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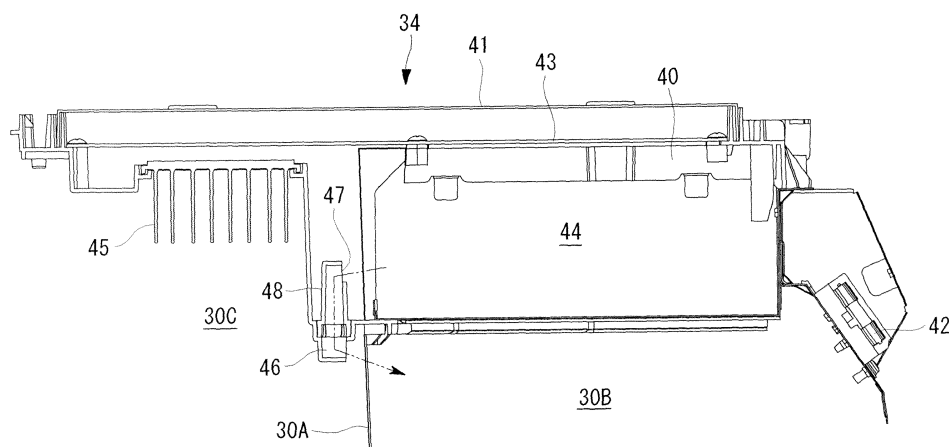
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(54) **CONTROL BOX OF OUTDOOR UNIT**

(57) Provided is an outdoor unit control box capable of preventing water droplets from traveling backward through a ventilation system and entering the control box, to thereby avoid corrosion, failure, and the like of electric components such as a control board resulting from entry of droplets, so as to enhance the quality and the reliability of a product. A control box (34) of an outdoor unit (3) is disposed above a machine chamber (30B) in a casing (30), the interior of which is partitioned by a partition panel

(30A) into a heat exchange chamber (30C) and the machine chamber (30B), while a part of the control box (34) protrudes to the side of the heat exchange chamber (30C), wherein an air exhaust port (46) which opens to face the partition panel (30A) in the heat exchange chamber (30C) is provided at one end of an air passage (44) formed in the control box (34), and an exhaust air duct (48) extending into the control box (34) and having at an end thereof an air vent port (47) which opens toward the air passage (44) is provided to the air exhaust port (46).

FIG. 3



Description

Technical Field

[0001] The present invention relates to an outdoor unit control box which is disposed in an outdoor unit of an air conditioner and which has a control board and other electric components housed and equipped therein.

Background Art

[0002] Inside a casing of an outdoor unit of a split type air conditioner are devices such as a compressor, an outdoor heat exchanger, an outdoor fan, and a four-way switch valve, as well as a control box which has a control board for controlling these devices in the outdoor unit and other electric components housed and equipped therein. The interior of the casing of the outdoor unit is partitioned by a partition panel into a heat exchange chamber which houses the outdoor heat exchanger, the outdoor fan, and such devices, and a machine chamber which houses a compressor, a four-way switch valve, and such devices. The control box is disposed above the partition panel and astride the heat exchange chamber and the machine chamber so that fins for radiating heat from some of the electric components and the like can be exposed to the heat exchange chamber side.

[0003] Almost all outdoor units are installed outside. Therefore, it is inevitable that rainwater enters the heat exchange chamber side inside the casing. On the other hand, the control box is generally disposed in a position at which it can be difficult for outside air and rainwater to enter directly, within the casing of the outdoor unit. However, since electric components include heat-generating parts, outside air is allowed to blow therethrough for the purpose of heat radiation. Patent Document 1 discloses a structure in which outside air introduced from one end of a control box blows through the interior of the control box and then is discharged at the other end of the control box from an air exhaust port which opens to face toward the partition panel in the heat exchange chamber, into the heat exchange chamber.

[0004]

Patent Citation 1: Japanese Unexamined Patent Application, Publication No. 2004-271168

Disclosure of Invention

[0005] However, the heat-radiating ventilation system formed in the control box serves as a pathway for water droplets to enter from the heat exchange chamber side into the control box. Therefore, the structure shown in Patent Document 1 relates to a concern that a droplet caught up by the rotation of the outdoor fan in the heat exchange chamber may hit against and splash back from the partition panel, in which case the droplet may directly enter the control box. If a droplet enters the control box

and clings to an electric component such as the control board provided in the control box, it may cause corrosion, failure, or the like of the electric component, leading to a problem of impairment in the quality and the reliability of a product.

[0006] The present invention was made to address such situations, with an object of providing an outdoor unit control box capable of preventing water droplets from traveling backward through the ventilation system which runs from the control box to the heat exchange chamber, and entering the control box, to thereby avoid corrosion, failure, and the like of the control board and other electric components resulting from entry of droplets, so as to enhance the quality and the reliability of a product.

