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(71) Applicant: **Daikin Industries, Ltd.**
Osaka-shi, Osaka 530-8323 (JP)

(72) Inventor: **MASUI, Tomohiro**
Osaka-shi, Osaka 530-8323 (JP)

(74) Representative: **Hoffmann Eitle**
Patent- und Rechtsanwälte PartmbB
Arabellastraße 30
81925 München (DE)

(54) **OUTDOOR UNIT FOR REFRIGERATION DEVICE**

(57) To fix a bracket made of aluminum or aluminum alloy for attaching a heat exchanger made of aluminum or aluminum alloy and a side panel made of a non-aluminum metal and to prevent corrosion of the bracket made of aluminum or aluminum alloy. An attachment piece (53) of a bracket (50) made of aluminum is fixed to a blower chamber-side side panel (23) made of sheet steel. The blower chamber-side side panel (23) made of sheet steel has an opening portion (233g) through which the attachment piece (53) of the bracket (50) made of aluminum passes. The attachment piece (53) of the bracket (50) made of aluminum passes through the opening portion (23 3 g) and is fixed. A resin cover (60) is interposed between the bracket (50) made of aluminum and the blower chamber-side side panel (23) made of sheet steel and forms a predetermined space between them.

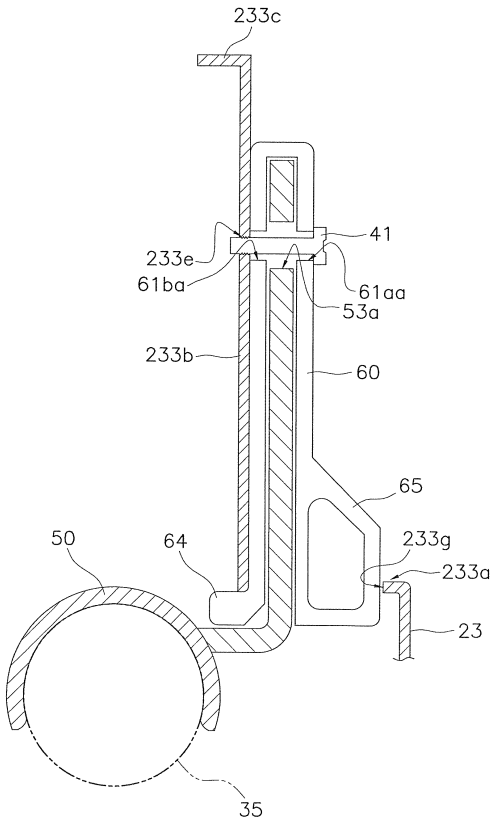

FIG. 13

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Description

TECHNICAL FIELD

[0001] The present invention relates to an outdoor unit of a refrigeration apparatus and particularly an outdoor unit of a refrigeration apparatus equipped with a heat exchanger made of aluminum or aluminum alloy.

BACKGROUND ART

[0002] In recent years, in order to make heat exchangers lighter in weight, aluminum and aluminum alloys have sometimes been used not just for the fins of the heat exchanger but also for the heat transfer tubes and the header collection tubes of the heat exchanger. At the same time, the heat exchanger made of aluminum or aluminum alloy is housed in a casing of an outdoor unit, for example, and because of advantages such as processing ease and cost the casing tends to be made of a non-aluminum metal different from aluminum or aluminum alloy, such as sheet steel for example.

[0003] Direct contact between the non-aluminum metal and the heat exchanger made of aluminum or aluminum alloy leads to corrosion of the heat exchanger. Therefore, as described in patent document 1 (JP-A No. H7-234088) for example, conventionally a bracket made of aluminum or aluminum alloy has been fixed to the header collection tube of the heat exchanger made of aluminum or aluminum alloy, and the heat exchanger has been attached via the bracket made of aluminum or aluminum alloy to a non-aluminum metal of a vehicle body of an automobile, for example.

SUMMARY OF INVENTION

<Technical Problem>

[0004] However, in this configuration, the section where the bracket made of aluminum or aluminum alloy and the non-aluminum metal contact one another causes corrosion of the bracket made of aluminum or aluminum alloy. Corrosion of the bracket made of aluminum or aluminum alloy triggers problems such as a poor outer appearance and looseness of the attachment of the heat exchanger.

