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

(11) EP 2 023 048 A1

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
11.02.2009 Bulletin 2009/07

(51) Int Cl.:
F24F 1/00 *(2006.01)* ***F24F 13/20*** *(2006.01)*

(21) Application number: **08013278.0**

(22) Date of filing: **23.07.2008**

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

(30) Priority: **25.07.2007 JP 2007192790**

(71) Applicant: **Sanyo Electric Co., Ltd.**
Osaka 570-8677 (JP)

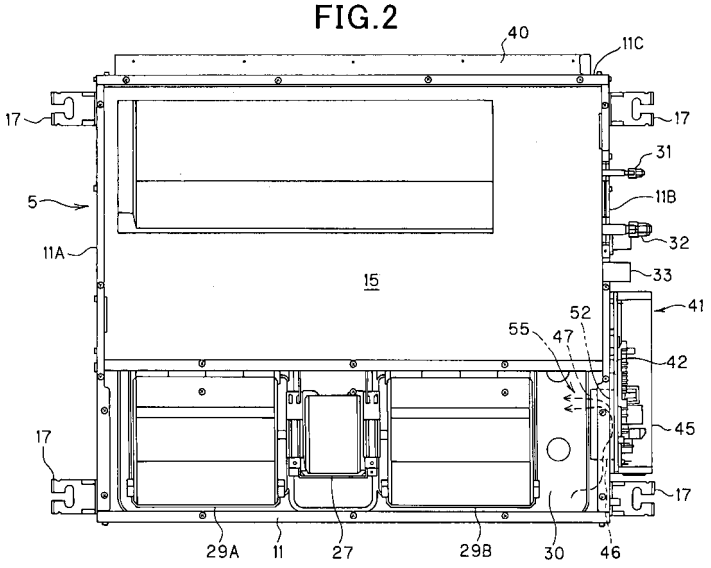
(72) Inventors:
- **Koga, Seiichi**
  Ota-shi
  Gunma 373-0806 (JP)
- **Ogura, Nobuhiro**
  Kiryu-shi
  Gunma 376-0034 (JP)
- **Hyugano, Kazuhiro**
  Ashikaga-shi
  Tochigi 326-0338 (JP)
- **Okada, Akira**
  Ashikaga-shi
  Tochigi 326-0842 (JP)
- **Nonaka, Akihiro**
  Ora-gun
  Gunma 370-0533 (JP)

(74) Representative: **Glawe, Delfs, Moll**
Patentanwälte
Postfach 26 01 62
80058 München (DE)

(54) Air conditioner having electrical equipment box cooling mechanism

(57) In an air conditioner having an electrical equipment box mounted on the outer surface of a unit body in which an air blowing fan and an indoor heat exchanger are mounted, the electrical equipment box has an accommodating portion in which a control board is mounted, and a projecting portion that is connected to the accommodating portion so that the inside of the projecting portion intercommunicates with the inside of the accommodating portion and has an air inlet port and an air discharge port, and the unit body has an opening formed in the outer surface thereof through which the projecting portion of the electrical equipment box is inserted, the projecting portion being secured to the outer side surface of the unit body under the state that the projecting portion projects through the opening into an air flowing passage of the air blowing fan.

FIG.2



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Description

BACKGROUND OF THE INVENTION

1. Field of the Invention

[0001] The present invention relates to an air conditioner having an electrical equipment box on the outside surface of an unit body set up in a ceiling space of a building or the like.

2. Description of the Related Art

[0002] There is known an air conditioner in which an electrical equipment box is provided on the outer surface of a unit body which is set up in a ceiling space of a building and contains a heat exchanger and an air blowing fan therein (for example, see Japanese Patent No. 2,562,675). In this type of air conditioner, the unit body is set up in the ceiling space, and thus air heat-exchanged by the heat exchanger in the unit body can be led to a proper position in a room through an air blow-out duct and blown out into the room, so that air-conditioning operation can be implemented without spoiling the beautify of the room.

[0003] A control board for controlling the operation of an electrical expansion valve connected to the air blowing fan and the heat exchanger is mounted in the electrical equipment box. This control board generates heat in connection with the driving operation of the air blowing fan and the electrical expansion valve, and thus the temperature in the electrical equipment box increases. Therefore, it is necessary to cool the electrical equipment box.