[0007] In order to achieve the above object, the present invention provides the following solutions. That is, an aspect of the outdoor unit control box according to the present invention is an outdoor unit control box disposed above a machine chamber in a casing, the interior of which is partitioned by a partition panel into a heat exchange chamber housing an outdoor heat exchanger, an outdoor fan, and the like, and the machine chamber housing a compressor and the like, while a part of the control box protrudes to the side of the heat exchange chamber, wherein an air exhaust port which opens to face the partition panel in the heat exchange chamber is provided at one end of an air passage formed in the control box, and an exhaust air duct extending into the control box and having at an end thereof an air vent port which opens toward the air passage is provided to the air exhaust port.

[0008] According to the aforementioned aspect, the air exhaust port which opens to face the partition panel in the heat exchange chamber is provided at one end of the air passage formed in the control box, and the exhaust air duct extending into the control box and having at an end thereof the air vent port which opens toward the air passage is provided to the air exhaust port. Therefore, a droplet caught up by the outdoor fan will not be allowed to travel backward from the air exhaust port through the exhaust air duct and the air vent port, and thus is not able to enter the control box, even if the droplet once splashed back by the partition panel keeps going further and further by repeatedly splashing back within the exhaust air duct, while the heat in the control box can be radiated by discharging the air from the inside of the air passage of the control box to the heat exchange chamber side through the air vent port, the exhaust air duct, and the air exhaust port, because the outdoor fan is driven to create a suction effect when outside air is circulated in the heat exchange chamber. By so doing, droplets can be prevented from traveling backward through the ventilation system and entering the control box. Accordingly, corrosion, failure, and the like of electric components such as a control board resulting from droplets adhered thereto can be avoided, by which the quality and the reliability of a product can be enhanced. In addition, since the position, the area, and the like of the opening of the air vent port can be arbitrarily set in the exhaust air duct, the heat radiation

efficiency within the control box or the cooling efficiency on the electric components can be optimized, by which the heat radiation efficiency or the cooling efficiency can be improved. Furthermore, since the exhaust air duct is provided to the air exhaust port, its muffler effect can be utilized to reduce mechanical noise (noise of the compressor) emitting from the machine chamber through the ventilation system toward the heat exchange chamber.

[0009] In addition, in the above-mentioned aspect, an exhaust air pathway curved in a bent shape can be defined by the air vent port, the exhaust air duct, and the air exhaust port in the outdoor unit control box.

[0010] According to the above-mentioned aspect, the exhaust air pathway curved in a bent shape is defined by the air vent port, the exhaust air duct, and the air exhaust port. Therefore, it is difficult for a droplet caught up by the outdoor fan on the heat exchange chamber side to enter the control box, unless the droplet keeps going further and further by repeatedly hitting against and splashing back from the inner surfaces of the exhaust air pathway curved in a bent shape. Accordingly, intrusion of droplets into the control box can be reliably blocked, and mechanical noise (noise of the compressor) emitting through the exhaust air pathway can be more efficiently reduced.

[0011] Furthermore, in the above-mentioned aspect, a flashing may also be formed in the attachment of the exhaust air duct.

[0012] According to the above-mentioned aspect, since the flashing is formed in the attachment of the exhaust air duct, a droplet intruding from the gap in the attachment of the exhaust air duct into the control box can be intercepted by the flashing. Accordingly, intrusion of droplets from the ventilation system into the control box can be almost perfectly blocked, and thereby the quality and the reliability of a product can be enhanced.

[0013] According to the present invention, a droplet caught up by the outdoor fan will not be allowed to travel backward from the air exhaust port through the exhaust air duct and the air vent port, and thus is not able to enter the control box, unless the droplet once splashed back by the partition panel keeps going further and further by repeatedly splashing back within the exhaust air duct. By so doing, intrusion of droplets into the control box can be blocked. Therefore, corrosion, failure, and the like of electric components such as a control board resulting from droplets adhered thereto can be avoided, by which the quality and the reliability of a product can be enhanced. Moreover, since the position, the area, and the like of the opening of the air vent port can be arbitrarily set in the exhaust air duct, the heat radiation efficiency within the control box or the cooling efficiency on electric components can be optimized, by which the heat radiation efficiency or the cooling efficiency can be improved. Furthermore, because of the muffler effect of the exhaust air duct, mechanical noise (noise of the compressor) emitting from the machine chamber through the ventilation system toward the heat exchange chamber side can be

reduced.

Brief Description of Drawings

5 [0014]

[FIG. 1] FIG. 1 is a perspective view of a split type air conditioner comprising an outdoor unit control box according to one embodiment of the present invention.

[FIG. 2] FIG. 2 is an external perspective view of the outdoor unit control box shown in FIG. 1.

[FIG. 3] FIG. 3 is a partially broken front view of the outdoor unit control box shown in FIG. 2.

[FIG. 4] FIG. 4 is an enlarged longitudinal cross-sectional view of a part of the air exhaust port of the outdoor unit control box shown in FIG. 3.

[FIG. 5] FIG. 5 is a perspective view of the exhaust air duct provided in the air exhaust port of the outdoor unit control box shown in FIG. 3.

[FIG. 6] FIG. 6 is a perspective view of an engaging portion of the attachment of the exhaust air duct shown in FIG. 5.

