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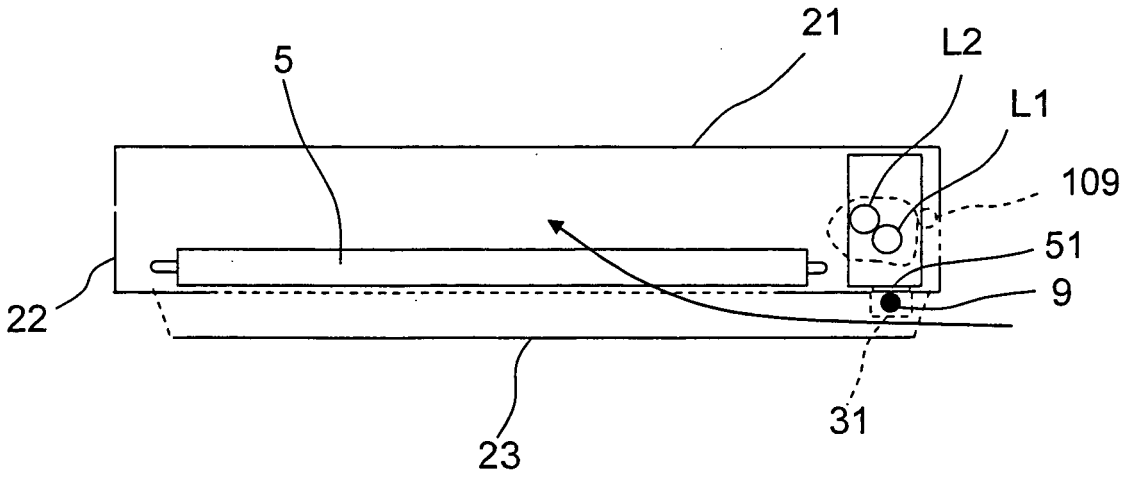
(54) **AIR CONDITIONER**

(57) An air conditioner includes a bottom frame (21) housing an indoor heat exchanger (5), a front grill (22) fitted to a front side of the bottom frame (21), a front panel (23) fitted to a front side of the front grill (22), a temperature sensor (9) provided between the indoor heat exchanger (5) and connection pipings (L1 and L2) connected to the indoor heat exchanger (5), and a board (51) shielding the temperature sensor (9) from the indoor heat exchanger (5) and connection pipings (L1 and L2). The temperature sensor (9) is placed in an air passage between the front grill (22) and front panel (23).

Fig.5B



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Description

TECHNICAL FIELD

[0001] The present invention relates to air conditioners.

BACKGROUND ART

[0002] A conventional air conditioner has a temperature sensor mounted in front of a heat exchanger by means of a fitting (see JP 9-178305 A, for example).

[0003] In this air conditioner, the temperature sensor can precisely detect the temperature of air taken in from a room while the air conditioner is operating because the sensor is located in an air passage. In a multi-type air conditioner including two or more indoor units, however, when an indoor unit is out of operation while other indoor units are operating, a refrigerant is made to circulate even in the out-of-operation indoor unit to prevent pool of the refrigerant therein. In this case, disadvantageously, the temperature sensor in the out-of-operation indoor unit cannot detect the indoor temperature correctly under the influence of the temperature of the heat exchanger.

[0004] It is conceivable to design an air conditioner such that a temperature sensor is placed in a position distant from the heat exchanger. However, even in such a case, due to a limited space within the air conditioner, the temperature sensor may fail to correctly detect the indoor temperature under the influence of the temperature of connection piping connected to the heat exchanger.

SUMMARY OF INVENTION

TECHNICAL PROBLEM

[0005] An object of the present invention is to provide an air conditioner capable of correctly and precisely detecting the indoor temperature with a simple structure even when the air conditioner is out of operation.

SOLUTION TO PROBLEM

[0006] In order to solve the problem, an air conditioner according to the present invention includes:

a casing that houses a heat exchanger;
a front grill fitted to a front side of the casing;
a front panel fitted to a front side of the front grill;
a temperature sensor placed between the heat exchanger and a connection piping connected to the heat exchanger; and
a cover for shielding the temperature sensor from the heat exchanger and/or the connection piping,

wherein the temperature sensor is provided so as to be located in an air passage between the front grill and the front panel.

[0007] In the air conditioner with the above arrangement, the temperature sensor is located in a position between the heat exchanger and the connection piping, and moreover the temperature sensor is shielded or blocked from the heat exchanger and the connection piping by the cover. Therefore, it is possible to reduce the influence of radiant heat from the heat exchanger and the connection piping irrespective of whether the air conditioner is in operation or out of operation. Also, while the air conditioner is operating, air circulates through the air passage between the front panel and the front grill where the temperature sensor is located. The temperature sensor, therefore, can correctly detect the temperature. That is, the air conditioner achieves correct detection of the indoor temperature with simple arrangement even when it is out of operation.

[0008] In one embodiment, the cover constitutes a part of the front grill.