[0005] It is an object of the present invention to fix a bracket made of aluminum or aluminum alloy for attaching a heat exchanger made of aluminum or aluminum alloy and a side panel made of a non-aluminum metal and to prevent corrosion of the bracket made of aluminum or aluminum alloy.

<Solution to Problem>

[0006] An outdoor unit of a refrigeration apparatus pertaining to a first aspect of the present invention comprises: a heat exchanger made of aluminum or aluminum alloy; a bracket made of aluminum or aluminum alloy that has a fixing portion and securing portions that are attached directly to the heat exchanger made of aluminum or aluminum alloy; a side panel made of a non-aluminum metal that has an opening portion through which the fixing portion of the bracket made of aluminum or aluminum alloy passes, with the side panel being fixed to the fixing portion of the bracket made of aluminum or aluminum alloy disposed through the opening portion; and a non-metal component that is interposed between the bracket made of aluminum or aluminum alloy and the side panel made of a non-aluminum metal and forms a predetermined space between the bracket made of aluminum or aluminum alloy and the side panel made of a non-aluminum metal.

[0007] The non-metal component here includes a member comprising a polymer material, such as a resin member or a rubber member, and a member comprising a non-metal inorganic material, such as a ceramic member.

[0008] In the outdoor unit of the refrigeration apparatus pertaining to the first aspect, the bracket made of aluminum or aluminum alloy and the side panel made of a non-aluminum metal do not contact one another because of the non-metal component, so corrosion of the bracket caused by corrosion occurring between the non-aluminum metal and the aluminum metal is prevented. Moreover, the fixing portion of the bracket passes through the opening portion of the side panel, so a structure where work such as fixing the bracket can be performed from the outside of the side panel of the outdoor unit can be provided.

[0009] An outdoor unit of a refrigeration apparatus pertaining to a second aspect of the present invention is the outdoor unit of the refrigeration apparatus pertaining to the first aspect, wherein the non-metal component has first space maintaining portion that is disposed around the bracket made of aluminum or aluminum alloy in order to dispose a clearance between the opening portion of the side panel made of a non-aluminum metal and the bracket made of aluminum or aluminum alloy.

[0010] In the outdoor unit of the refrigeration apparatus pertaining to the second aspect, the clearance between the bracket and the opening portion of the side panel is formed by the first space maintaining portion around the bracket, so even in the neighborhood of the opening portion of the side panel, contact between the non-aluminum metal and the aluminum metal is prevented, and corrosion caused by contact between these can be prevented from occurring in the bracket made of aluminum or aluminum alloy.

[0011] An outdoor unit of a refrigeration apparatus pertaining to a third aspect of the present invention is the outdoor unit of the refrigeration apparatus pertaining to the second aspect, further comprising an anchoring part made of a non-aluminum metal for fastening the non-metal component to the side panel made of a non-aluminum metal in a state in which the fixing portion of the

bracket made of aluminum or aluminum alloy is inserted into the non-metal component.

[0012] In the outdoor unit of the refrigeration apparatus pertaining to the third aspect, because the non-metal component is fastened by the anchoring part, a non-aluminum metal can be used for the anchoring part made of a non-aluminum metal, such as a screw made of iron for example, so the fastening of the bracket and the side panel can be performed at a low cost while ensuring the necessary strength.

[0013] An outdoor unit of a refrigeration apparatus pertaining to a fourth aspect of the present invention is the outdoor unit of the refrigeration apparatus pertaining to the third aspect, wherein a through hole larger than the anchoring part made of a non-aluminum metal is formed in the fixing portion of the bracket made of aluminum or aluminum alloy, and the anchoring part made of a non-aluminum metal passes through the through hole in such a way as to not contact the bracket made of aluminum or aluminum alloy and fastens the non-metal component to the side panel made of a non-aluminum metal.