30 Explanation of Reference:

[0015]

- 1: Air conditioner (split type air conditioner)
- 35 3: Outdoor unit
- 30: Casing
- 30A: Partition panel
- 30B: Machine chamber
- 30C: Heat exchange chamber
- 40 31: Outdoor heat exchanger
- 32: Outdoor fan
- 33: Compressor
- 34: Control box
- 44: Air passage
- 45 46: Air exhaust port
- 47: Air vent port
- 48: Exhaust air duct
- 48A: Flashing
- 49: Exhaust air pathway (air vent path)

50 Best Mode for Carrying Out the Invention

[0016] Hereunder is a description of an embodiment according to the present invention, with reference to FIG. 1 through FIG. 6.

FIG. 1 shows a perspective view of a split type air conditioner comprising an outdoor unit control box according to one embodiment of the present invention.

The split type air conditioner 1 comprises an indoor unit 2 to be installed inside a room, an outdoor unit 3 to be installed outside the room, a refrigerant pipe 4 and an electric cable 5 connecting between the indoor unit 2 and the outdoor unit 3, and a remote control 6 for operating the air conditioner 1.

[0017] The indoor unit 2 comprises: a casing 22 having an air inlet 20 for taking in air from a room and an air outlet 21 for supplying temperature-controlled air; and an air filter 23, an indoor heat exchanger 24, an indoor fan 25, and an indoor controller 26 disposed in the casing 22; and the like. The indoor unit 2 has a function to circulate the air in a room with the indoor fan 25, to heat up or cool down this air with the indoor heat exchanger 24 through heat-exchange with a refrigerant, and to blow out the temperature-controlled air into the room to thereby condition the air in the room.

[0018] Meanwhile, the outdoor unit 3 comprises: a casing 30, the interior of which is partitioned by a partition panel 30A into a machine chamber 30B and a heat exchange chamber 30C in which outside air can be circulated; an outdoor heat exchanger 31 and an outdoor fan 32 disposed on the heat exchange chamber 30C side in the casing 30; a compressor 33 disposed on the machine chamber 30B side in the casing 30; a four-way switch valve (not shown); a control box 34 which has a control board for controlling devices in the outdoor unit and other electric components housed and equipped therein; and the like. The outdoor unit 3 has a function to compress the refrigerant with the compressor 33 into a high-temperature and high-pressure gas or a high-pressure liquid refrigerant condensed by the outdoor heat exchanger 31, by switching over the four-way switch valve, and to supply the gas or liquid to the indoor unit 2.

[0019] The control box 34 is disposed above the machine chamber 30B and just under the top panel constituting the casing 30 at a predetermined distance from the top panel. An air exhaust port, a portion having fins for radiating heat from heat-generating parts, and the like, which partially constitute the control box and will be described later, are set above the partition panel 30A and astride the machine chamber 30B and the heat exchange chamber 30C so that these parts protrude to the heat exchange chamber 30C side (refer to FIG. 3 and FIG. 4).

[0020] FIG. 2 shows an external perspective view of the control box 34 provided in the casing 30. FIG. 3 shows a partially broken front view of thereof. FIG. 4 shows an enlarged longitudinal cross-sectional view of a part of the air exhaust port of the control box 34.

The control box 34 comprises a main box body 40 and a lid 41 attached so as to cover the top face of the main box body 40. These main box body 40 and lid 41 are resin moldings respectively made of a flame-retardant ABS resin or like resin.

[0021] On the exterior side of the main box body 40, a terminal block 42 to be connected to the electric cable is provided. On the interior side of the main box body 40 a control board 43 and various electric components such

as an inverter power module, a capacitor, and an inductor (not shown) are housed and equipped. The control board 43 is placed on the main box body 40 having a pattern surface facing upward in a substantially hermetic manner so that the pattern surface can be protected from water and dust by the lid 41. On the bottom side within the main box body 40 an air passage 44 is formed with a structure by which outside air let into one end of the main box body 40 can pass through the air passage 44 and then can be discharged from the other end of the main box body 40 into the heat exchange chamber 30C side, to effect heat radiation from the main box body 40.

[0022] As described above, the other end of the main box body 40 protrudes to the heat exchange chamber 30C side. In the protruding part exposed to the heat exchange chamber 30C, the heat sink radiation fins 45 for cooling down the heat-generating parts such as an inverter power module are disposed. Also, the lower part of the protruding part is provided with an air exhaust port 46 for discharging cooling air that has passed through the main box body 40 to the heat exchange chamber 30C side. As shown in FIG. 4, the air exhaust port 46 has a structure which opens to face the partition panel 30A in the heat exchange chamber 30C, by a guide portion 46A integrally formed with the main box body 40.

[0023] The air exhaust port 46 is equipped with a resin exhaust air duct 48 extending into the main box body 40 and having at an end thereof an air vent port 47 which opens toward the air passage 44. This defines an exhaust air pathway 49 curved in a bent shape from the air vent port 47 through exhaust air duct 48 to the air exhaust port 46. The exhaust air duct 48 is open at the bottom end, and is integrally formed with a flashing 48A in the attachment for the air exhaust port 46 positioned thereunder. In addition, the extension length (height dimension) of the exhaust air duct 48 into the main box body 40 is determined so that a droplet hitting against and splashing back from the partition panel 30A will not be able to reach the air vent port 47, even if the droplet enters from the air exhaust port 46 and repeatedly hits against and splashes back from the inner surfaces of the duct.