[0009] In the embodiment, because the cover for blocking radiant heat from the heat exchanger and/or the connection piping constitutes part of the front grill, portions of the front grill around the cover are also usable as a heat shield. As a result, the heat blocking effect may be enhanced.

[0010] In one embodiment, the temperature sensor is on a plane located forward of a front-side plane of the heat exchanger.

[0011] In the embodiment, because the temperature sensor is located on the plane forward of the front-side plane of the heat exchanger, the temperature sensor is distant from the heat exchanger and/or the connection piping. This contributes further to the reduction of the influence of radiant heat from the heat exchanger and/or the connection piping.

ADVANTAGEOUS EFFECTS OF INVENTION

[0012] As is apparent from the above, the present invention can achieve an air conditioner capable of correctly detecting the indoor temperature with a simple arrangement even while the air conditioner is out of operation.

[0013] According to an embodiment, the cover blocking the radiant heat from the heat exchanger and/or the connection piping constitutes a part of the front grill, portions around the cover of the front grill are also usable as a heat shield. As a result, the heat blocking effect is enhanced.

[0014] In an embodiment, because the temperature sensor is located on a plane forward of the front-side plane of the heat exchanger, the temperature sensor is distant from the heat exchanger and/or the connection piping. This contributes further to the reduction of the influence of radiant heat from the heat exchanger and/or the connection piping.

BRIEF DESCRIPTION OF DRAWINGS

[0015]

Fig. 1 shows a refrigerant circuit diagram of an air conditioner in one embodiment of the invention;
Fig. 2 shows a perspective view of a floor standing type indoor unit of the air conditioner;
Fig. 3 shows a perspective view of the floor standing type indoor unit from which a front panel has been removed;
Fig. 4 is a sectional view of the above indoor unit;
Fig. 5A shows a schematic front view for explaining the position of a temperature sensor in the above indoor unit; and
Fig. 5B shows a schematic top plan view for explaining the position of the temperature sensor in the above indoor unit.

DESCRIPTION OF EMBODIMENTS

[0016] Hereinbelow, embodiments of the air conditioner according to the present invention will be described in detail with reference to the attached drawings.

[0017] Fig. 1 shows a refrigerant circuit diagram of the air conditioner as one embodiment of the invention. As shown in Fig. 1, the air conditioner has a compressor 1, a four-way directional control valve 2 one end of which is connected to a discharge side of the compressor 1, an outdoor heat exchanger 3 one end of which is connected to another end of the four-way directional control valve 2, an electric expansion valve 4 one end of which is connected to the other end of the outdoor heat exchanger 3, an indoor heat exchanger 5 one end of which is connected to the other end of the electric expansion valve 4 via a closing valve 12 and connection piping L1, and an accumulator 6 one end of which is connected to the other end of the indoor heat exchanger 5 via a closing valve 13, connection piping L2 and the four-way directional control valve 2 while the other end of the accumulator 6 is connected to a suction side of the compressor 1. A refrigerant circuit is formed by the compressor 1, the four-way directional control valve 2, the outdoor heat exchanger 3, the electric expansion valve 4, the indoor heat exchanger 5 and the accumulator 6.

[0018] The air conditioner further has an outdoor fan 7 placed in the vicinity of the outdoor heat exchanger 3, an indoor fan 8 placed in the vicinity of the indoor heat exchanger 5, a temperature sensor 9 for detecting an indoor temperature, and a control unit 11 for controlling the compressor 1, the electric expansion valve 4, the outdoor fan 7, the indoor fan 8, the temperature sensor 9 and the like.

[0019] The control unit 11 is made up of a microcomputer, an input/output circuit and the like. The control unit 11 controls the compressor 1, the four-way directional control valve 2, the electric expansion valve 4, the indoor fan 7, etc.

[0020] The compressor 1, the four-way directional control valve 2, the outdoor heat exchanger 3, the electric expansion valve 4, the accumulator 6, the outdoor fan 7, and the control unit 11 are components of an outdoor unit 10. And, the indoor heat exchanger 5, the indoor fan 8, and the temperature sensor 9 are components of an indoor unit 20.

[0021] In heating operation of the air conditioner having the above configuration, when the compressor 1 is started after the four-way directional control valve 2 is switched to a position shown by a solid line, a high pressure refrigerant discharged from the compressor 1 goes into the indoor heat exchanger 5 via the four-way directional control valve 2. Then, the refrigerant is condensed by the indoor heat exchanger 5, decompressed by the electric expansion valve 4, and goes into the outdoor heat exchanger 3. The refrigerant is evaporated in the outdoor heat exchanger 3 and returns to the suction side of the compressor 1 via the four-way directional control valve 2 and the accumulator 6. In this way, to implement a refrigerating cycle, the refrigerant circulates through the refrigerant circuit which is formed by the compressor 1, the indoor heat exchanger 5, the electric expansion valve 4, the outdoor heat exchanger 3 and the accumulator 6. Indoor air is circulated through the indoor heat exchanger 5 by the indoor fan 8 to thereby heat a room.

