduced. Moreover, disassembly also becomes easier, which facilitates recycling.

[0064] Since each of the two heat insulating plates (38), (39), the partition plate (48), and the main body portion (22) of the fan housing (22a) is formed of styrofoam, they can be manufactured easily at low cost.

EMBODIMENT 2

[0065] Although the drain pan (28) has been molded integrally with the main body portion (22) of the fan housing (22a) in the foregoing first embodiment, the drain pan (28) may also be formed of styrofoam different from the styrofoam forming the main body portion (22). In a second embodiment, a drain pan (28) is formed of styrofoam having an expansion ratio lower than that of the styrofoam forming the main body portion (22) of the fan housing (22a).

[0066] Specifically, the drain pan (28) is formed of styrofoam having an expansion ratio of about 1:15, while the main body portion (22) of the fan housing (22a) is formed of styrofoam having an expansion ratio of about 1:25. That is, the main body portion (22) of the fan housing (22a) is formed of the styrofoam having a relatively high expansion ratio since it has no problem

even if it has water permeability, which is different from the drain pan (28). On the other hand, the drain pan (28) is formed of the styrofoam having a relatively low expansion ratio such that it is not impregnated with water, since the drain pan (28) should receive the drain and discharge it. The styrofoam forming the drain pan (28) may have any expansion ratio provided that it is not penetrated by the drain but preferably has an expansion ratio of 1:15 or less.

[0067] Thus, since the main body portion (22) of the fan housing (22a) is formed of the styrofoam having an expansion ratio higher than that of the styrofoam forming the drain pan (28) in the second embodiment, the main body portion (22) of the fan housing (22a) can be formed at lower cost than in the first embodiment. Therefore, a lower-cost air conditioning unit (1) can be implemented.

Industrial Applicability

[0068] Thus, the present invention is useful in an air conditioner device, a freezer, or the like.

Claims

1. An air conditioning unit comprising:

a unit casing (2) disposed in a standing position on a floor surface, a front face of the unit casing (2) having an air suction port (73) and an air discharge port (74) formed in lower and upper sides thereof, respectively;

a fan (23a) having a fan housing (22a) and an impeller (23), the fan housing (22a) being held in a lower portion of the unit casing (2) and having a volute portion (32) formed with a suction hole (29) opposing the air suction port (73) and a diffuser portion (33) adapted to upwardly discharge air, the impeller (23) being held in the volute portion (32) of the fan housing (22a); and

a heat exchanger (4) disposed above the fan (23a) in the unit casing (2), at least a part of a peripheral wall of an air passage extending from the air suction port (73) to the air discharge port (74) in the unit casing (2) being formed of styrofoam (22, 38, 39, 48).

2. The air conditioning unit of claim 1, wherein a left heat insulating plate (38) and a right heat insulating plate (39) each formed of the styrofoam are provided between left and right side faces of the heat exchanger (4) and left and right side faces of the unit casing (2), respectively.

3. The air conditioning unit of claim 2, wherein a sheet metal (43) for supporting a bottom portion of the heat exchanger (4) is inserted in a lower portion of

each of the left and right heat insulating plates (38,39).

4. The air conditioning unit of claim 2, further comprising:

support pieces (40, 41) for supporting side edge portions of the heat exchanger (4) being tilted in a front-to-rear direction, the support pieces (40, 41) being formed integrally with the corresponding heat insulating plates (38, 39) to protrude inwardly from respective inner faces of the left and right heat insulating plates (38,39) and extend in a direction tilted from a perpendicular direction.

5. The air conditioning unit of claim 1, wherein the fan housing (22a) comprises:

a main body portion (22) covering a front side of the impeller (23); and

a mounting board (25) secured to the main body portion (22) in such a manner as to hold the impeller (23) in a space between the mounting board (25) and the main body portion (22), the main body portion (22) being molded in one piece of the styrofoam.

6. The air conditioning unit of claim 5, wherein an upper portion of the main body portion (22) of the fan housing (22a) is provided with a drain pan (28) molded integrally with the main body portion (22).

7. The air conditioning unit of claim 6, further comprising:

a left heat insulating plate (38) and a right heat insulating plate (39) each formed of the styrofoam, the left and right heat insulating plates (38,39) being disposed between left and right side faces of the heat exchanger (4) and left and side faces of the unit casing (2), respectively; and

a partition plate (48) molded in one piece of the styrofoam, the partition plate (48) being disposed between the heat exchanger (4) and the front face (62) of the unit casing (2), the main body portion (22) of the fan housing (22a) and the drain pan (28) being formed of the styrofoam having an expansion ratio lower than an expansion ratio of the styrofoam composing the left and right heat insulating plates (38,39) and the partition plate (48).

8. The air conditioning unit of claim 5, wherein a pipe pressing plate (34) for fixing a pipe of the heat exchanger (4) is inserted in a front face of the main

body portion (22) of the fan housing (22a).

9. The air conditioning unit of either one of claims 6 and 7, wherein a groove (36) for permitting a pipe of the heat exchanger (4) to vertically extend there- 5
through is formed in the drain pan (28).

10. The air conditioning unit of claim 1, wherein a parti-
tion plate (48) molded in one piece of the styrofoam
is disposed between the heat exchanger (4) and 10
the front face (62) of the unit casing (2).

11. The air conditioning unit of claim 10, wherein a front
face of the partition plate (48) has projecting and
depressed portions (49) each for fixing a wire held 15
therebetween, the projecting and depressed por-
tions (49) being molded integrally with the partition
plate (48).

12. The air conditioning unit of claim 2, wherein 20

a partition plate (48) molded in one piece of the
styrofoam is disposed between the heat
exchanger (4) and the front face (62) of the unit
casing (2), 25
a projecting portion (58) is formed on either
one of a left edge portion of the partition plate
(48) and a front edge portion of the left heat
insulating plate (38), while a depressed portion
(67) is formed in the other thereof, the partition 30
plate (48) and the left heat insulating plate (35)
being assembled with the projecting portion
(58) fitted in the depressed portion (67), and
the projecting portion (58) is formed on either 35
one of a right edge portion of the partition plate
(48) and a front edge portion of the right heat
insulating plate (39), while the depressed por-
tion (67) is formed in the other thereof, the par-
tition plate (48) and the right heat insulating
plate (39) being assembled with the projecting 40
portion (58) fitted in the depressed portion (67).