[0014] In the outdoor unit of the refrigeration apparatus pertaining to the fourth aspect, the anchoring part passes through the through hole in the bracket, so the bracket can be strongly fastened by the anchoring part via the non-metal component, and therefore the bracket can be strongly fastened in little space. Moreover, the anchoring part made of a non-aluminum metal does not contact the bracket made of aluminum or aluminum alloy, so corrosion of the bracket caused by contact between the non-aluminum metal and the aluminum can be prevented.

[0015] An outdoor unit of a refrigeration apparatus pertaining to a fifth aspect of the present invention is the outdoor unit of the refrigeration apparatus pertaining to the third aspect, wherein a through hole larger than the anchoring part made of a non-aluminum metal is formed in the fixing portion of the bracket made of aluminum or aluminum alloy, and the outdoor unit further comprises an anchored structure made of a non-aluminum metal for fastening, in cooperation with the anchoring part made of a non-aluminum metal that passes through the through hole in such a way as to not contact the bracket made of aluminum or aluminum alloy, the fixing portion of the bracket to the side panel made of a non-aluminum metal via the non-metal component.

[0016] In the outdoor unit of the refrigeration apparatus pertaining to the fifth aspect, the fixing portion of the bracket is fastened, via the non-metal component, by the anchoring part and the anchored structure that are made of a non-aluminum metal, so the bracket can be strongly fixed by the non-metal component, and the fixing of the bracket can be strengthened.

[0017] An outdoor unit of a refrigeration apparatus pertaining to a sixth aspect of the present invention is the outdoor unit of the refrigeration apparatus of any of the third aspect to the fifth aspect, wherein the side panel has a first bent surface, which is bent in such a way as to extend in a direction intersecting a side surface configured by the side panel as seen in a plan view and in which the opening portion is formed, and a second bent surface, which is disposed after the first bent surface and is bent in such a way as to extend in a direction intersecting the first bent surface, and the non-metal component is fastened to the second bent surface by the anchoring part.

[0018] In the outdoor unit of the refrigeration apparatus pertaining to the sixth aspect, the non-metal component is fastened to the second bent surface, so the fixing portion of the bracket can be inserted and removed in a direction substantially parallel to the second bent surface, and the assembly and maintenance of the outdoor unit become easy.

[0019] An outdoor unit of a refrigeration apparatus pertaining to a seventh aspect of the present invention is the outdoor unit of the refrigeration apparatus of the sixth aspect, further comprising a front panel made of a non-aluminum metal that has a bent end surface that covers the second bent surface of the side panel, wherein the non-metal component further has second space maintaining portion that is interposed between the bent end surface and the fixing portion of the bracket made of aluminum or aluminum alloy.

[0020] In the outdoor unit of the refrigeration apparatus pertaining to the seventh aspect, the bracket and the non-metal component can be covered by the bent end surface of the side panel, so the outer appearance of the outdoor unit can be beautifully finished with a small number of parts.

<Advantageous Effects of Invention>

[0021] In the outdoor unit of the refrigeration apparatus pertaining to the first aspect, the fixing of the bracket made of aluminum or aluminum alloy for attaching the heat exchanger made of aluminum or aluminum alloy and the side panel made of a non-aluminum metal can be performed from the outside of the side panel, and corrosion of the bracket made of aluminum or aluminum alloy can be prevented.

[0022] In the outdoor unit of the refrigeration apparatus pertaining to the second aspect, corrosion of the bracket made of aluminum or aluminum alloy in the neighborhood of the opening portion of the side panel is prevented, and the effect of preventing corrosion is improved.

[0023] In the outdoor unit of the refrigeration apparatus pertaining to the third aspect, the bracket made of aluminum or aluminum alloy and the side panel made of a non-aluminum metal can be strongly fixed, and the strength of the outdoor unit can be improved.

[0024] In the outdoor unit of the refrigeration apparatus pertaining to the fourth aspect, corrosion of the bracket caused by contact between the aluminum and the non-aluminum metal resulting from the anchoring part can be prevented, and the fixing of the heat exchanger made of aluminum or aluminum alloy can be strongly performed.

[0025] In the outdoor unit of the refrigeration apparatus

pertaining to the fifth aspect, corrosion of the bracket caused by contact between the aluminum and the non-aluminum metal resulting from the anchoring part can be prevented, and the fixing of the heat exchanger made of aluminum or aluminum alloy can be strongly performed by the cooperation between the anchoring part and the anchored structure.