[0022] On the other hand, in a cooling operation, the four-way directional control valve 2 is switched to a position shown by a dotted line. The refrigerating cycle is implemented by circulation of the refrigerant in order of the compressor 1, the outdoor heat exchanger 3, the electric expansion valve 4, the indoor heat exchanger 5, and the accumulator 6.

[0023] Fig. 2 shows a perspective view of the indoor unit 20 of the air conditioner. The indoor unit 20 has a base frame 21, a front grill 22 and a front panel 23, as shown in Fig. 2. The base frame 21, which is an example of the casing, has a generally rectangular shape whose rear side is mounted on an indoor wall surface. The front grill 22 is fitted to a front side of the base frame 21 and has a generally rectangular-shaped opening 22c at its front face. Also, the front panel 23 is fitted so as to cover the opening 22c of the front grill 22.

[0024] An upper side outlet 22a is provided in an upper part of the front grill 22. A lower side outlet 22b is provided in a lower part of the front grill 22. The upper side outlet 22a of the front grill 22 is equipped with a flap 24. The flap 24 rotates during cooling and heating operations to respectively blow off cool and warm air through the upper side outlet 22a in an obliquely upward and forward direction. At the time of stoppage, the flap 24 covers the upper side outlet 22a, as shown in Fig. 2.

[0025] The front panel 23 is provided with an upper side inlet 23a at its upper part. A lower side inlet 23b is provided at a lower part of the front panel 23. Further, lateral inlets 23c are provided at the right and left sides of the front panel 23 (Fig. 2 shows only the right-side inlet).

[0026] Fig. 3 shows a perspective view of the floor standing type indoor unit 20 of the air conditioner from which the front panel 23 has been removed, wherein components same as those shown in Fig. 4 are denoted by the same reference numbers in Fig. 4.

[0027] As shown in Fig. 3, provided in an air passage between the front grill 22 and the front panel 23 is a sensor section 31 protruding forward from the right side of the front grill 22. A temperature sensor 9 is placed in this sensor section 31. The temperature sensor 9 is at a position not confronting the indoor fan 8 as seen from the front side. A humidity sensor may be placed together with the temperature sensor 9 in the sensor section 31.

[0028] The sensor section 31 is generally cubical in shape and has slits at each of its five sides, namely all sides other than the bottom that faces the front grill 22. Also, a board 51 (shown in Figure 5A and Figure 5B) mounted with the temperature sensor 9 is fixed to the bottom of the sensor section 31 so that the back side of the temperature sensor 9 is covered or shielded by the board. In this way, the temperature sensor 9 is shielded from radiant heat coming from the indoor heat exchanger 5 and/or the connection pipings L1, L2 (shown in Figures 5A and 5B). Thus, the indoor temperature can be detected precisely by the temperature sensor 9 while the air conditioner is out of operation.

[0029] Then, upon starting the operation of the air conditioner, room air that is taken into the front panel 23 through the lateral inlet 23c provided on the right side surface of the front panel 23 goes along the air passage between the front grill 22 and the front panel 23 and is taken into the opening 22c of the front grill 22. Thus, the indoor temperature can be detected precisely by the temperature sensor 9 also while the air conditioner is in operation.

[0030] Fig. 4 shows a sectional view of the indoor unit 20 of the air conditioner. In Fig. 4, the reference numeral 31 indicates the sensor section.

[0031] As shown in Fig. 4, a motor 26 is fixed onto a generally central portion of the base frame 21. The indoor fan 8 is placed on the base frame 21 so as to be connected to a shaft of the motor 26 which is oriented in the front-back direction. The indoor fan 8 is a turbo fan for blowing off air, which is sucked from the front side, in the radially outward direction with respect to the shaft. A bell mouth 27 is provided in the base frame 21 and in front of the indoor fan 8. The indoor heat exchanger 5 is placed to the front side of the bell mouth 27. The front grill 22 is mounted in front of the indoor heat exchanger 5. The front panel 23 is fitted to the front side of the front grill 22. The opening 22c of the front grill 22 is equipped with a filter 25. A drain pan 28 is placed below the bell mouth 27 and the indoor heat exchanger 5.

[0032] The flap 24 for controlling the air blowing direction vertically is provided at the upper side outlet 22a of an upper outlet passageway P1 of the front grill 22. Also, a shutter 30 for closing and opening the lower side outlet 22b is provided in a lower outlet passageway P2 of the front grill 22. The shutter 30 pivots around an axis 30a which is installed to the bottom frame 21 at a lower part of the lower outlet passageway P2. The dash-dot line A shows an open state of the shutter 30, while the dash-dot line B shows a closed state of the shutter 30.

[0033] The indoor fan 8 takes in air through the opening 22c of the front panel 22 and discharges radially outwardly of the shaft of the fan motor. More specifically, air is passed through the upper outlet passageway P1 and discharged diagonally upward and forward through the upper side outlet 22a, while air is passed through the lower outlet passageway P2 and discharged forward through the lower side outlet 22b.

[0034] Figs. 5A and 5B are schematic explanatory views to explain the position of the temperature sensor 9 in the indoor unit 20, wherein Fig. 5A shows a schematic front view, and Fig. 5B shows a schematic top plan view.