[0024] Furthermore, it is needless to say that the cross-sectional dimension of the exhaust air duct 48, the position and the area of the air vent port 47, and the like can be appropriately set to achieve an optimum exhaust efficiency obtained as a whole by taking into account the positions and the calorific values of the electric components disposed in the main box body 40, and the like. In addition, as shown in FIG. 6, between the exhaust air duct 48 and an attachment of the main box body 40 for the exhaust air duct, a dent 50 is formed in either one of them and a convex part 51 is integrally formed on the other one, so that the dent 50 and the convex part 51 can be engaged with each other when fitting the exhaust air duct 48 into the main box body 40.

[0025] According to this embodiment, the above-mentioned structure provides the following operations and effects.

The split type air conditioner 1 performs cooling and heating operations by: supplying the indoor unit 2 through the refrigerant pipe 4 with either a high-pressure liquid refrigerant or a high-temperature and high-pressure gas refrigerant conditioned by the compressor 33, the outdoor heat exchanger 31, the four-way switch valve (not shown), or the like in the outdoor unit 3; exchanging heat between this refrigerant and air in a room circulated by the indoor fan 25, by using the indoor heat exchanger 24 in the indoor unit 2, to thereby heat up or cool down the air; and blowing the temperature-controlled air out into the room.

[0026] The outdoor unit 3 is usually installed outside and exposed to the weather. However, as shown in FIG. 1, the control box 34 provided within the outdoor unit 3 is generally disposed just under the top panel of the machine chamber 30B in the casing 30, and thus is not directly exposed to the weather. Meanwhile, the control box 34 houses heat-generating electric components such as an inverter power module, a capacitor, and an inductor. Therefore, in order to emit the heat radiated from these electric components, the air passage 44 is formed so that outside air can blow therethrough.

[0027] The blowing of outside air through the air passage 44 is achieved by discharging the outside air that has been let in from one end of the main box body 40 through the air exhaust port 46 provided at the other end of the main box body 40 into the heat exchange chamber 30C, because the outdoor fan 32 is driven to create a suction effect when the outside air is circulated on the heat exchange chamber 30C side. By so doing, heat generated in the main box body 40 can be radiated to the outside. However, if the air conditioner 1 is operated when it rains, rainwater drawn into the heat exchange chamber 30C may be caught up by the outdoor fan 32 and droplets thereof may travel backward from the air exhaust port 46 and may enter the control box 34.

[0028] Therefore, in this embodiment, the air exhaust port 46 is provided with the exhaust air duct 48 extending into the air passage 44 of the main box body 40, and furthermore, the exhaust air pathway 49 curved in a bent shape is formed by the air exhaust port 46 which opens to face the partition panel 30A, the exhaust air duct 48, and the air vent port 47 provided in the exhaust air duct 48. Therefore, it is difficult for a droplet caught up by the outdoor fan 32 to reach the air vent port 47 and enter the main box body 40, even if the droplet hits against the partition panel 30A, splashes back therefrom, and enters the air exhaust port 46, unless the droplet keeps going further and further by repeatedly hitting against and splashing back from the inner surfaces of the exhaust air pathway 49.

[0029] In this way, if it rains, or in such weather, rainwater that has traveled backward through the heat-radiation ventilation system (exhaust air pathway 49) running from the control box 34 to the heat exchange chamber 30C, and has flown into the heat exchange chamber 30C, can be reliably prevented from entering the control box

34 in the form of droplets. Accordingly, corrosion, failure, and the like of the control board 43 and other electric components resulting from entry of droplets into the control box and adhesion of the droplets to such components can be avoided, by which the quality and the reliability of a product can be enhanced.

[0030] In addition, the position, the area, and the like of the air vent port 47 can be arbitrarily set in the exhaust air duct 48, taking into account the positions and the calorific values of the electric components disposed in the main box body 40, and the like. Therefore, the heat radiation efficiency within the main box body 40 or the cooling efficiency on heat-generating parts can be optimized by having the air vent port 47 in the vicinity of the heat-generating parts, or by narrowing down the size of the opening, by which the heat radiation efficiency or the cooling efficiency can be improved. Furthermore, since the exhaust air duct 48 is provided to the air exhaust port 46, its muffler effect can be utilized to reduce mechanical noise (noise of the compressor) emitting from the machine chamber 30B through the ventilation system (exhaust air pathway) 49 toward the heat exchange chamber 30C side.

[0031] Moreover, since the attachment of the exhaust air duct 48 is provided with the flashing 48A, a droplet intruding from the gap in the attachment of the exhaust air duct 48 into the main box body 40 can be intercepted by the flashing 48A. Accordingly, intrusion of droplets from the ventilation system (exhaust air pathway) 49 into the main box body 40 can be almost perfectly blocked, and thereby the quality and the reliability of a product can be enhanced.