13. The air conditioning unit of claim 1, wherein

a partition plate (48) molded in one piece of the 45
styrofoam is disposed between the heat
exchanger (4) and the front face (62) of the unit
casing (2) and
each of upper and lower portions of the parti-
tion plate (48) is formed with a fitting portion 50
(57) composed of a depressed or projecting
portion to be engaged with a receiving portion
(71) of the unit casing (2) which is composed of
a depressed or projecting portion, the partition
plate (48) being assembled with the fitting por- 55
tion (57) engaged with the receiving portion
(71).

Fig. 1

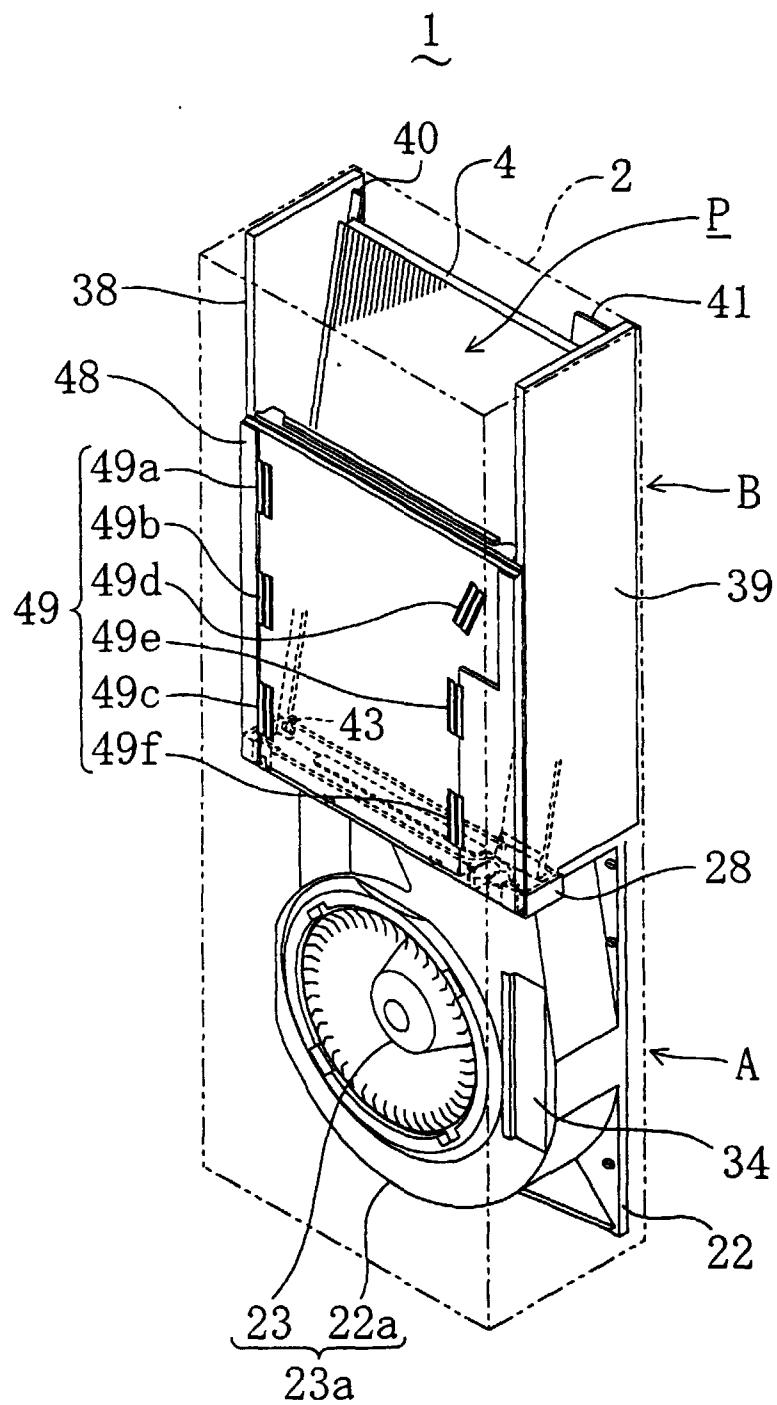


Fig. 2

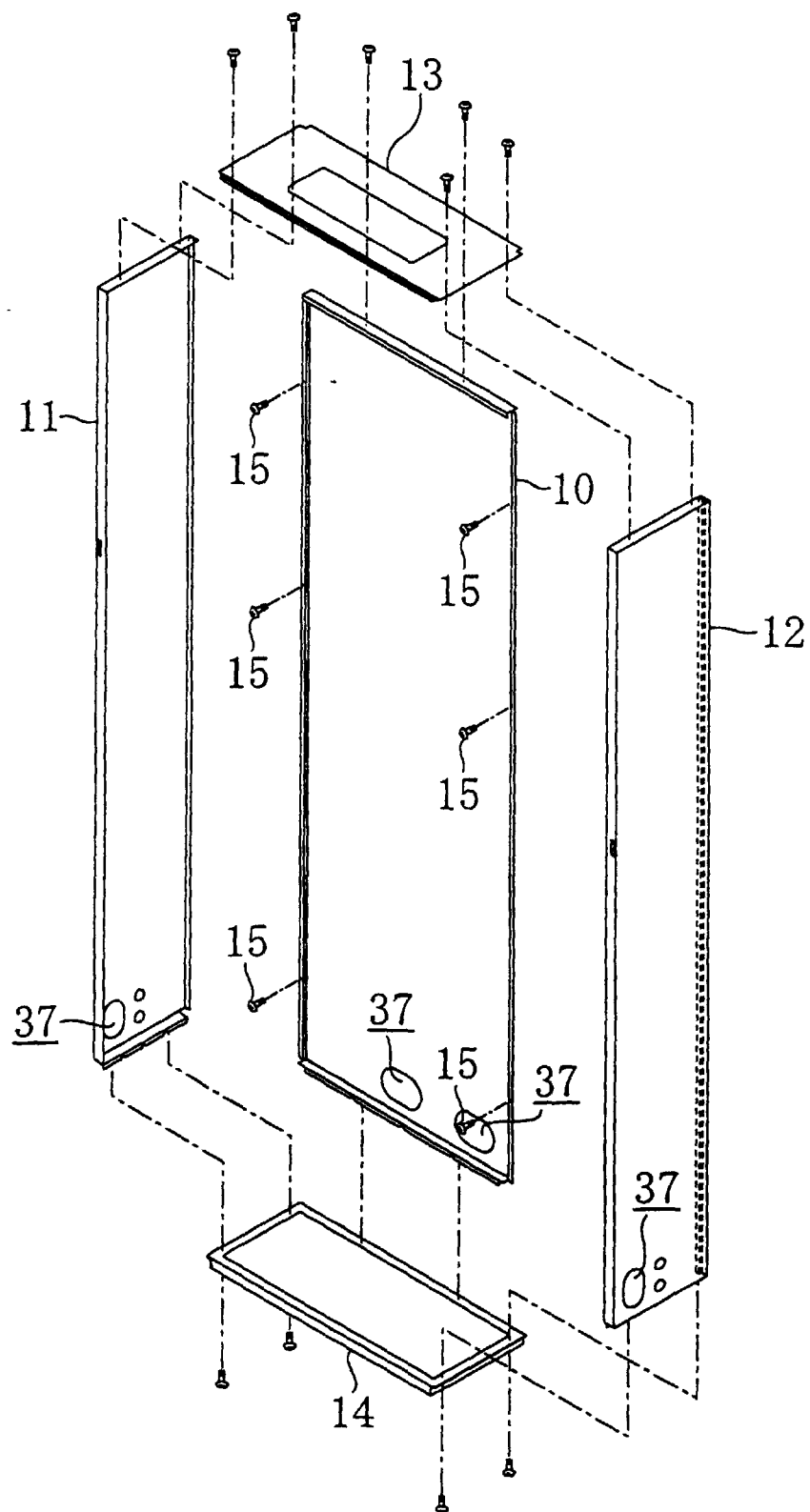


Fig. 3

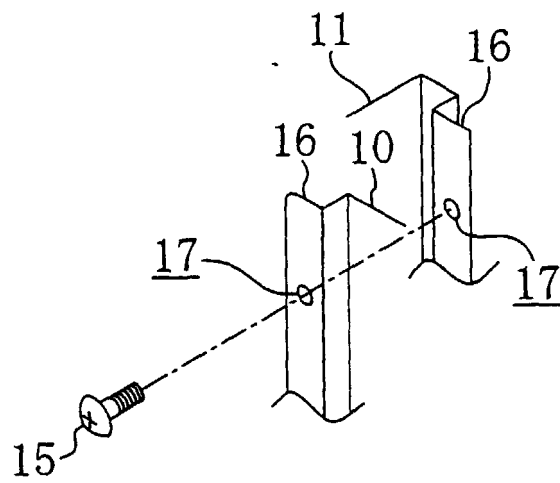


Fig. 4

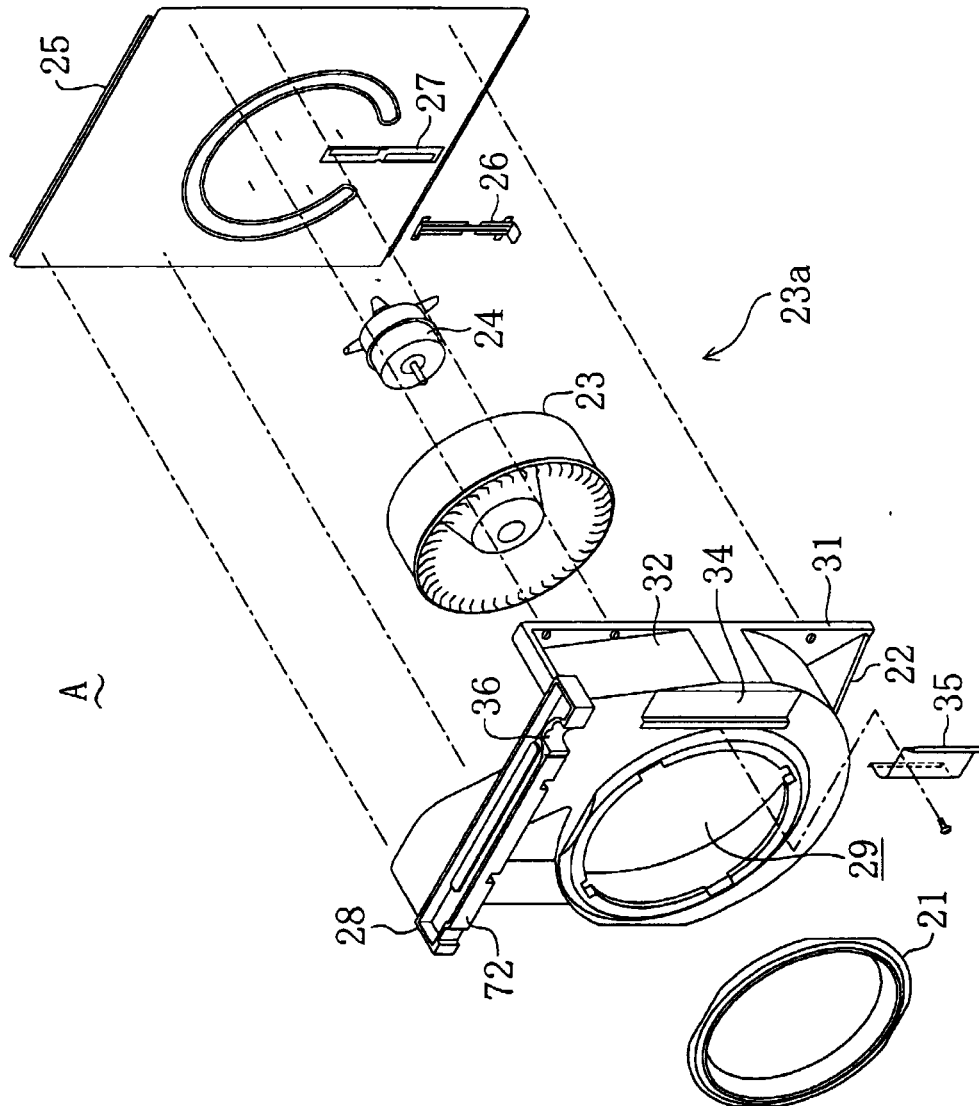


Fig. 5

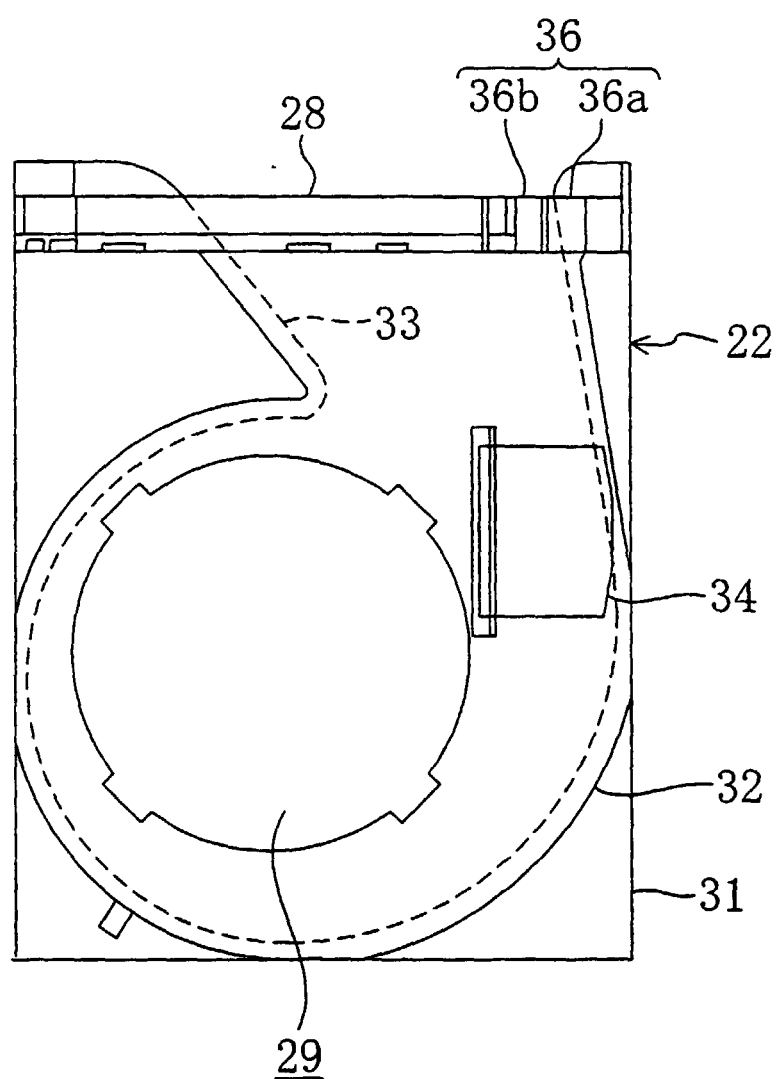


Fig. 6

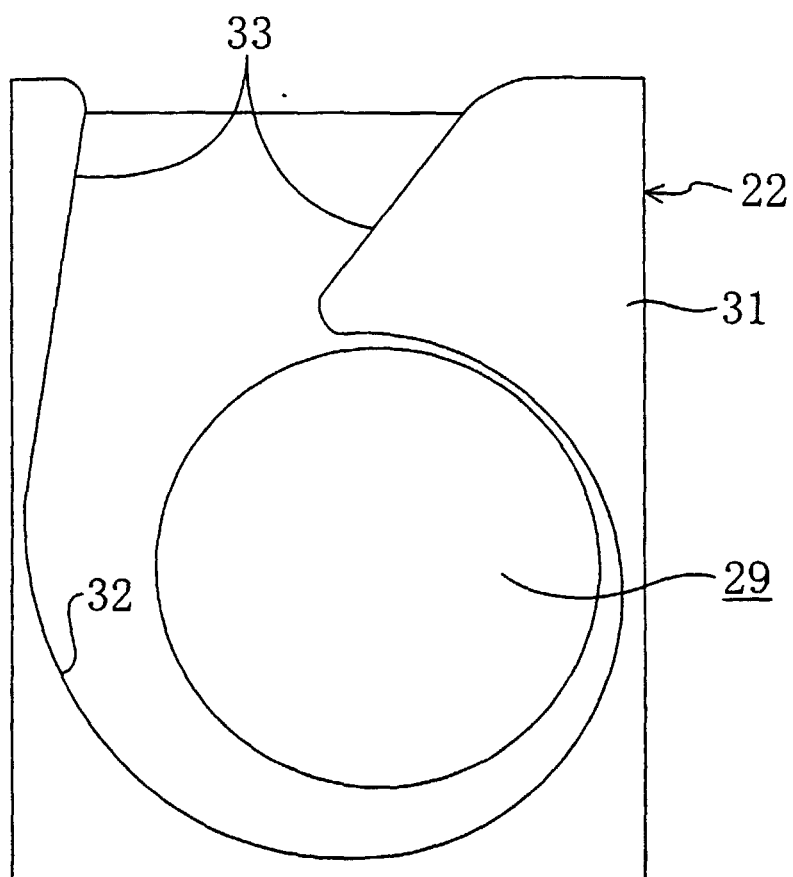


Fig. 7

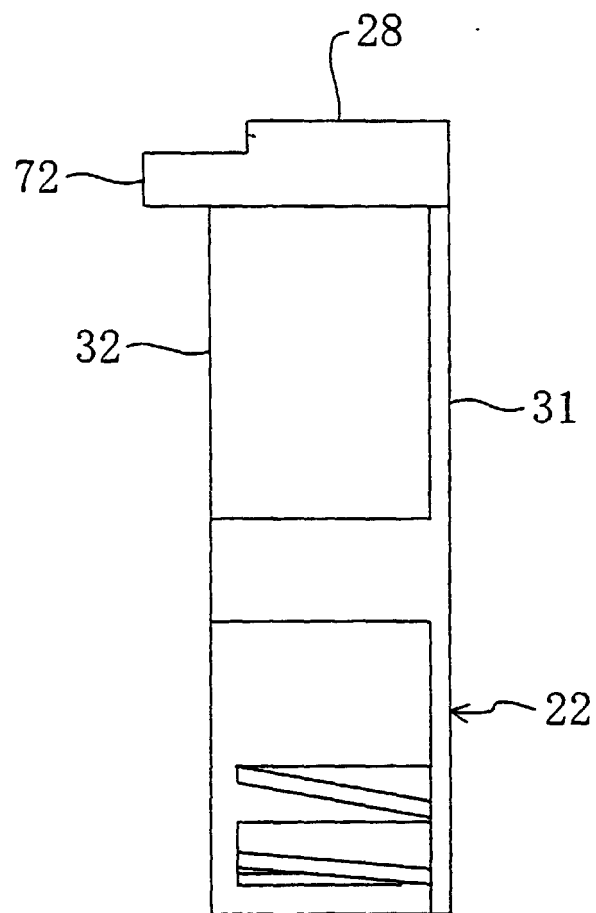


Fig. 8