[0004] However, the electrical equipment box is disposed in the ceiling space together with the unit body, and thus even when the electrical equipment box is provided with an opening intercommunicating with the ceiling space, it is impossible to sufficiently cool the electrical equipment box. In addition, the air in the ceiling space generally contains lots of dust, and thus a filter for removing dust is required to be provided at the opening of the electrical equipment box, so that the construction of the electrical equipment box is cumbersome.

SUMMARY OF THE INVENTION

[0005] Therefore, an object of the present invention has been implemented in view of the foregoing situation, and has an object to provide an air conditioner in which an electrical equipment box mounted on the outer surface of an unit body set up in a ceiling space of a building can be simply cooled.

[0006] In order to attain the above obj ect, according to the present invention, in an air conditioner having an electrical equipment box mounted on the outer surface of a unit body in which an air blowing fan and an indoor heat exchanger are mounted, the electrical equipment box has an accommodating portion in which a control board is mounted, and a projecting portion that is connected to the accommodating portion so that the inside of the projecting portion intercommunicates with the inside of the accommodating portion and has an air inlet port and an air discharge port, and the unit body has an opening formed in the outer surface thereof through which the projecting portion of the electrical equipment box is inserted, the projecting portion being secured to the outer side surface of the unit body under the state that the projecting portion projects through the opening into an air flowing passage of the air blowing fan.

[0007] In the above air conditioner, the projecting portion may be provided in proximity to an air suction port of the air blowing fan.

[0008] In the above air conditioner, the air discharge port may be formed in a surface of the projecting portion that faces the air suction port of the air blowing fan.

[0009] In the above air conditioner, the air inlet port may be provided to a side surface of the projecting portion.

[0010] According to the present invention, air introduced to the projecting portion by the air flow based on the air blowing fan flows in the projecting portion and the accommodating unit which intercommunicates with each other, and the electrical parts containing the control board, etc. in the accommodating portion are efficiently cooled by the air. Accordingly, the electrical equipment box mounted on the outer surface of the unit body set in the ceiling space of a building can be simply cooled.

BRIEF DESCRIPTION OF THE DRAWINGS

[0011]

Fig. 1 is a cross-sectional view showing an embodiment of the present invention;
Fig. 2 is a plan view of the embodiment when viewed from the lower side;
Fig. 3 is a perspective view showing a unit body;
Fig. 4 is a side view of an electrical equipment box; and
Fig. 5 is a perspective view of the electrical equipment box.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

[0012] An embodiment according to the present invention will be described hereunder with reference to the accompanying drawings.

[0013] Figs. 1 and 2 sow a built-in type air conditioner (hereinafter referred to as "air conditioner") according to an embodiment of the present invention.

[0014] The air conditioner 1 has a box-shaped unit body 5 formed of a steel sheet which is suspended through bolts in a ceiling space 3 of a building.

[0015] As shown in Fig. 3, the unit body 5 has four side plates 11 which are disposed in a rectangular frame

shape so as to face one another, a top plate 13 is fixed to the upper edge portions of the respective side plates 11 and a bottom plate 15 is fixed to the lower edge portions of the respective side plates 11. A heat insulating material is attached to parts of the side plates 11, the top plate 13 and the bottom plate 15. Suspending fittings 17 are fixed to both the ends of each of the side plates 11A, 11B at the short side, and the suspending fittings 17 are fixed to suspending bolts (not shown) hung from the ceiling of the building, whereby the unit body 5 is suspended from the ceiling.

[0016] The inside of the unit body 5 is divided into a machine chamber 9 at the left side of Fig. 1 and a heat exchange chamber 10 at the right side of Fig. 1 by a partition plate 7. In the heat exchange chamber 10 at the right side are disposed an indoor heat exchanger 21, a drain pan 23 which is located below the indoor heat exchanger 21 to receive drain water dropped form the indoor heat exchanger 21, and a drain pump 25 for discharging the drain water stocked in the drain pan 23 to the outside. As shown in Fig. 2, in the machine chamber 9 at the left side are disposed an air blowing fan driving motor 27, and air blowing fans 29A, 29B (for example, a sirocco fan having cascades of about 50) which are coupled to each other in series through the air blowing fan driving motor 27 in the longitudinal direction of the unit body 5.

[0017] As shown in Figs. 1 and 2, the lower side of the drain pan 23 is covered by the bottom plate 15 described above, the lower portions of the air blowing fans 29A, 29B are opened, and a suction grille (not shown) is detachably secured to the lower portions of the air blowing fans 29A, 29B. The opened portions of the air blowing fans 29A, 29B serve as an air suction port 30. An air blow-out port 40 of the unit body 5 is formed in the side plate 11C.