Furthermore, between the exhaust air duct 48 and the main box body 40, a concave part 50 is provided in either one of them and a convex part 51 is provided on the other one in an engagable manner. Therefore, misassembling of the exhaust air duct 48 with the air exhaust port 46 can be prevented to avoid having the air vent port 47 set the other way around.

[0032] The present invention is not to be limited by the invention according to the embodiment mentioned above, and can be appropriately modified without departing from the gist thereof. For example, the above-mentioned embodiment has been described as an example where the control box 34 is made of a resin, but needless to say the control box 34 can also be made of a sheet metal. Moreover, although it is desirable that the exhaust air duct 48 is made of a resin in terms of the ease of molding or the like, the material is not to be limited to resins.

Claims

1. An outdoor unit control box disposed above a machine chamber in a casing, the interior of which is partitioned by a partition panel into a heat exchange chamber housing an outdoor heat exchanger, an

outdoor fan, and the like, and the machine chamber housing a compressor and the like, while a part of the control box protrudes to the side of the heat exchange chamber, wherein

an air exhaust port which opens to face the partition panel in the heat exchange chamber is provided at one end of an air passage formed in the control box, and an exhaust air duct extending into the control box and having at an end thereof an air vent port which opens toward the air passage is provided to the air exhaust port. 5 10

2. An outdoor unit control box according to claim 1, wherein an exhaust air pathway curved in a bent shape is defined by the air vent port, the exhaust air duct, and the air exhaust port. 15

3. An outdoor unit control box according to either one of claim 1 and claim 2, wherein a flashing is formed in an attachment of the exhaust air duct. 20