[0026] In the outdoor unit of the refrigeration apparatus pertaining to the sixth aspect, the assembly and maintenance of the outdoor unit become easy, and costs associated with manufacturing and maintenance can be reduced.

[0027] In the outdoor unit of the refrigeration apparatus pertaining to the seventh aspect, the design can be improved and costs can be reduced.

BRIEF DESCRIPTION OF DRAWINGS

[0028]

FIG. 1 is a circuit diagram for describing an overview of the configuration of an air conditioning apparatus pertaining to an embodiment;

FIG. 2 is a perspective view showing the outer appearance of an outdoor unit;

FIG. 3 is a schematic plan view showing the outdoor unit in a state in which a top panel has been removed;

FIG. 4 is a schematic back view showing the general configuration of an outdoor heat exchanger;

FIG. 5 is a partial sectional view for describing the configuration of the outdoor heat exchanger;

FIG. 6 is an enlarged sectional view for describing the configuration of a heat exchange section of the outdoor heat exchanger;

FIG. 7(a) is a left side view of a blower chamber-side side panel, FIG. 7(b) is a front view of the blower chamber-side side panel, and FIG. 7(c) is a right side view of the blower chamber-side side panel;

FIG. 8(a) is a plan view of the blower chamber-side side panel, and FIG. 8(b) is a sectional view taken along line I-I of FIG. 7(b) as seen from the direction of the arrows;

FIG. 9(a) is a plan view of a bracket, FIG. 9(b) is a front view of the bracket, and FIG. 9(c) is a side view of the bracket;

FIG. 10 is a partially enlarged perspective view showing the bracket brazed to a header collection tube;

FIG. 11 (a) is a left side view of a resin cover, and FIG. 11 (b) is a bottom view of the resin cover;

FIG. 12(a) is a back view of the resin cover, and FIG. 12(b) is a right side view of the resin cover;

FIG. 13 is a partial sectional view showing a state in which the bracket and the resin cover are attached to the blower chamber-side side panel;

FIG. 14 is a partial sectional view showing a state in which the bracket and the resin cover are attached to the blower chamber-side side panel according to an example modification; and

FIG. 15(a) is a side view of the resin cover pertaining to the example modification, and FIG. 15(b) is a side view of the bracket pertaining to the example modification.

DESCRIPTION OF EMBODIMENT

(1) Overall Configuration of Air Conditioning Apparatus

[0029] A refrigeration apparatus used in an air conditioning apparatus will be described as a refrigeration apparatus pertaining to an embodiment of the present invention. FIG. 1 is a circuit diagram showing an overview of an air conditioning apparatus. An air conditioning apparatus 1 is configured by an outdoor unit 2 and an indoor unit 3. The air conditioning apparatus 1 is an apparatus used to cool and heat rooms in a building by performing a vapor compression refrigeration cycle operation. The air conditioning apparatus 1 is equipped with the outdoor unit 2 that serves as a heat source unit, the indoor unit 3 that serves as a utilization unit, and refrigerant connection tubes 6 and 7 that interconnect the outdoor unit 2 and the indoor unit 3.

[0030] In the air conditioning apparatus 1 configured by connecting the outdoor unit 2, the indoor unit 3, and the refrigerant connection tubes 6 and 7, the refrigeration apparatus has a configuration wherein a compressor 11, a four-way switching valve 12, an outdoor heat exchanger 13, an expansion valve 14, an indoor heat exchanger 4, and an accumulator 15 and the like are interconnected by refrigerant tubes. The refrigeration apparatus is charged with refrigerant, and a refrigeration cycle operation is performed wherein the refrigerant is compressed, is cooled, has its pressure reduced, is heated and evaporated, and is thereafter compressed again. During operation, a liquid refrigerant-side stop valve 17 and a gas refrigerant-side stop valve 18 of the outdoor unit 2 that are connected to the refrigerant connection tubes 6 and 7, respectively, are placed in an open state.