[0018] Furthermore, as shown in Figs. 1 and 2, a refrigerant (liquid) pipe connection port 31, a refrigerant (gas) pipe connection port 32 and a drain pipe connection port 33 extend from the side plate 11B at the right side of Fig. 2 of the unit body 5. The refrigerant (liquid) pipe connection port 31 and the refrigerant (gas) pipe connection port 32 are connected to the indoor heat exchanger 21 at one ends thereof, and also connected to an outdoor unit (not shown) at the other ends thereof. The drain pipe connection port 33 is connected to the drain pump 25 at one end thereof, and also connected to a drain hose (not shown) at the other end thereof. The drain hose is led out to the outside.

[0019] In this embodiment, as shown in Figs. 2 and 3, an electrical equipment box 41 is mounted on the outer surface of the machine room 9 side of the side plate 11B at the short side.

[0020] As shown in Figs. 4 and 5, the electrical equipment box 41 has a box-shaped accommodating portion 45, and a box-shaped projecting portion 48 which intercommunicates with or connects to the accommodating portion 45. In the box-shaped accommodating portion 45 are disposed a control board 42 for controlling the operation of the air blowing fans 29A, 29B, the operation of an electrical expansion valve (not shown) connected to the indoor heat exchanger 21, etc., electrical equipment parts 43, a heat sink 44, etc. The control board 42 is disposed so as to face an intercommunication opening 49 through which the accommodating portion 45 and the projecting portion 48 intercommunicate with each other, and has a plate surface whose size is larger than the opening 49. The control board 42 is fixed to the wall surface 45A of the accommodating portion 45 by plural fixing members 50 so as to be spaced from the wall surface 45A at a predetermined interval K. A circular hole 54 through which wires connected to the control board 42 and the electrical parts 43 are passed is provided at the lower side of the projecting portion 48.

[0021] The box-shaped projecting portion 48 connects to the accommodating portion 45 to be near to the heat sink 44 side, and the insides of the projecting portion 48 and the inside of the heat sink 44 intercommunicate with each other through the opening 49. In addition, it has an air inlet port (slit) 46 and an air discharge port (slit) 47. The projecting portion 48 is homothetic to the accommodating portion 45. The homothetic ratio of the projecting portion 48 is equal to about one third in size of the accommodating portion 45, the volume thereof is remarkably smaller than the accommodating portion 45, the inside thereof is hollow and the hollow portion serves as an air flowing passage.

[0022] As shown in Fig. 3, the electrical equipment box 41 has a fixing bracket 51, and it is fixed to the outer surface of the unit body 5 through the bracket 51 under the state that the projecting portion 48 is inserted in an opening 52 formed in the side plate 11B of the unit body 5.

[0023] As shown in Fig. 2, the projecting portion 48 inserted in the opening 52 of the side plate 11B projects into the air flowing passage 55 based on one air blowing fan 29B, and under this state, the projecting portion 48 is disposed so that the air inlet port (slit) 46 is oriented in the downward direction in Fig. 2 and the air discharge port (slit) 47 is oriented in the air suction axis direction of the air blowing fan 29B. The air inlet port 46 is provided to the side plate 48A of the projecting portion 48. The discharge port 47 is provided at a position distant from the air inlet port 46 on the side plate 48B which is adjacent to the side plate 48A and faces the air suction port 60 of the air blowing fan 29B.

[0024] In this construction, air introduced from the air inlet port 46 cools the back surface of the control board 42, blown out from the discharge port 47 formed in the side plate 48B distant from the air inlet port 46 in the air suction axis direction of the air blowing fan 29B, and then sucked into the air blowing fan 29B.

[0025] Next, the operation will be described.

[0026] In this embodiment, when the air blowing fans 29A, 29B are driven, air is sucked from the air suction port 30 to the unit body 5. This air is heat-exchanged in the indoor heat exchanger 21 and blown out from the air

blow-out port 40 of the unit body 5, and the air-conditioned air is blown into the room through an air blow-out port of the room which is connected to the air blown-out port 40 through the duct.

[0027] In this process, the projecting portion 48 projecting from the accommodating portion 45 is located in the air suction passage of the air blowing fan 29B, and thus a part of the sucked air is introduced from the air inlet port 46 of the projecting portion 48 into the projecting portion 48, and the air introduced into the projecting portion 48 induces turbulent flow while passing through the slit 46.