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FIG. 1

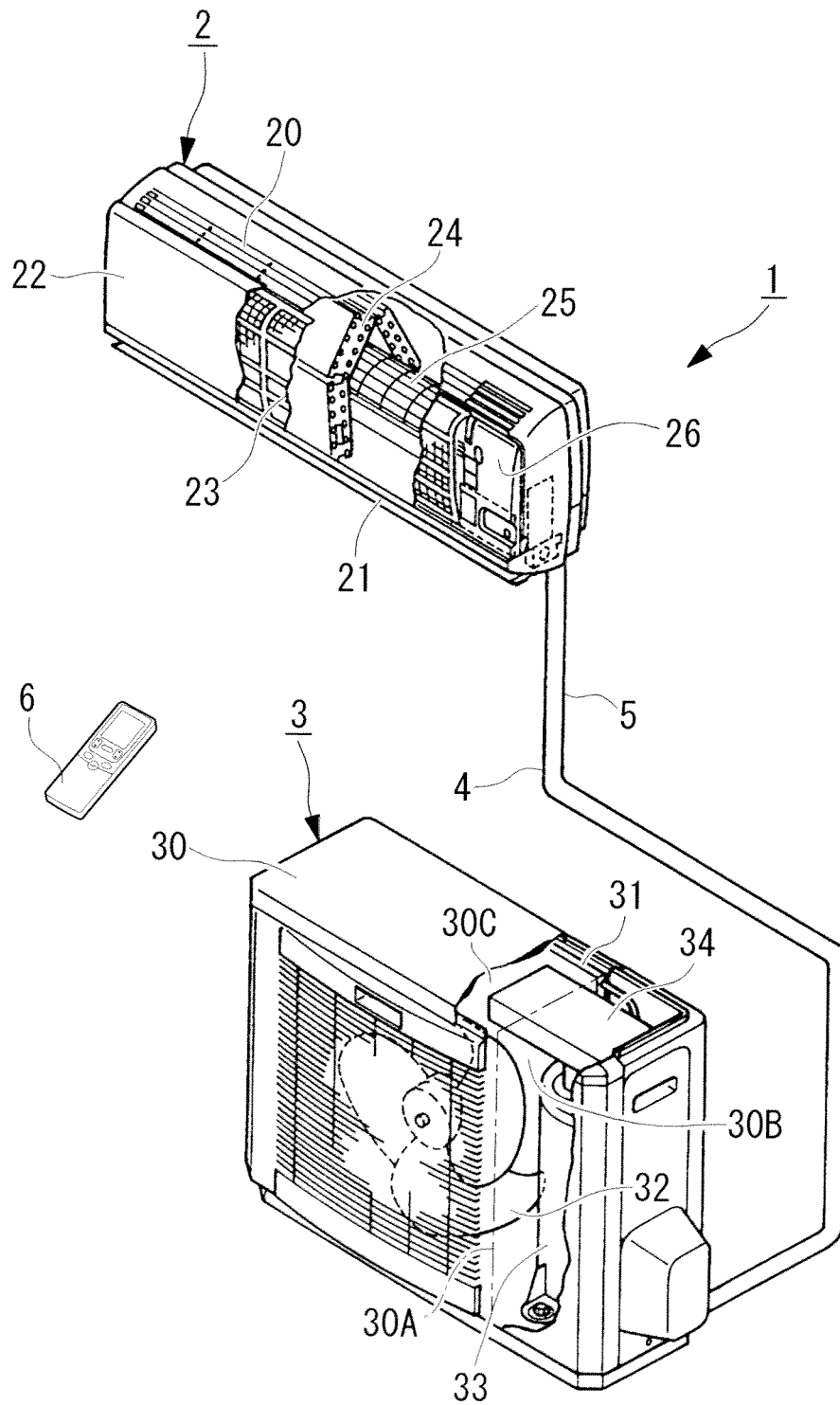


FIG. 2

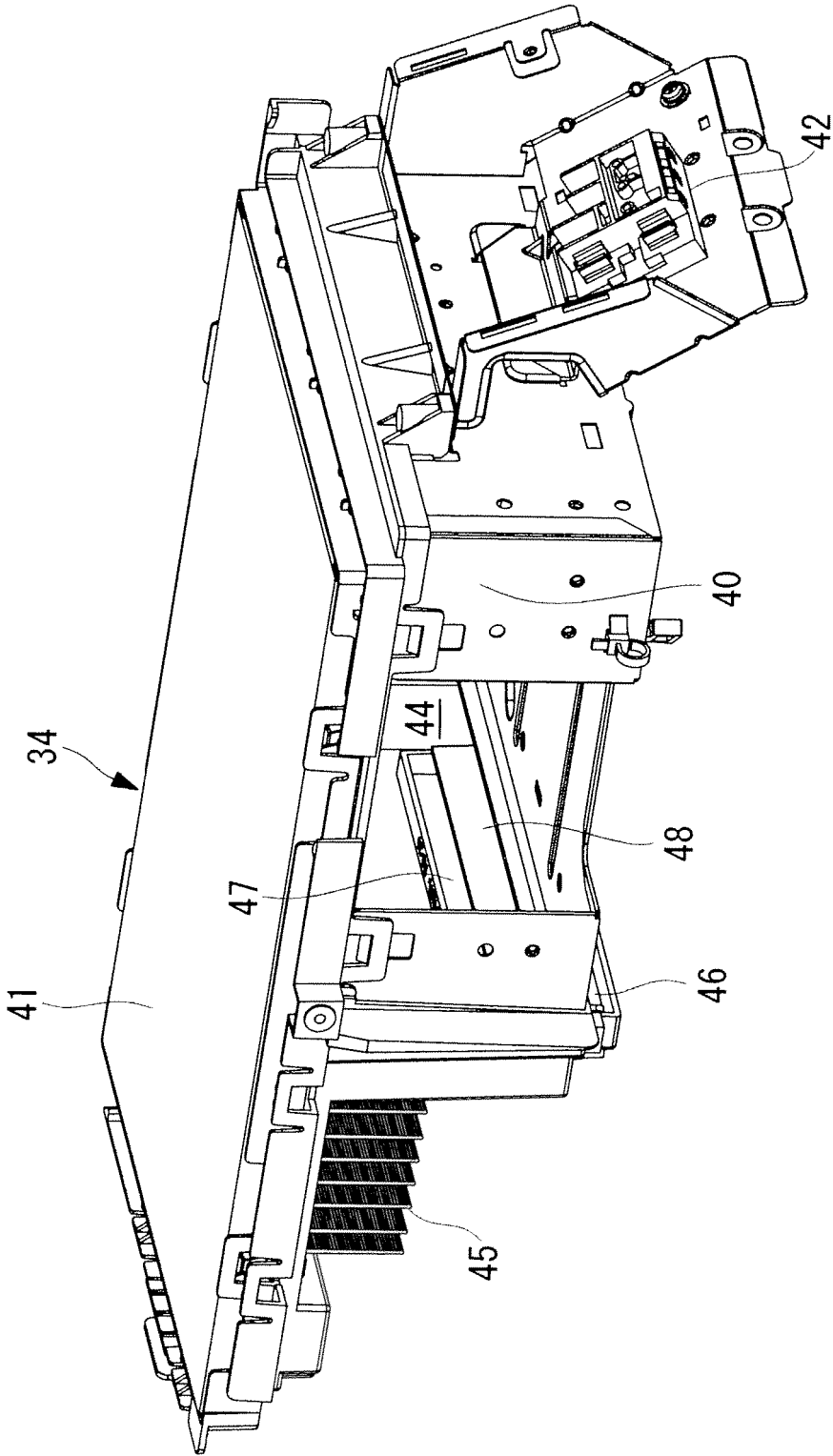


FIG. 3

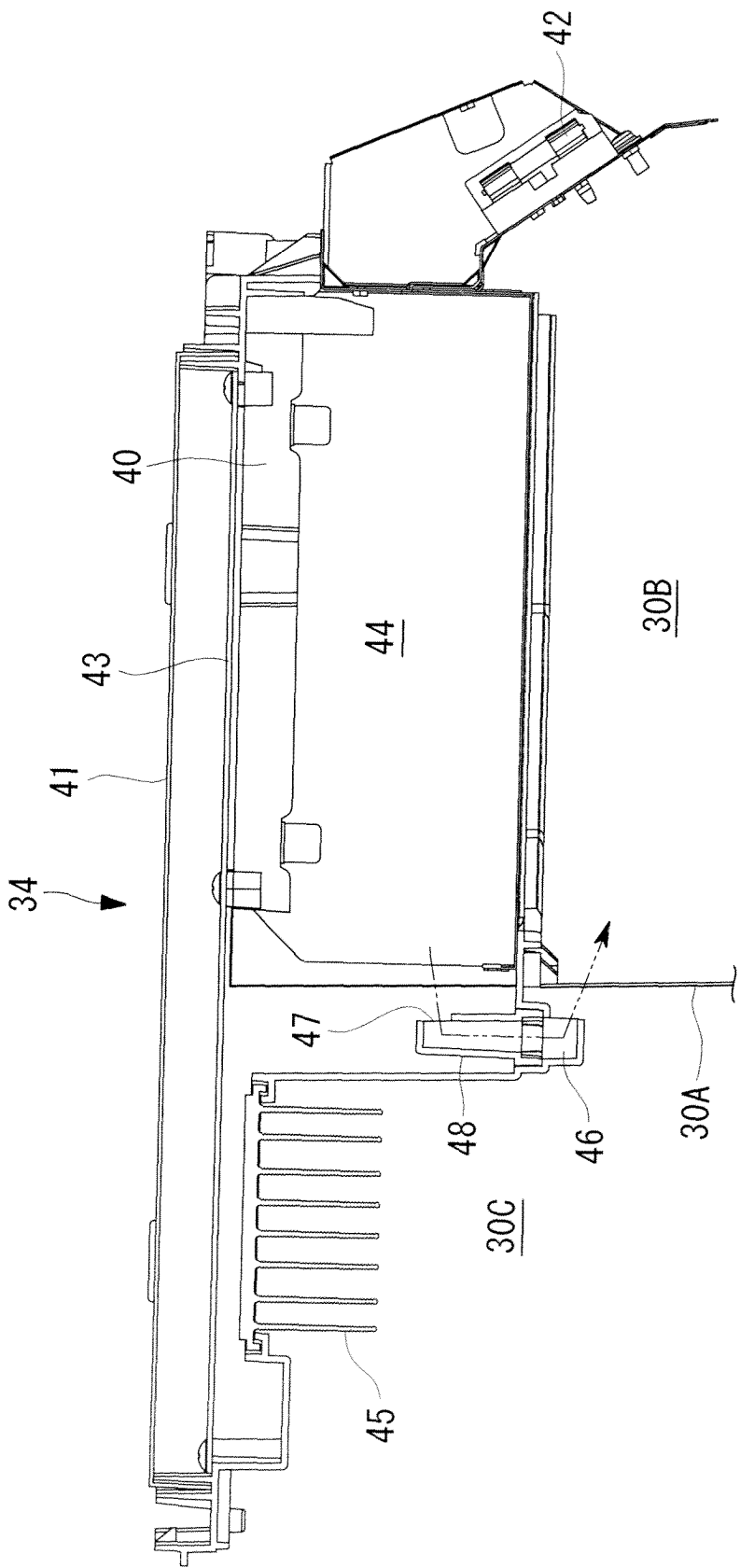


FIG. 4

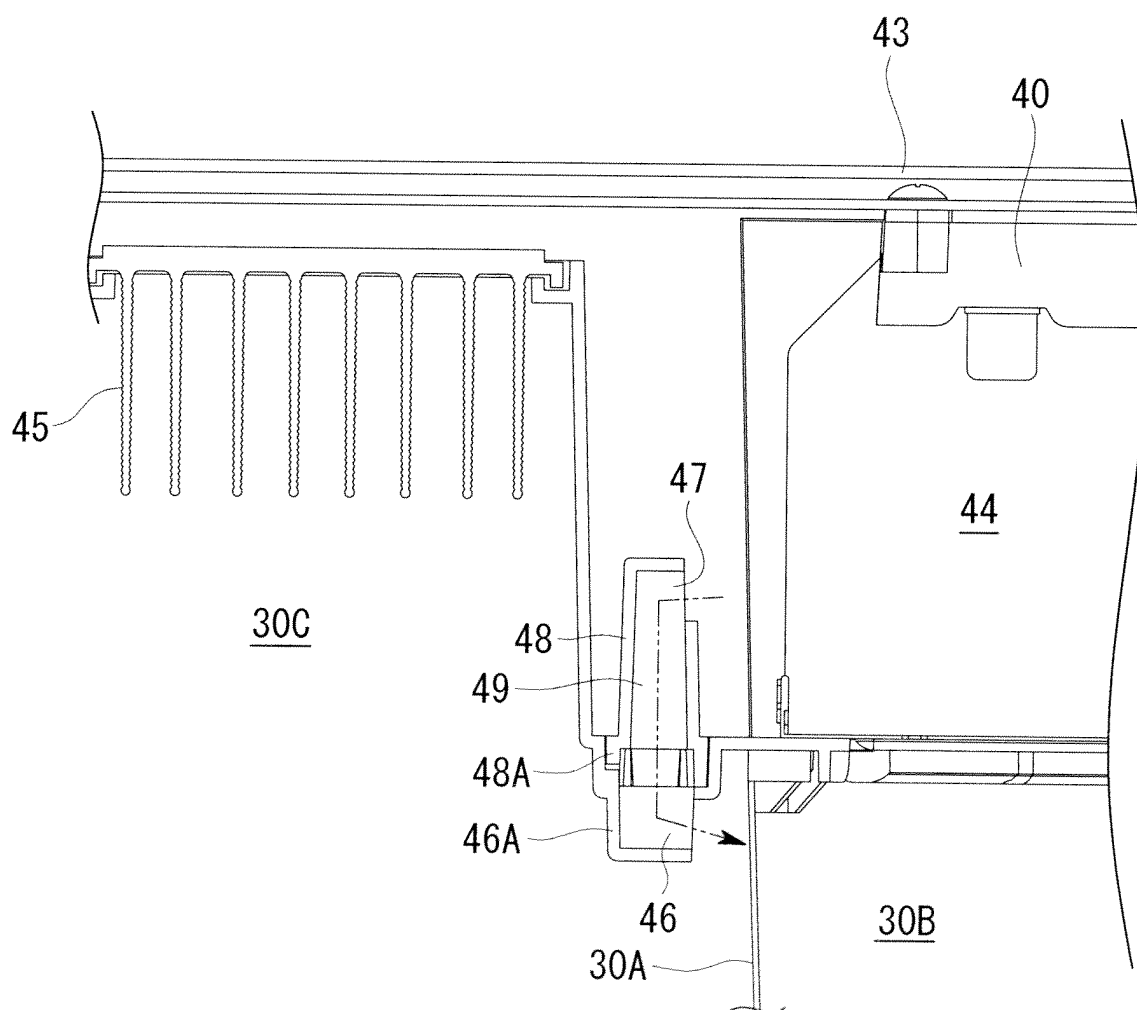


FIG. 5

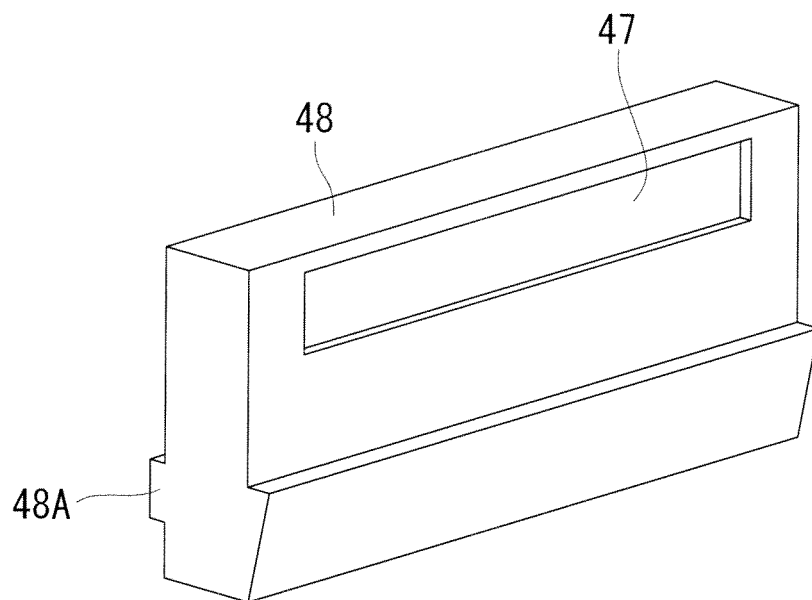
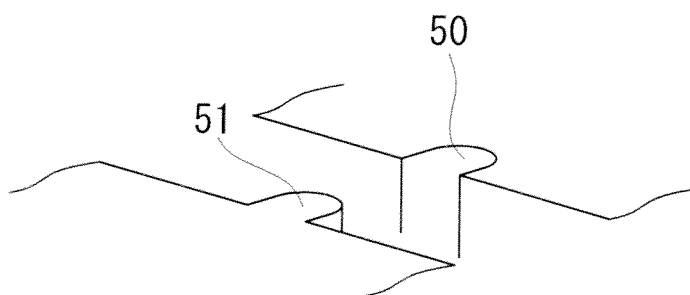


FIG. 6



INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2009/051790

A. CLASSIFICATION OF SUBJECT MATTER

F24F5/00 (2006.01) i

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

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

F24F5/00

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

Jitsuyo Shinan Koho 1922-1996 Jitsuyo Shinan Toroku Koho 1996-2009

Kokai Jitsuyo Shinan Koho 1971-2009 Toroku Jitsuyo Shinan Koho 1994-2009

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 11-241840 A (Sharp Corp.), 07 September, 1999 (07.09.99), Fig. 5 (Family: none)	1-3
Y	JP 2004-239532 A (Toshiba Carrier Corp.), 26 August, 2004 (26.08.04), Fig. 4 (Family: none)	1-3
Y	JP 2003-56865 A (Toshiba Carrier Corp.), 26 February, 2003 (26.02.03), Figs. 7, 10 & EP 1416230 A1 & WO 2003/016788 A1	1-3

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

* Special categories of cited documents:

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Date of the actual completion of the international search

26 March, 2009 (26.03.09)

Date of mailing of the international search report

07 April, 2009 (07.04.09)

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Patent documents cited in the description

- JP 2004271168 A [0004]