[0031] During the cooling operation, the four-way switching valve 12 is switched to a state indicated by the solid lines in FIG. 1, that is, a state in which the discharge side of the compressor 11 is connected to the gas side of the outdoor heat exchanger 13 and in which the suction side of the compressor 11 is connected to the gas side of the indoor heat exchanger 4 via the accumulator 15, the gas refrigerant-side stop valve 18, and the refrigerant connection tube 7. In the cooling operation, the air conditioning apparatus 1 causes the outdoor heat exchanger 13 to function as a condenser of the refrigerant compressed in the compressor 11 and causes the indoor heat exchanger 4 to function as an evaporator of the refrigerant that has been condensed in the outdoor heat exchanger 13.

[0032] During the heating operation, the four-way switching valve 12 is switched to a state indicated by the dashed lines in FIG. 1, that is, a state in which the dis-

charge side of the compressor 11 is connected to the gas side of the indoor heat exchanger 4 via the gas refrigerant-side stop valve 18 and the refrigerant connection tube 7 and in which the suction side of the compressor 11 is connected to the gas side of the outdoor heat exchanger 13. In the heating operation, the air conditioning apparatus 1 causes the indoor heat exchanger 4 to function as a condenser of the refrigerant compressed in the compressor 11 and causes the outdoor heat exchanger 13 to function as an evaporator of the refrigerant that has been condensed in the indoor heat exchanger 4.

(2) Detailed Configuration of Air Conditioning Apparatus

(2-1) Indoor Unit

[0033] The indoor unit 3 is installed as a result of being mounted on a wall surface in a room or being embedded in or suspended from a ceiling in a room of a building or the like. The indoor unit 3 has the indoor heat exchanger 4 and an indoor fan 5. The indoor heat exchanger 4 is, for example, a cross fin type fin-and-tube heat exchanger configured by heat transfer tubes and numerous fins; during the cooling operation, the indoor heat exchanger 4 functions as an evaporator of the refrigerant to cool the room air, and during the heating operation, the indoor heat exchanger 4 functions as a condenser of the refrigerant to heat the room air.

(2-2) Outdoor Unit

[0034] The outdoor unit 2 is installed outside a building or the like and is connected to the indoor unit 3 installed in the room via the refrigerant connection tubes 6 and 7. As shown in FIG. 2 and FIG. 3, the outdoor unit 2 is equipped with a substantially cuboidal unit casing 20. As shown in FIG. 3, the outdoor unit 2 has a structure (a so-called trunk structure) in which a blower chamber S1 and a machine chamber S2 are formed as a result of the inside space of the unit casing 20 being divided in two by a partition panel 28 extending in the vertical direction. As shown in FIG. 3, the outdoor heat exchanger 13 and an outdoor fan 16 and the like are disposed in the blower chamber S 1. Furthermore, the compressor 11 and the accumulator 15 shown in FIG. 3 and the four-way switching valve 12, the expansion valve 14, the liquid refrigerant-side stop valve 17, and the gas refrigerant-side stop valve 18 and the like not shown in FIG. 3 are disposed in the machine chamber S2.

[0035] The unit casing 20 is configured to include a top panel 21, a bottom panel 22, a blower chamber-side side panel 23, a machine chamber-side side panel 24, a blower chamber-side front panel 25, and a machine chamber-side front panel 26. The top panel 21 is a panel member made of sheet steel that configures the top surface section of the unit casing 20. The bottom panel 22 is a panel member made of sheet steel that configures the bottom surface section of the unit casing 20. The blower chamber-side side panel 23 is a panel member made of sheet steel that configures the side surface section of the unit casing 20 near the blower chamber S 1. The machine chamber-side side panel 24 is a panel member made of sheet steel that configures part of the side surface section of the unit casing 20 near the machine chamber S2 and the back surface section of the unit casing 20 near the machine chamber S2. The blower chamber-side front panel 25 is a panel member made of sheet steel that configures the front surface section of the unit casing 20 in front of the blower chamber S1 and part of the front surface section of the unit casing 20 in front of the machine chamber S2. The blower chamber-side front panel 25 and the blower chamber-side side panel 23 may also be integrally formed by pressing and forming a single sheet of sheet steel.