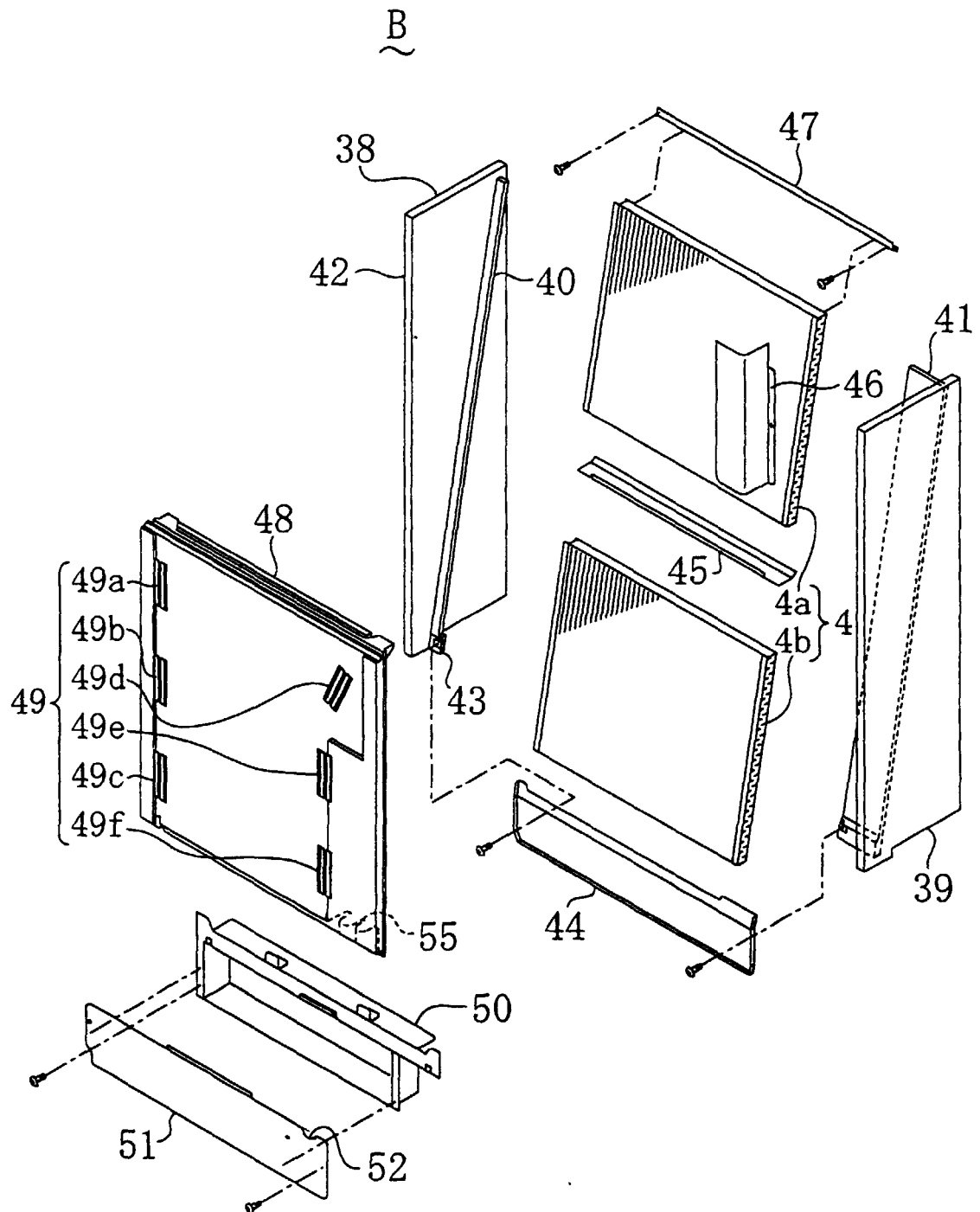


Fig. 9

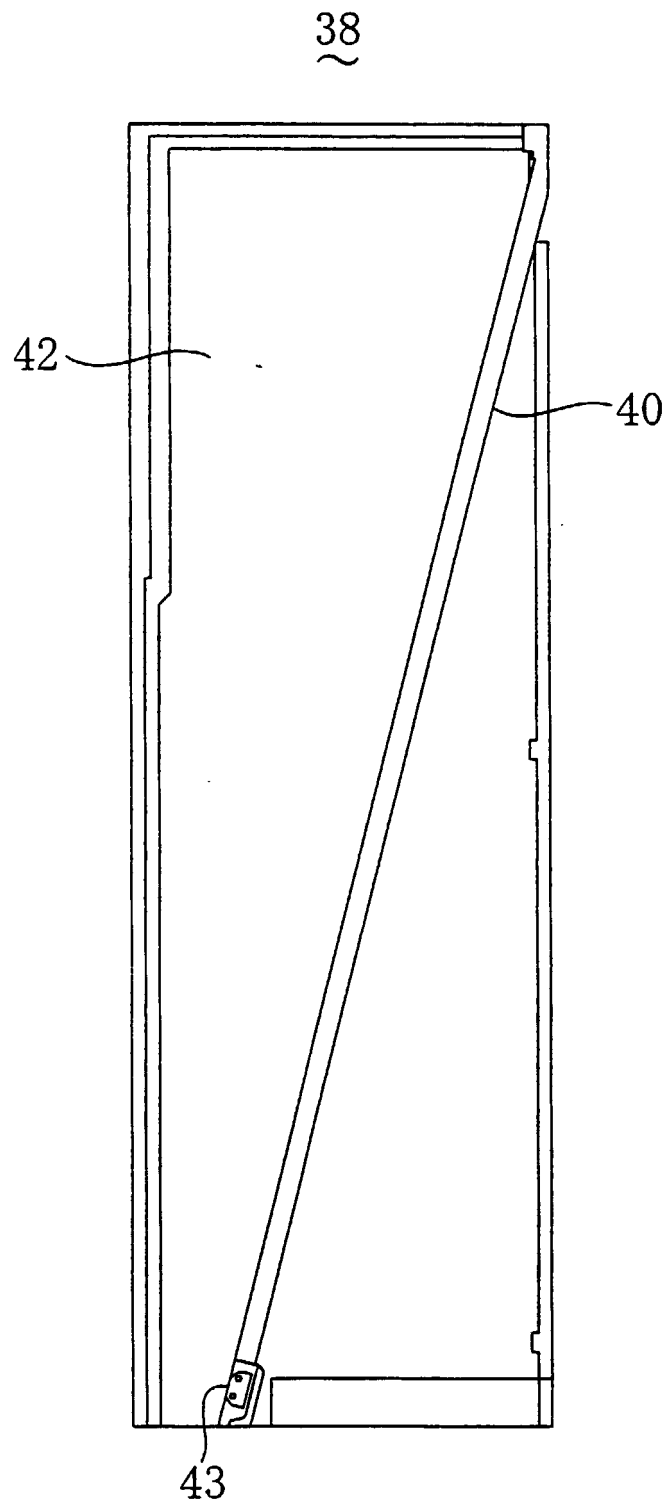


Fig. 10

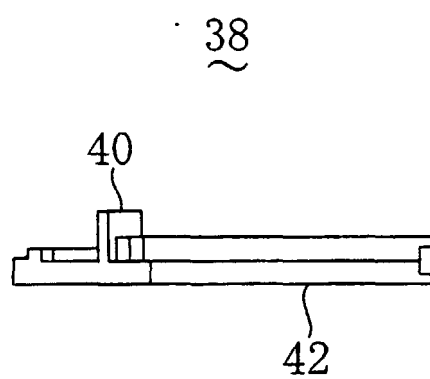


Fig. 11

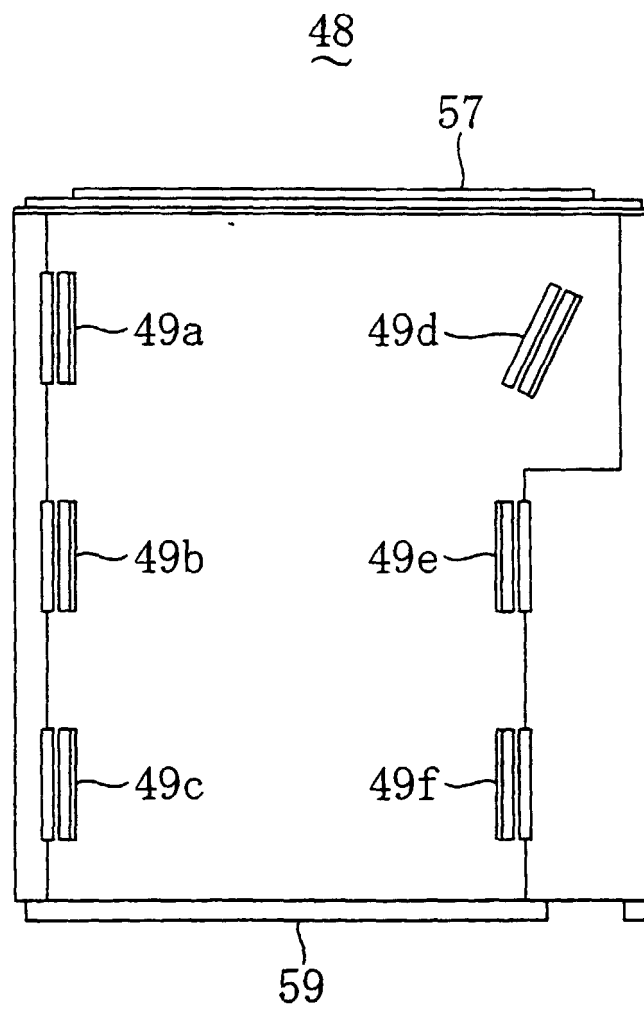


Fig. 12

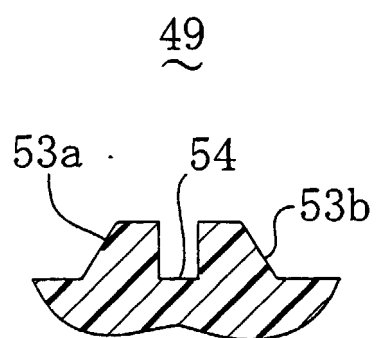


Fig. 13

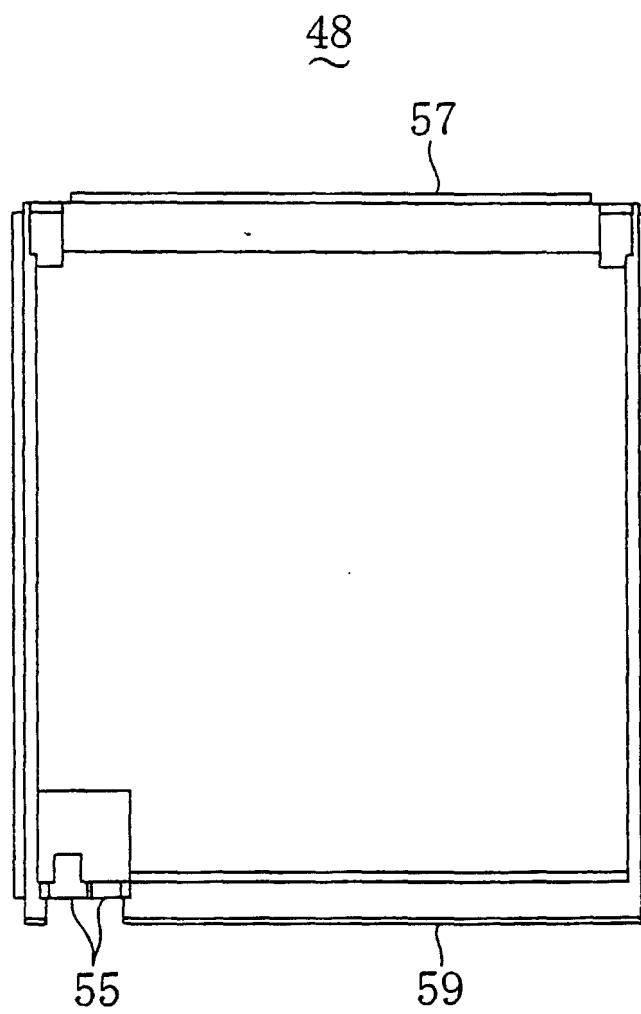


Fig. 14

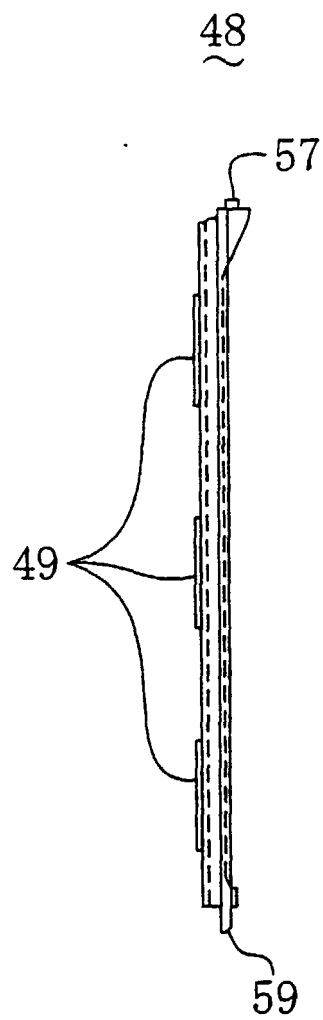


Fig. 15

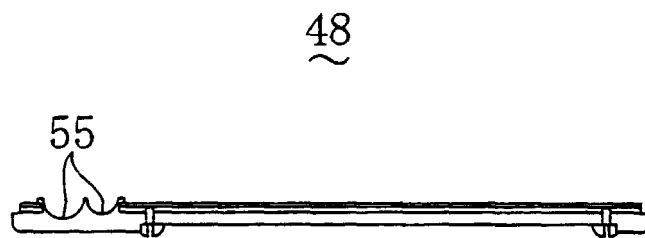


Fig. 16

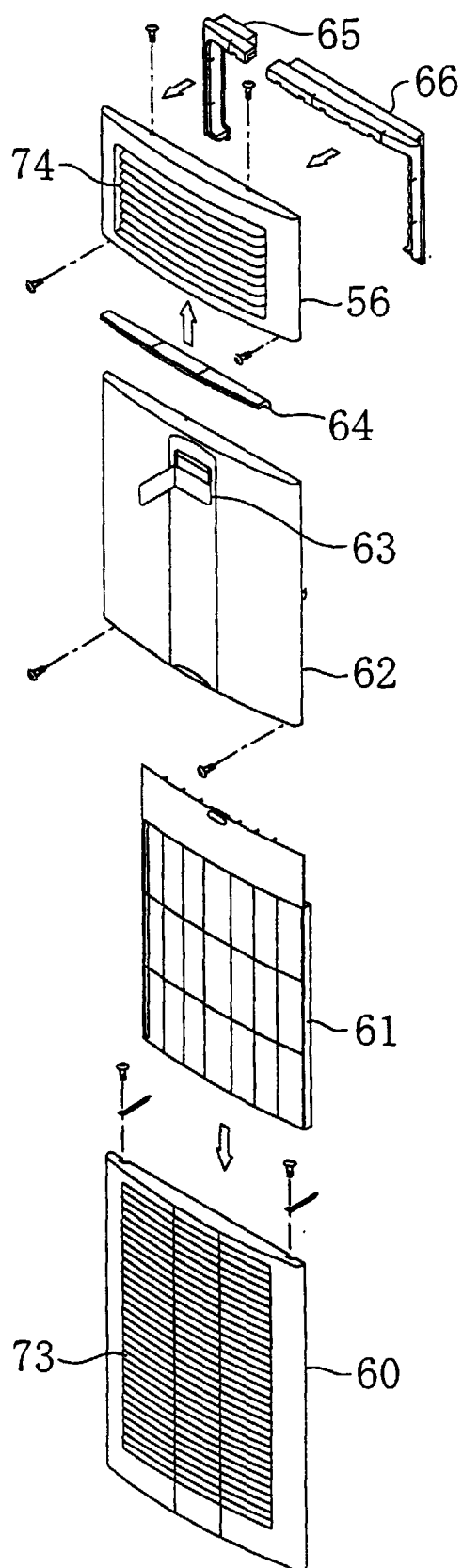


Fig. 17

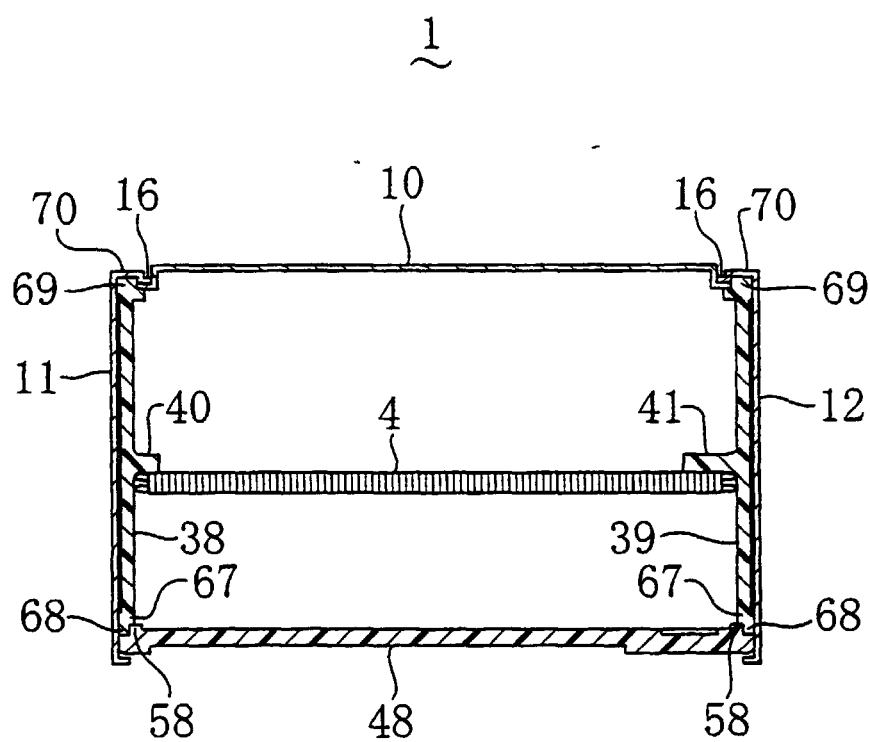