[0028] The back surface of the control board 42 is exposed in the accommodating portion 45, and thus it is heat-exchanged by forced convection when the air passes over the back surface of the control board, so that the temperature of the air is increased. The temperature-increased air is fed from the slit 47 of the side plate 48B of the projecting portion 48 to the outside of the projecting portion 48, and then led to the outer peripheral portion of the air suction port 60 of the air blowing fan 29B by air suction pressure.

[0029] In this construction, the air introduced from the air inlet port 46 is blown out from the discharge port 47 which is far away from the air inlet port 46, and thus the air is broadly circulated in the projecting portion 48 and effectively cools the back surface of the control board 42. Accordingly, according to this embodiment, the surface of the board is exposed to forced convection at all times by indoor air whose temperature is lower than air in the space under the roof in which the unit body 5 is set, so that the electrical equipment box 41 can be more simply cooled as compared with the conventional air conditioner. Furthermore, the amount of air passing through the inside of the electrical equipment box 41 is increased, and the increase of the temperature of the electrical equipment box 41 can be suppressed. As compared with the temperature of the electrical equipment box 41 when no slit is provided in the projecting portion 48, experiment data indicated the maximum temperature difference of about 40° in some sites.

[0030] The present invention is not limited to the electrical equipment box cooling mechanism used in the above embodiment, and various modifications may be made without departing from the subject matter of the present invention. For example, in this embodiment, the main body of the projecting portion is designed in rectangular parallelepiped, however, the present invention is not limited to this shape. Furthermore, vertically cut-out slits are used as the opening portion, however, the main body of the projecting portion may be formed in a cylindrical shape and the slits may be designed in a mesh structure. Furthermore, the numbers of slits formed in the air inlet port and the air outlet port are not limited to those numbers illustrated in the figures.

Claims

1. An air conditioner having an electrical equipment box mounted on the outer surface of a unit body in which an air blowing fan and an indoor heat exchanger are mounted, wherein the electrical equipment box has an accommodating portion in which a control board is mounted, and a projecting portion that is connected to the accommodating portion so that the inside of the projecting portion intercommunicates with the inside of the accommodating portion and has an air inlet port and an air discharge port, and the unit body has an opening formed in the outer surface thereof through which the projecting portion of the electrical equipment box is inserted, the projecting portion being secured to the outer side surface of the unit body under the state that the projecting portion projects through the opening into an air flowing passage of the air blowing fan.

2. The air conditioner according to claim 1, wherein the projecting portion is provided in proximity to an air suction port of the air blowing fan.

3. The air conditioner according to claim 2, wherein the air discharge port is formed in a surface of the projecting portion that faces the air suction port of the air blowing fan.

4. The air conditioner according to claim 3, wherein the air inlet port is provided to a side surface of the projecting portion.