[0036] The outdoor unit 2 is configured to suck outdoor air into the blower chamber S 1 inside the unit casing 20 from the a part of back surface and the side surface of the unit casing 20 and blow out the sucked-in outdoor air from the front surface of the unit casing 20. For that reason, an air inlet 20a for the outdoor air sucked into the blower chamber S1 inside the unit casing 20 is formed between the end portion of the blower chamber-side side panel 23 on the back surface side and the end portion of the machine chamber-side side panel 24 on the blower chamber S1 side, and an air inlet 20b for the outdoor air is formed in the blower chamber-side side panel 23. Furthermore, an air outlet 20c for blowing outside the outdoor air that has been sucked into the blower chamber S1 is disposed in the blower chamber-side front panel 25. The front side of the air outlet 20c is covered by a fan grille 25a.

[0037] The outdoor heat exchanger 13 is disposed standing in the up and down direction (vertical direction) in the blower chamber S1, which is a space covered by the blower chamber-side side panel 23, the blower chamber-side front panel 25, the partition panel 28, and one section of the machine chamber-side side panel 24. The outdoor heat exchanger 13 has an L shape as seen in a plan view and opposes the air inlets 20a and 20b. The outdoor heat exchanger 13 is a heat exchanger made of aluminum. The outdoor heat exchanger 13 made of aluminum is, in order to prevent corrosion, attached by later-described brackets or the like made of aluminum to the unit casing 20 in such a way that the outdoor heat exchanger 13 does not directly contact the top panel 21, the bottom panel 22, the blower chamber-side side panel 23, the machine chamber-side side panel 24, and the partition panel 28 and the like that are made of sheet steel. One end of the outdoor heat exchanger 13 is connected to the four-way switching valve 12, and the other end of the outdoor heat exchanger 13 is connected to the expansion valve 14.

(2-2-1) Outdoor Heat Exchanger

[0038] Next, the configuration of the outdoor heat exchanger 13 will be described in detail using FIG. 4, FIG.

5, and FIG. 6. The heat exchanger made of aluminum is configured by heat transfer fins 32 made of aluminum, multi-hole flat tubes 33 made of aluminum, and header collection tubes 34 and 35 made of aluminum. The outdoor heat exchanger 13 is equipped with a heat exchange section 31 that causes heat exchange to be performed between the outdoor air and the refrigerant, and the heat exchange section 31 is configured by the numerous heat transfer fins 32 made of aluminum and the numerous multi-hole flat tubes 33 made of aluminum. The heat exchange section 31 has an upper heat exchange section 31a, in which are disposed gas refrigerant multi-hole flat tubes 33a that are included among the numerous multi-hole flat tubes 33 and are for allowing gas refrigerant or refrigerant in a gas-liquid multi-state to flow through when the outdoor heat exchanger 13 functions as a condenser, and a lower heat exchange section 31b, in which are connected liquid refrigerant multi-hole flat tubes 33b that are included among the numerous multi-hole flat tubes 33 and are for allowing the refrigerant in the gas-liquid multi-state or liquid refrigerant to flow through.

[0039] The multi-hole flat tubes 33 function as heat transfer tubes and cause the heat moving between the heat transfer fins 32 and the outdoor air to be exchanged between the refrigerant flowing inside and the heat transfer fins 32.

[0040] The outdoor heat exchanger 13 is equipped with the header collection tubes 34 and 35 made of aluminum that are disposed one each on both ends of the heat exchange section 31. The header collection tube 34 has a cylindrical pipe structure made of aluminum and has inside spaces 34a and 34b partitioned from one another by a baffle 34c made of aluminum. A heat exchanger-side gas tube 38 made of aluminum is connected to the inside space 34a in the upper portion of the header collection tube 34, and a heat exchanger-side liquid tube 39 made of aluminum is connected to the inside space 34b in the lower portion of the header collection tube 34.