Fig. 18

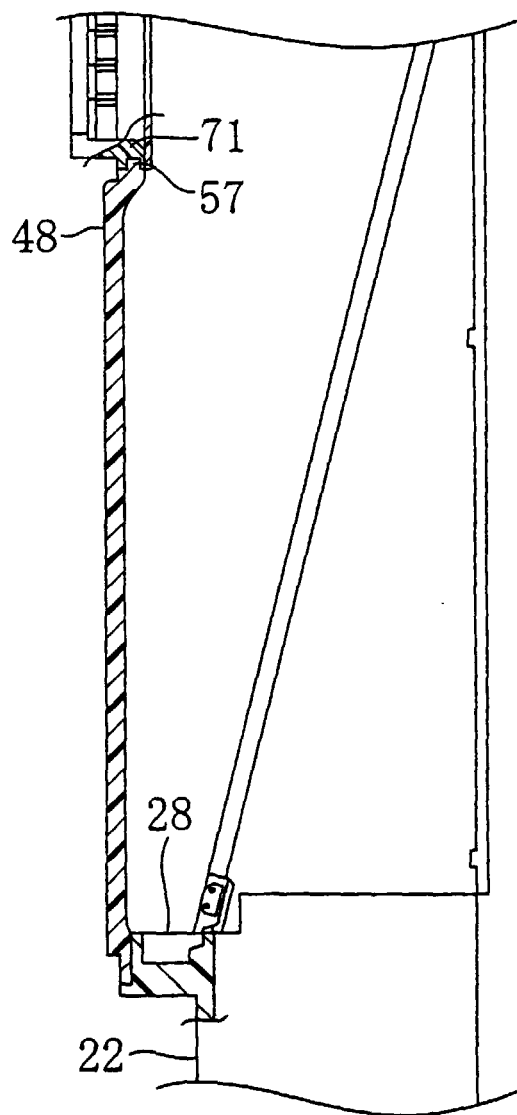
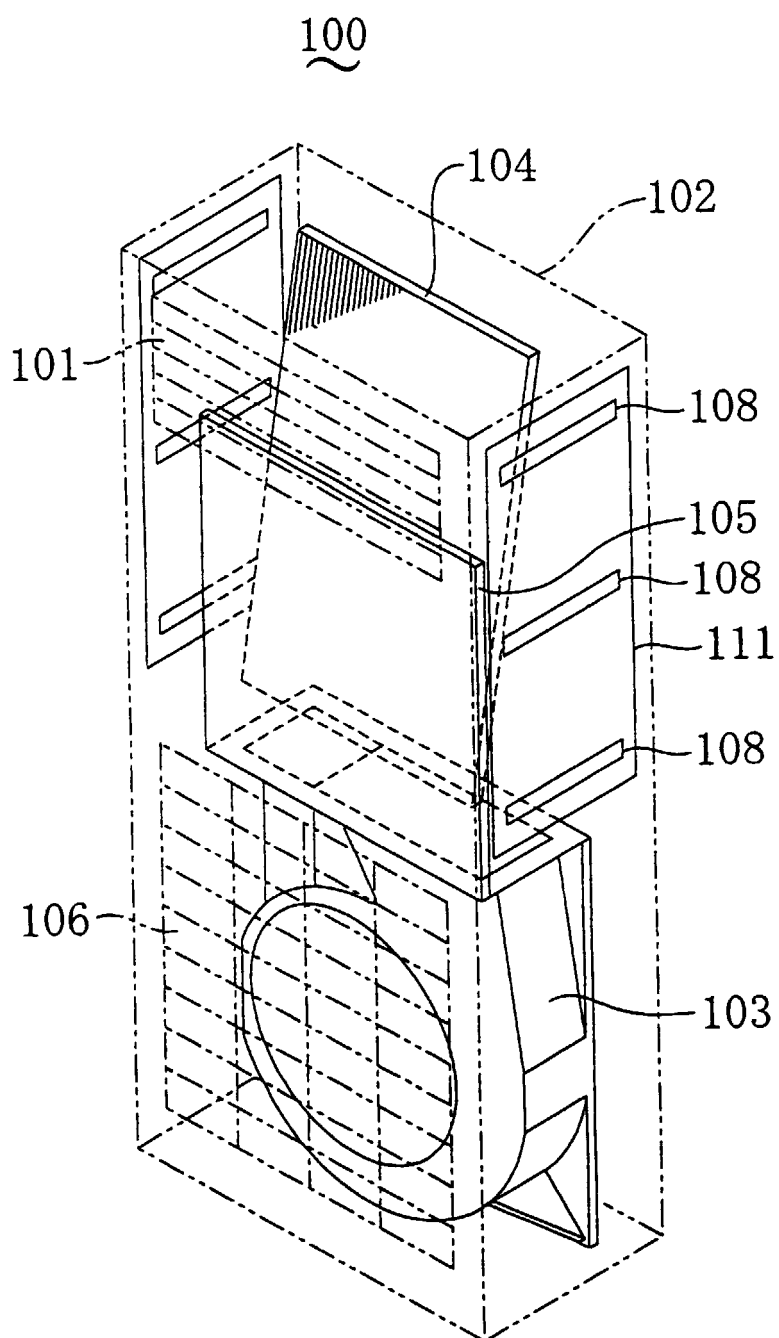


Fig. 19



INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP99/05307

A. CLASSIFICATION OF SUBJECT MATTER
Int. Cl.⁶ F24F1/00

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

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
Int. Cl.⁶ F24F1/00Documentation 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 1994-1999