FIG.1

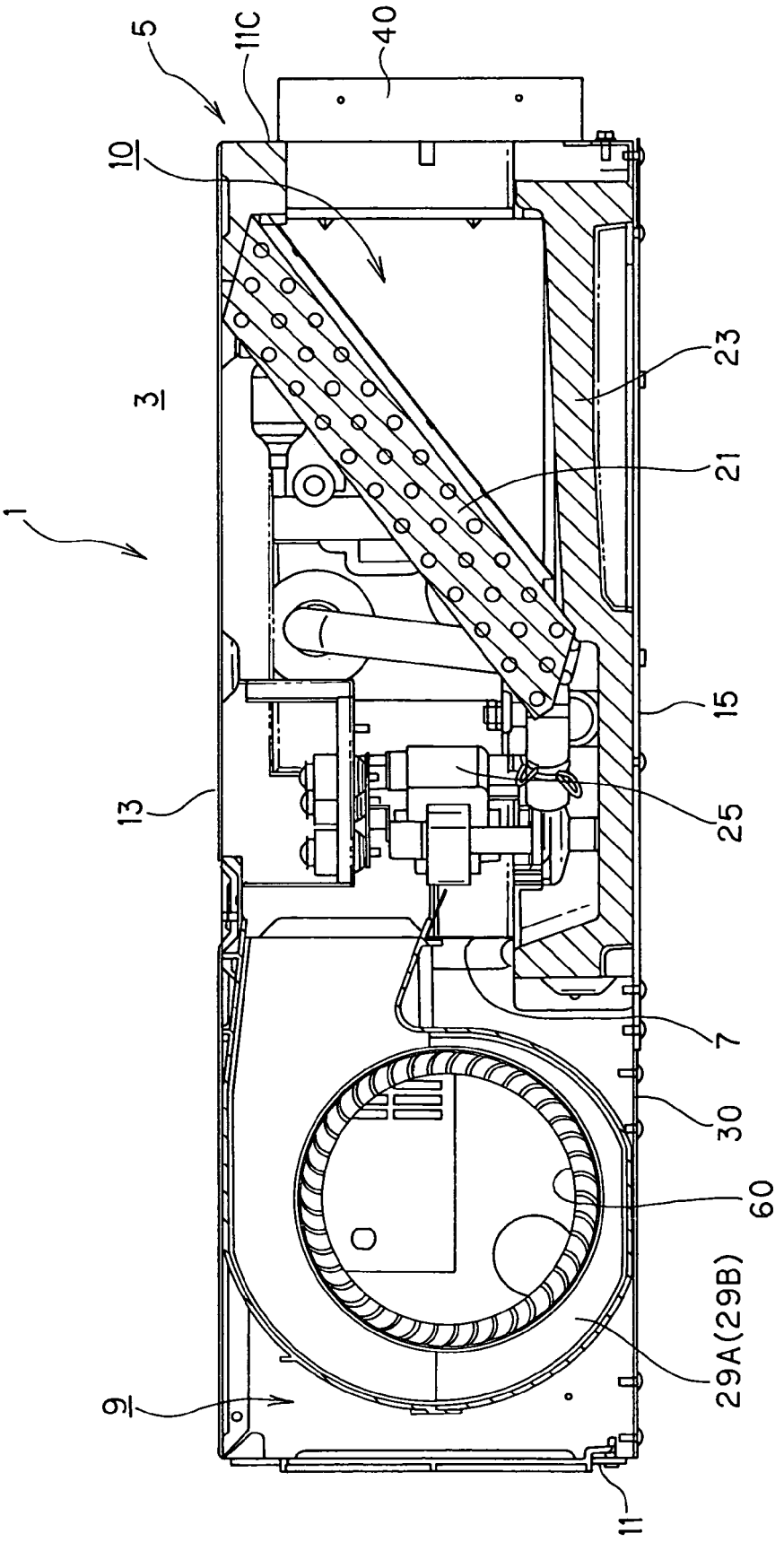

FIG.2

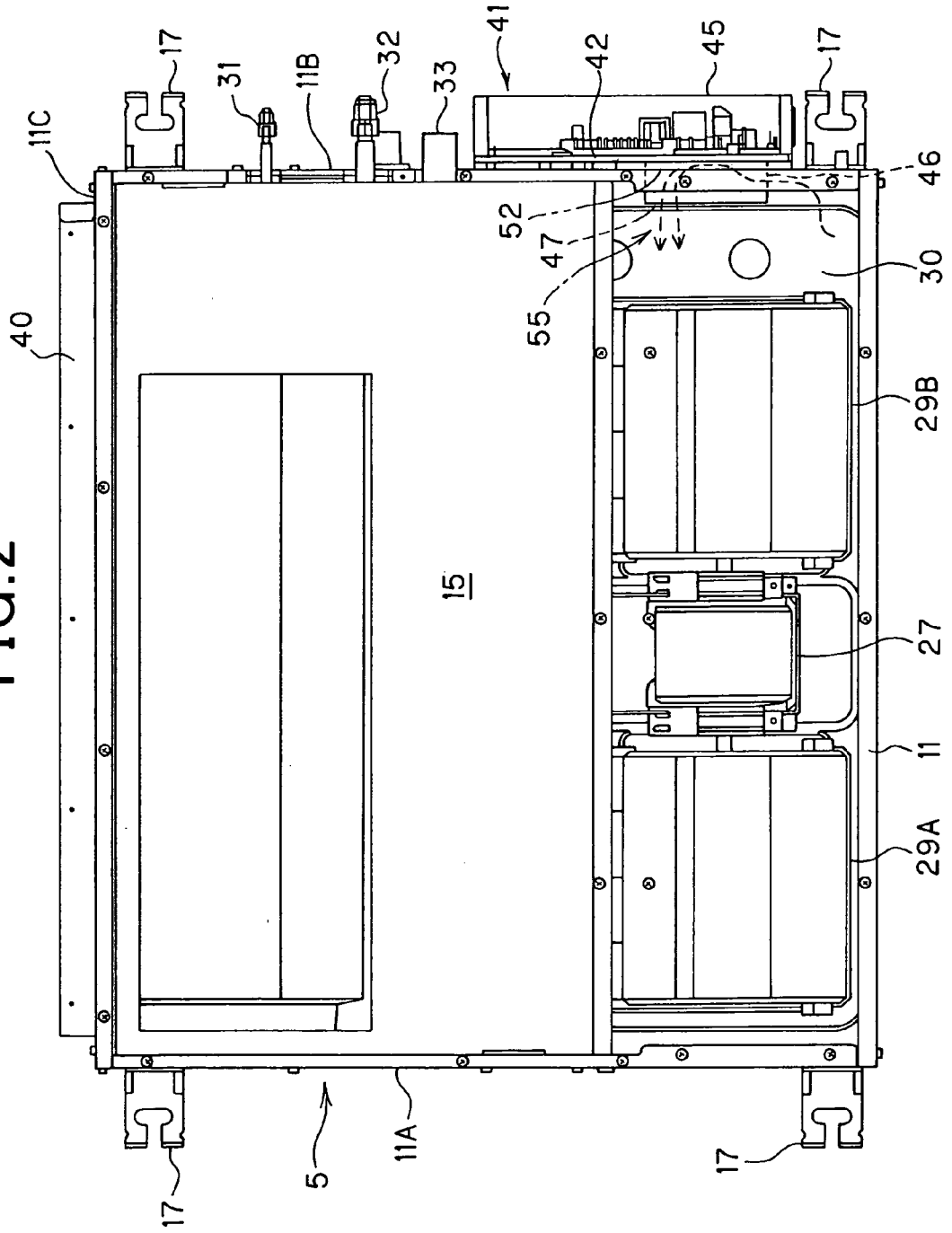
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FIG.3