[0041] The header collection tube 35 has a cylindrical pipe structure made of aluminum, and inside spaces 35a, 35b, 35c, 35d, and 35e are formed in the header collection tube 35 as a result of the inside space of the header collection tube 35 being partitioned by baffles 35f, 35g, 35h, and 35i made of aluminum. The numerous gas refrigerant multi-hole flat tubes 33a connected to the inside space 34a in the upper portion of the header collection tube 34 are connected to the three inside spaces 35a, 35b, and 35c of the header collection tube 35. Furthermore, the numerous liquid refrigerant multi-hole flat tubes 33b connected to the inside space 34b in the lower portion of the header collection tube 34 are connected to the three inside spaces 35c, 35d, and 35e of the header collection tube 35.

[0042] Furthermore, the inside space 35a and the inside space 35e of the header collection tube 35 are interconnected by a connection tube 36 made of aluminum, and the inside space 35b and the inside space 35d are interconnected by a connection tube 37 made of aluminum. The inside space 35c also fulfills the function of interconnecting part of the inside space in the upper portion of the heat exchange section 31 (the section connected to the inside space 34a) and part of the inside space in the lower portion of the heat exchange section 31 (the section connected to the inside space 34b). Because of these configurations, during the cooling operation (when the outdoor heat exchanger 13 functions as a condenser) for example, the gas refrigerant supplied to the inside space 35a in the upper portion of the header collection tube 35 by the heat exchanger-side gas tube 38 made of aluminum performs heat exchange in the upper portion of the heat exchange section 31, some of that refrigerant liquefies so that the refrigerant changes to a gas-liquid multi-state, the refrigerant in the gas-liquid multi-state doubles back in the header collection tube 35 and travels through the lower portion of the heat exchange section 31 where the remaining gas refrigerant liquefies, and the liquid refrigerant exits through the heat exchanger-side liquid tube 39 made of aluminum.

[0043] FIG. 6 is a partially enlarged view showing the cross-sectional structure of the heat exchange section 31 of the outdoor heat exchanger 13 as cut by a plane perpendicular to the lengthwise direction of the multi-hole flat tubes 33. The heat transfer fins 32 are flat plates made of thin aluminum, and plural cutouts 32a extending in the horizontal direction are formed adjacent to one another in the up and down direction in each of the heat transfer fins 32. The multi-hole flat tubes 33 have upper and lower planar portions serving as heat transfer surfaces and plural inside flow paths 331 through which the refrigerant flows. The multi-hole flat tubes 33, which are slightly thicker than the up and down width of the cutouts 32a, are arranged in plural tiers spaced apart from one another in a state in which the planar portions face up and down (a state in which the side surfaces of the multi-hole flat tubes 33 are arranged opposing one another), and the multi-hole flat tubes 33 are temporarily fixed in a state in which they have been fitted into the cutouts 32a. The heat transfer fins 32 and the multi-hole flat tubes 33 are put into a furnace and are brazed together in a state in which the multi-hole flat tubes 33 have been fitted into the cutouts 32a in the heat transfer fins 32 in this way. Furthermore, both ends of each of the multi-hole flat tubes 33 are fitted into and brazed to the header collection tubes 34 and 35.

[0044] The inside spaces 34a and 34b of the header collection tube 34 and the inside spaces 35a, 35b, 35c, 35d, and 35e of the header collection tube 35 are connected to the inside flow paths 331 in the multi-hole flat tubes 33. Baffle plates and the like for directing the flow of the refrigerant are disposed in the inside spaces 34a and 34b of the header collection tube 34 and the inside spaces 35a, 35b, 35c, 35d, and 35e of the header collection tube 35, but description of details such as these will be omitted.

[0045] The fixing of the outdoor heat exchanger 13 made of aluminum is performed as a result of the header

collection tubes 34 and 35 made of aluminum being fixed by a later-described bracket made of aluminum to the blower chamber-side side panel 23, the machine chamber-side side panel 24, and the partition panel 28. Among fixings in the outdoor heat exchanger 13 made of aluminum, fixing the outdoor heat exchanger 13 to the blower chamber-side side panel 23 will be detailed in method.

(2-2-2) Blower Chamber-side Side Panel

[0046] FIGS. 7(a), 7(b), and 7(c) show the blower chamber-side side panel 23 serving as a structural part, with FIG. 7(a) being a left side view, FIG. 7(b) being a front view, and FIG. 7(c) being a right side view. Furthermore, FIG. 8(a) is a plan view of the blower chamber-side side panel 23 serving as a structural part, and FIG. 8(b) is a sectional view taken along line I-I of FIG. 7(b) as seen from the direction of the arrows.