Kokai Jitsuyo Shinan Koho 1971-1999 Jitsuyo Shinan Toroku Koho 1996-1999Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
WPI

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X Y A	JP, 53-2934, A (Tokyo Shibaura Denki K.K.), 12 January, 1978 (12.01.78), page 1, lower right column, line 17 to page 2, lower left column, line 16 (Family: none)	1, 2 3-6 7-13
Y	Microfilm of the specification and drawings annexed to the request of Japanese Utility Model Application No. 71987/1981 (Laid-open No. 184417/1982) (Mitsubishi Heavy Industries, Ltd.), 22 November, 1982 (22.11.82), page 3, lines 10-16 (Family: none)	6
Y A	Microfilm of the specification and drawings annexed to the request of Japanese Utility Model Application No. 140208/1988 (Laid-open No. 62316/1990) (Matsushita Seiko Co., Ltd.), 09 May, 1990 (09.05.90), page 4, line 18 to page 5, line 7 (Family: none)	7, 9, 10 11-13

☐ 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
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 "O" document referring to an oral disclosure, use, exhibition or other
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 "P" document published prior to the international filing date but later
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"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
03 December, 1999 (03.12.99)Date of mailing of the international search report
14 December, 1999 (14.12.99)Name and mailing address of the ISA/
Japanese Patent Office

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