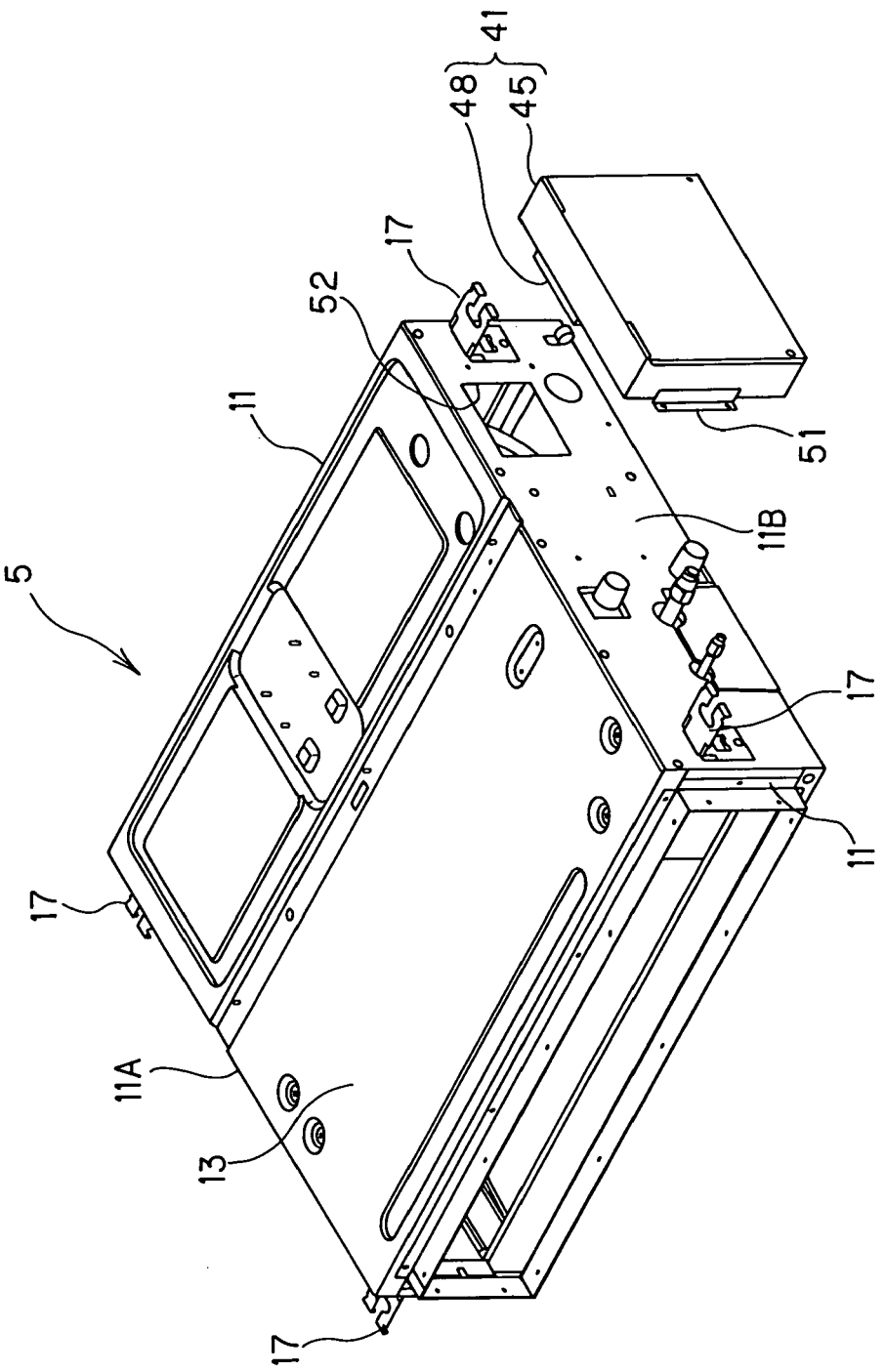


FIG.4

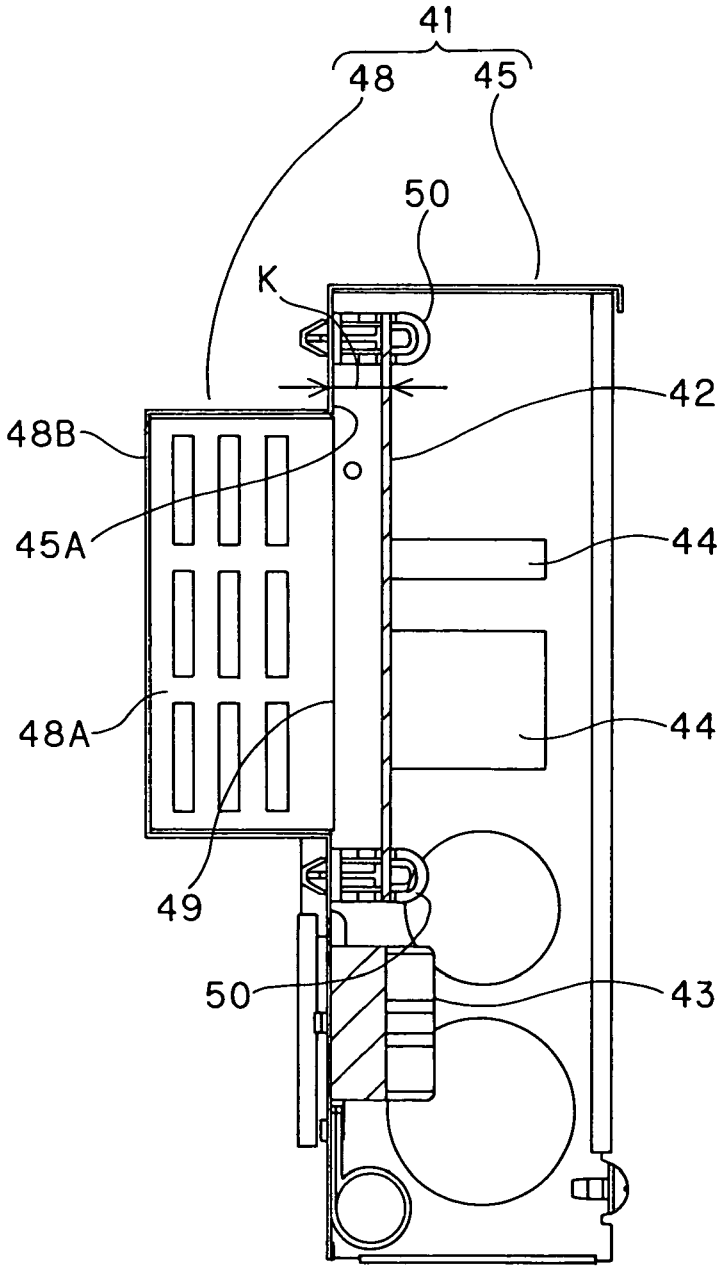
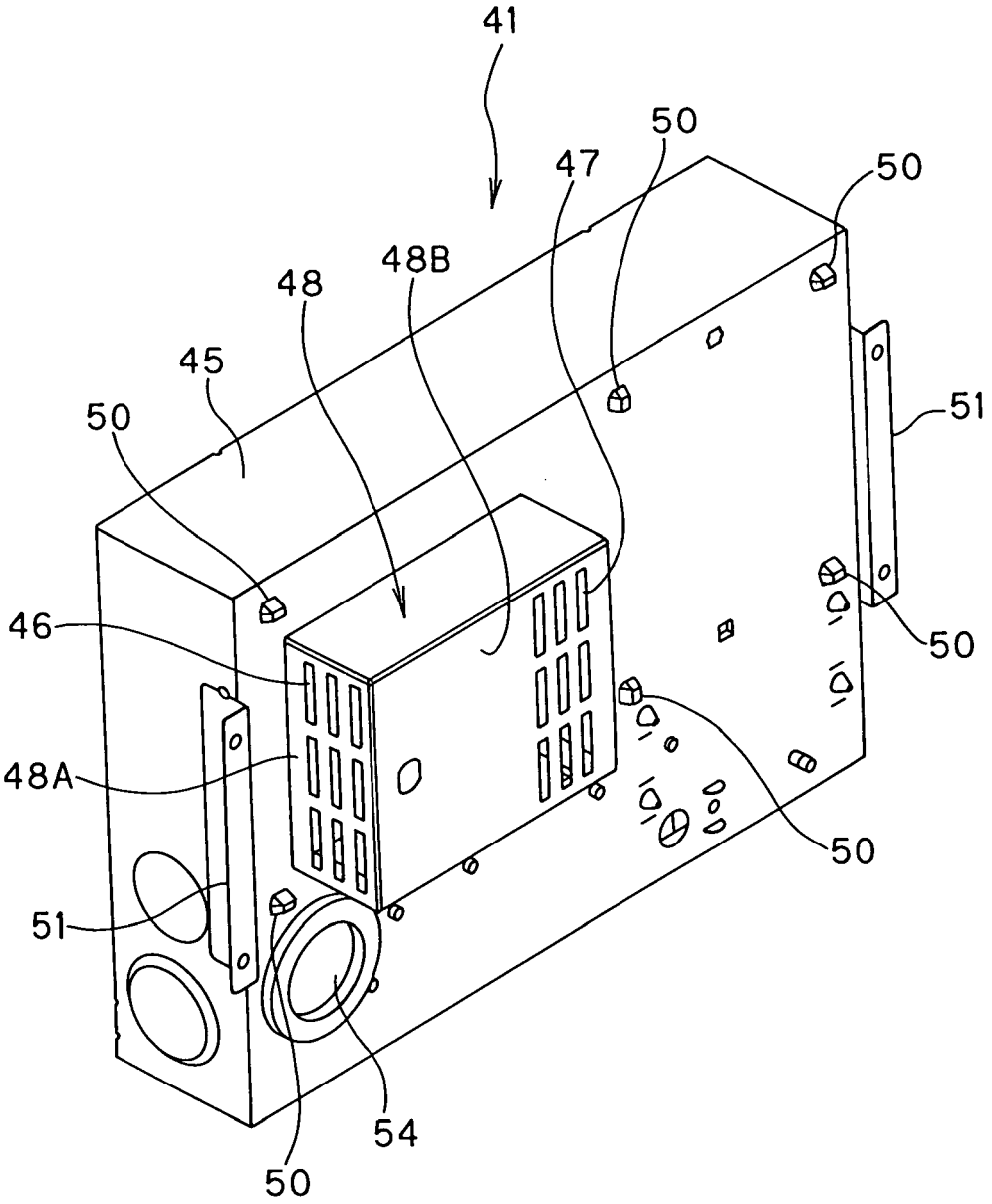


FIG.5



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EUROPEAN SEARCH REPORT

Application Number
EP 08 01 3278

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
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TECHNICAL FIELDS SEARCHED (IPC)

F24F

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	10 November 2008	Valenza, Davide

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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EPO FORM 1503 03.82 (P04C01)

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