[0035] As shown in Figs. 5A and 5B, an electrical equipment box 50 is placed to the upper right side of the indoor heat exchanger 5 within the bottom frame 21. The upper side outlet 22a is placed in the upper part of the front grill 22, while the lower side outlet 22b is placed in the lower part of the front grill 22. Also, placed to the right side of the indoor heat exchanger 5 and to the lower side of the electrical equipment box 50 within the bottom frame 21 are the connection pipings L1 and L2 connected to the indoor heat exchanger 5 at an end thereof. And, the temperature sensor 9 mounted on the board 51 serving as a cover is placed to the lower front side of the electrical equipment box 50. The temperature sensor 9 mounted on the board 51 is installed within the sensor section 31 on the front grill 22 so that the board 51 covers the back-side of the sensor section 31. A sealant or sealing member (not shown) is applied between the outer circumference of the board 51 and outer peripheral portions of an opening for the sensor section 31 of the front grill 22 to more prevent heat from the indoor heat exchanger 5 and/or the connection pipings L1 and L2 from affecting the temperature sensor 9.

[0036] According to prior art, the bottom frame 21 may be provided with slits at a lower portion of a right-hand lateral side thereof to provide a lateral air passage leading to the indoor heat exchanger 5, and a temperature sensor 109 may be placed near the slits. However, if this technique is adopted in a multi-type air conditioner in which a slight amount of refrigerant is circulated in an out-of-operation indoor unit to prevent the refrigerant from pooling in the air conditioner, it is impossible to correctly detect the room temperature due to the influence of radiant heat coming from the connection pipings L1 and L2.

[0037] In contrast, in this embodiment, the temperature sensor 9 is located in a position between the indoor heat exchanger 5 and the connection pipings L1 and L2 and moreover the temperature sensor 9 is blocked from the indoor heat exchanger 9 and the connection pipings L1 and L2 by the board 51 serving as a cover. Therefore, it is possible to reduce the influence of radiant heat from the indoor heat exchanger 5 and the connection pipings

L1 and L2 irrespective of whether the air conditioner or the indoor unit is in operation or out of operation. Also, while the air conditioner is operating, air circulates through the air passage between the front panel 23 and the front grill 22 where the temperature sensor 9 is located. The temperature sensor 9, therefore, can correctly detect the temperature. That is, the air conditioner achieves correct detection of the indoor temperature with simple arrangement even when it is out of operation.

[0038] Furthermore, because the board 51, which serves as a cover to block the radiant heat from the indoor heat exchanger 5 and/or the connection pipings L1 and L2, constitutes a part of the front grill 22, portions of the front grill 22 around the board 51 are also usable as a heat shield. As a result, the heat blocking effect may be enhanced.

[0039] Also, because the temperature sensor 9 is located on a plane forward of the front-side plane of the heat exchanger 5, the temperature sensor 9 is accordingly in a position distant from the indoor heat exchanger 5 and the connection pipings L1 and L2. This contributes further to the reduction of the influence of radiant heat from the indoor heat exchanger 5 and/or the connection pipings L1 and L2.

[0040] In the above embodiment, description has been made of a floor standing air conditioner, but the present invention is not limited to the air conditioner of this type.

[0041] In the above embodiment, description has been made of a separate type air conditioner having an indoor unit and an outdoor unit, but the present invention is applicable to air conditioners of other types.

Claims

1. Air conditioner comprising:

a casing (21) that houses a heat exchanger (5);
a front grill (22) fitted to a front side of the casing (21);
a front panel (23) fitted to a front side of the front grill (22);
a temperature sensor placed between the heat exchanger (5) and a connection piping (L1, L2) connected to the heat exchanger; and
a cover (51) for shielding the temperature sensor (9) from the heat exchanger (5) and/or the connection piping (L1, L2),

wherein the temperature sensor (9) is provided so as to be located in an air passage between the front grill (22) and the front panel (23).

2. The air conditioner as claimed in claim 1, wherein the cover (51) constitutes a part of the front grill (22).

3. The air conditioner as claimed in claim 1 or 2, wherein the temperature sensor (9) is on a plane located forward of a front-side plane of the heat exchanger (5).

Fig.1

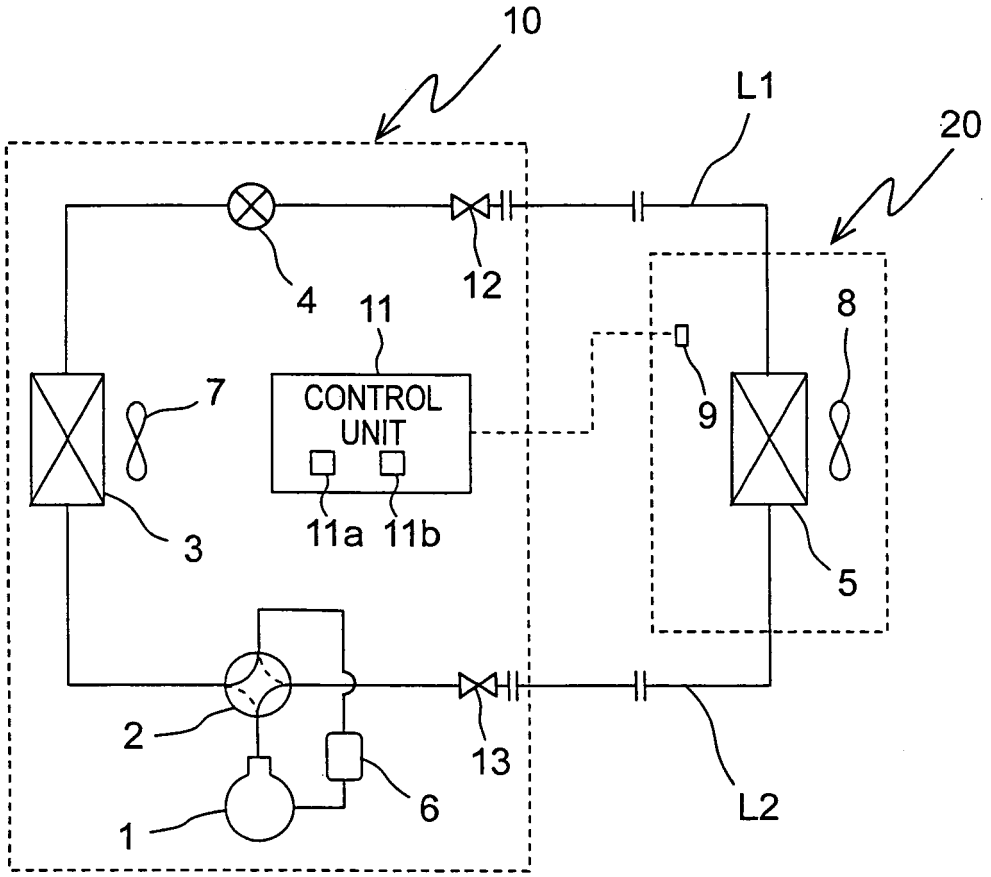


Fig.2

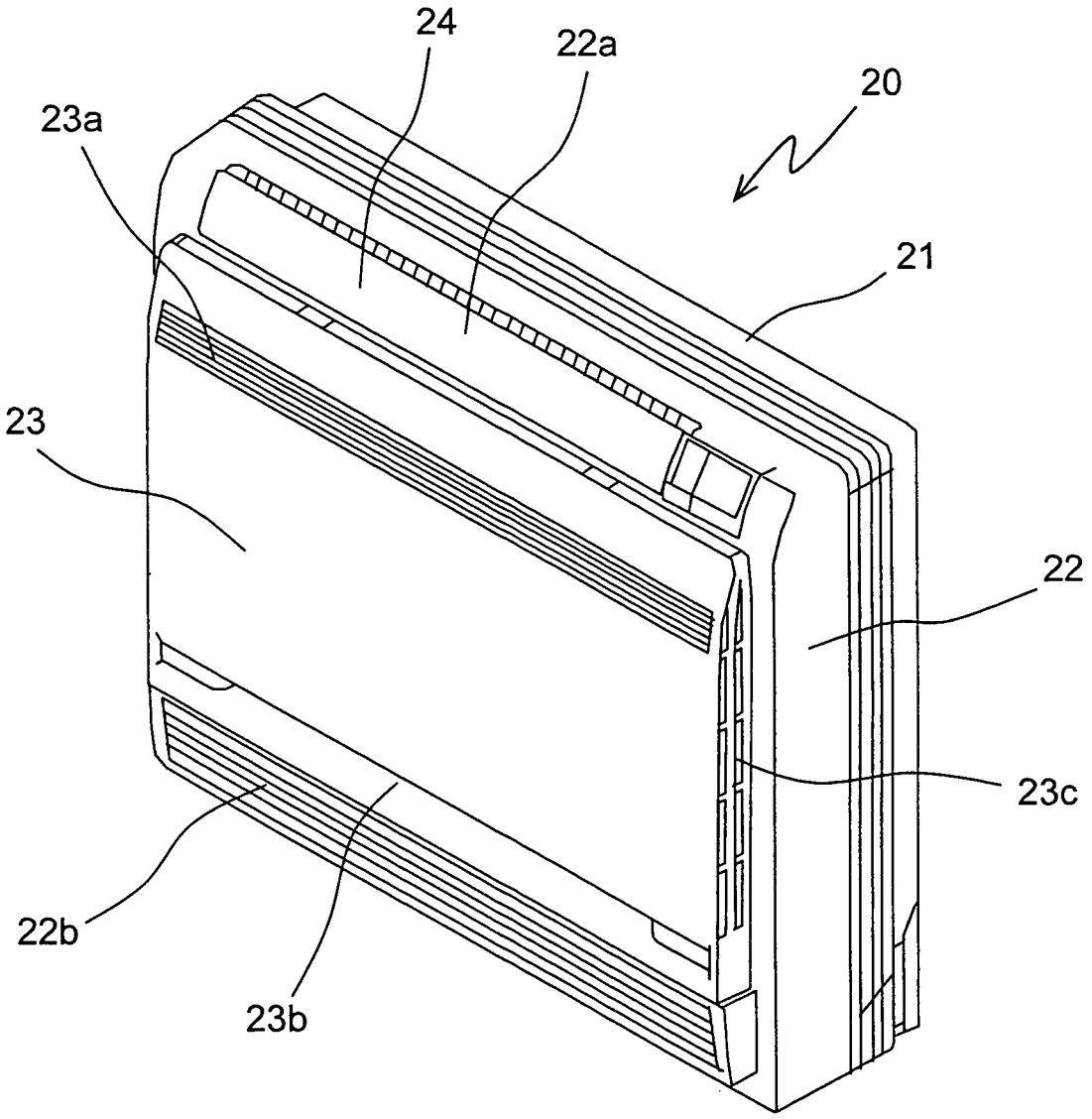


Fig.3

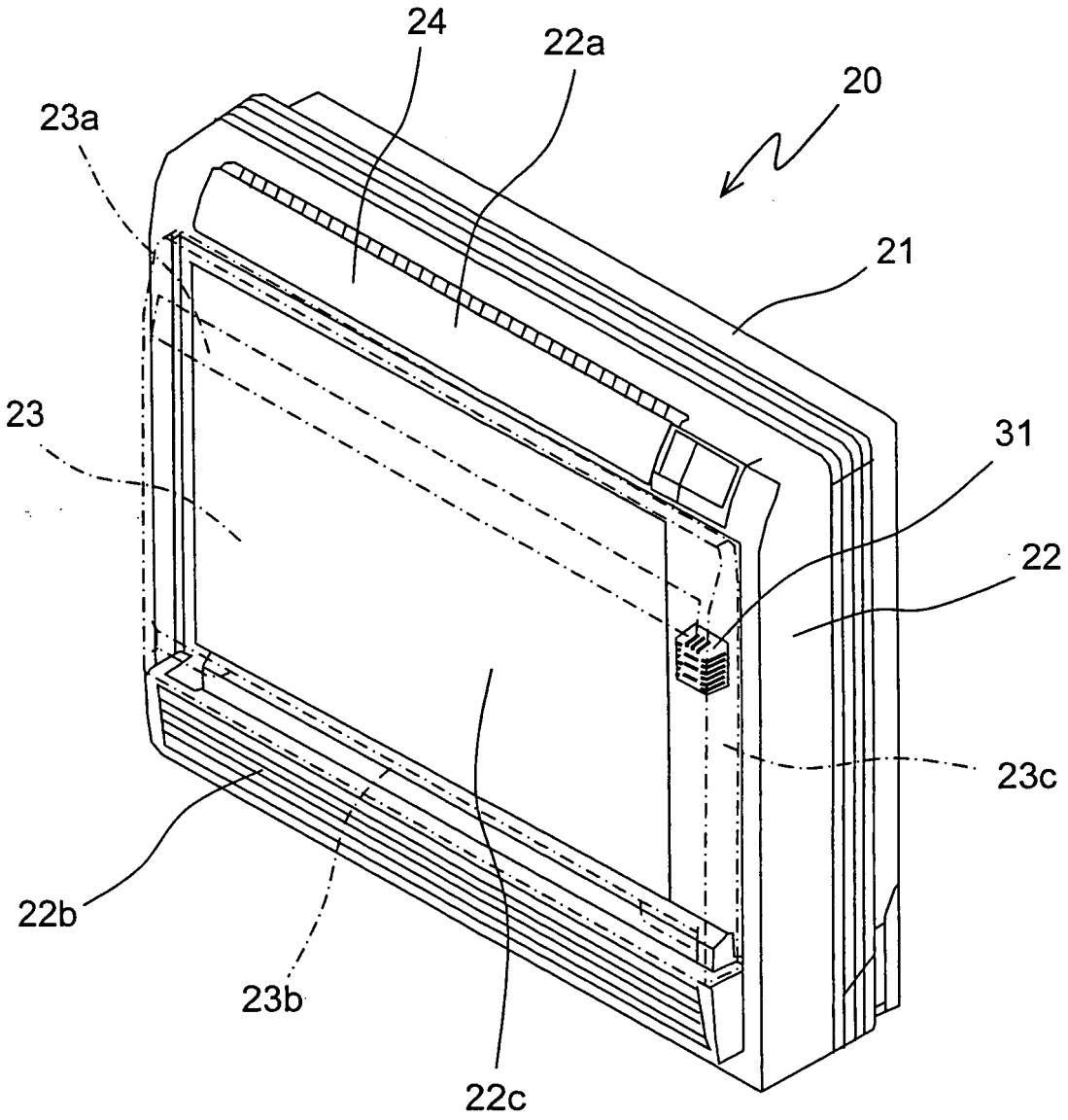


Fig.4

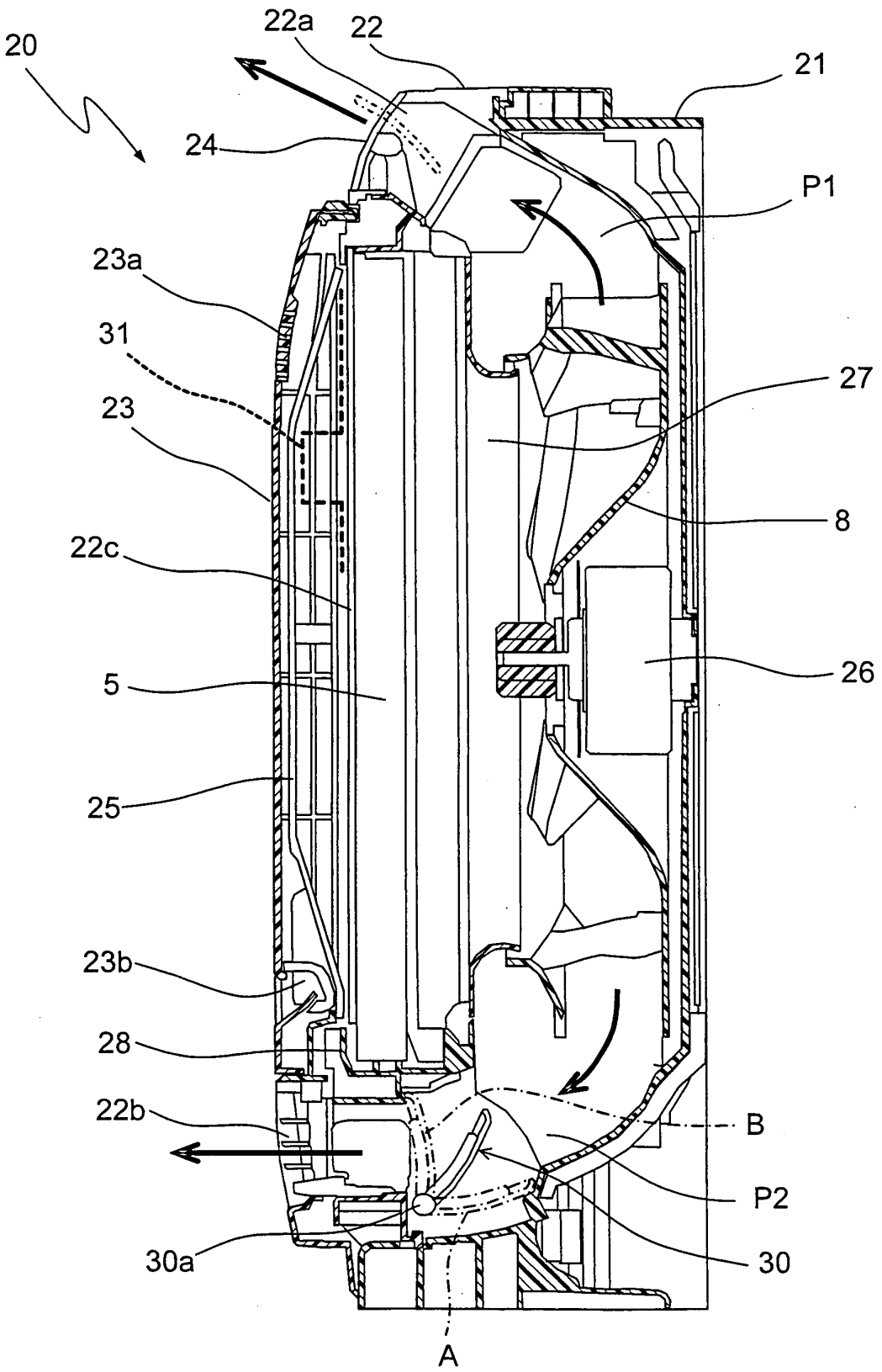


Fig.5A

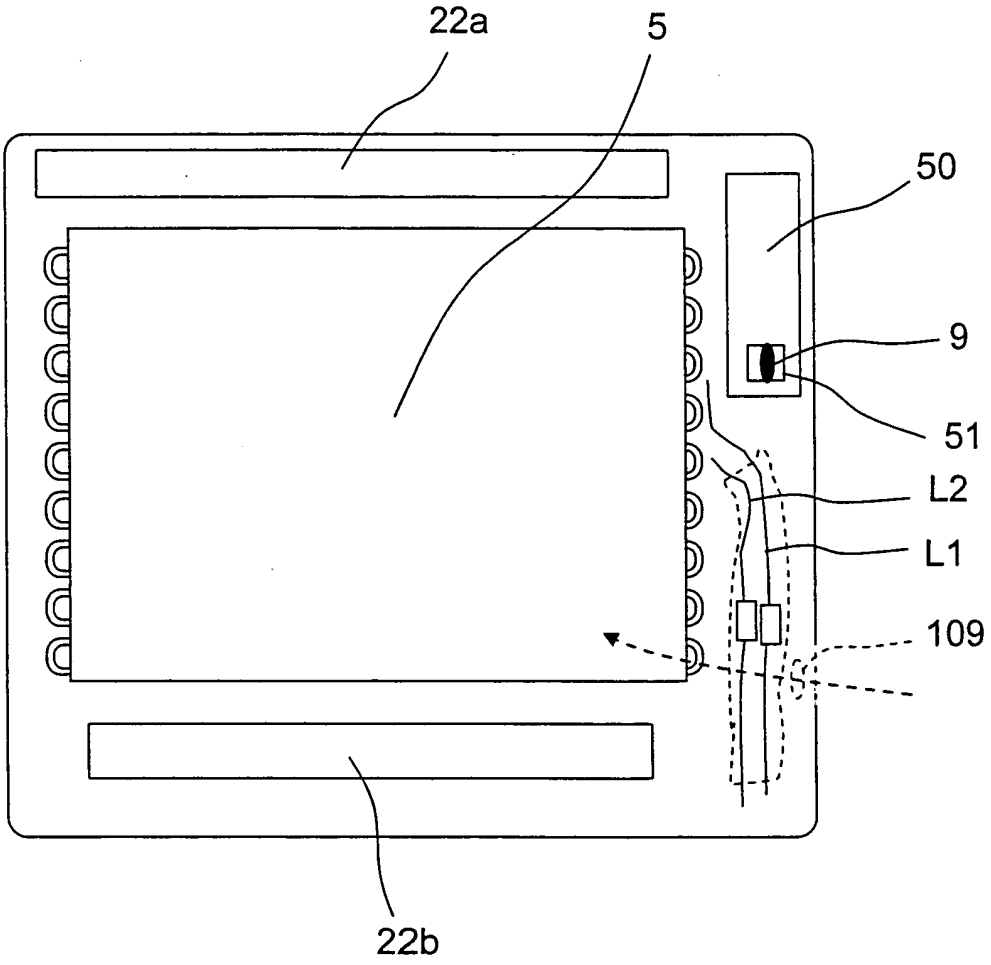
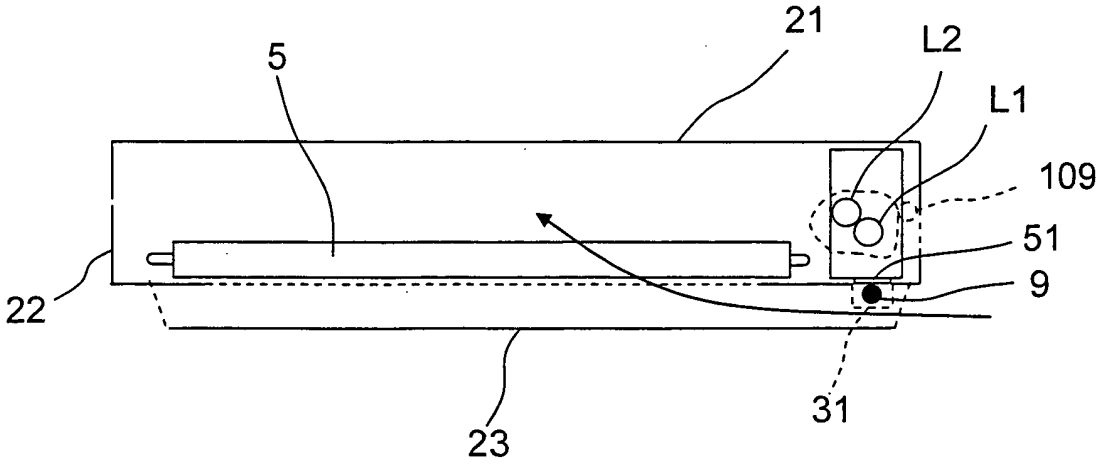


Fig.5B



INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2007/073396

A. CLASSIFICATION OF SUBJECT MATTER
F24F13/20(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)
F24F13/20

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
Jitsuyo Shinan Koho 1922-1996 Jitsuyo Shinan Toroku Koho 1996-2008
Kokai Jitsuyo Shinan Koho 1971-2008 Toroku Jitsuyo Shinan Koho 1994-2008

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	JP 7-139803 A (Sanyo Electric Co., Ltd.), 02 June, 1995 (02.06.95), Par. Nos. [0001] to [0034]; Figs. 1 to 13 (Family: none)	1,3
Y	JP 61-41840 A (Matsushita Electric Industrial Co., Ltd.), 28 February, 1986 (28.02.86), Page 2, upper left column, line 1 to upper right column, line 8; Fig. 2 (Family: none)	2,3
A	JP 9-178305 A (Sanyo Electric Co., Ltd.), 11 July, 1997 (11.07.97), Full text; all drawings (Family: none)	1-3

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

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Date of the actual completion of the international search	Date of mailing of the international search report
31 January, 2008 (31.01.08)	19 February, 2008 (19.02.08)
Name and mailing address of the ISA/ Japanese Patent Office	Authorized officer
Facsimile No.	Telephone No.

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REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- JP 9178305 A **[0002]**