[0047] A back surface side end portion 232 positioned on a back surface side of a body portion 231 of the blower chamber-side side panel 23 is formed as a result of being bent substantially perpendicularly to the body portion 231 toward the direction of the machine chamber side. A front surface side end portion 233 comprises a first end surface 233a that is bent substantially perpendicularly toward the inside of the blower chamber S1 (toward the direction of the machine chamber side), a second end surface 233b that is bent substantially perpendicularly to the first end surface 233a frontward and extends substantially parallel to the body portion 231, and a third end surface 233c that is bent substantially perpendicularly to the second end surface 233b toward the direction of the machine chamber side and extends substantially parallel to the first end surface 233a.

[0048] The blower chamber-side side panel 23 is fixed by male screws 40 to the blower chamber-side front panel 25. Screw holes 233d into which the male screws 40 are screwed are formed in the third end surface 233c, and the screw holes 233d are burred (see FIG. 7(c)).

[0049] A later-described bracket 50 made of aluminum (see FIGS. 9(a), 9(b), and 9(c) and FIG. 10) and a later-described resin cover 60 (see FIGS. 11 (a) and 11 (b) and FIGS. 12(a) and 12(b)) are attached to the second end surface 233b of the blower chamber-side side panel 23. In order to attach the bracket 50 and the resin cover 60, screw holes 233e into which male screws 41 are screwed are formed in the second end surface 233b, and the screw holes 233e are burred (see FIG. 7(b)). Furthermore, in order to raise the strength of the second end surface 233b, two channel portions 233f extending up and down are formed in the second end surface 233b.

[0050] Rectangular opening portions 233g that are open in such a way that the bracket 50 made of aluminum and the resin cover 60 pass through them are formed adjacent to one another in the up and down direction in the first end surface 233a of the blower chamber-side side panel 23 (see FIG. 7(c)). Furthermore, slits 233h into which fitting portions (not shown in the drawings) formed on a bent end surface 25b of the blower chamber-side front panel 25 are fitted are formed in three places in the first end surface 233a. The fitting portions projecting from the blower chamber-side front panel 25 are fitted into the slits 233h. Because of that, the bracket 50 made of aluminum and the resin cover 60 that are attached to the second end surface 233b are covered by the blower chamber-side front panel 25.

(2-2-3) Bracket Made of Aluminum

[0051] FIGS. 9(a), 9(b), and 9(c) and FIG. 10 show the bracket 50 made of aluminum for attaching the outdoor heat exchanger 13 to the blower chamber-side side panel 23. FIG. 9(a) is a plan view of the bracket 50, FIG. 9(b) is a front view of the bracket 50, and FIG. 9(c) is a side view of the bracket 50.

[0052] The bracket 50 is, for example, formed by pressing a single aluminum sheet. Four clamping pieces 52 that are attached to the header collection tube 35 of the outdoor heat exchanger 13 extend from a body portion 51 of the bracket 50. The clamping pieces 52 are each formed in a circular arc shape so as to conform to the outer periphery of the cylindrical header collection tube 35. A single attachment piece 53 extends from the side of the bracket 50 opposite the side with the clamping pieces 52. A through hole 53a for allowing the male screw 41 to pass through when attaching the bracket 50 to the blower chamber-side side panel 23 is disposed in the attachment piece 53. The through hole 53a is a m1 $\times$n1 oval hole. The lengthwise direction of the through hole 53a is in the horizontal direction (front and rear direction). The dimension of the through hole 53a (hole outer shape) in the bracket 50 is greater than an outer diameter d of the male screw 41. That is, there is the relationship: outer diameter d < hole diameters m1, n1. Furthermore, in order to position the bracket 50 and the resin cover 60, a fitting counterpart 43b formed as a result of part of the upper edge end portion of the attachment piece 53 being cut out is disposed in the attachment piece 53.

[0053] FIG. 10 shows a state in which the bracket 50 made of aluminum has been brazed to the header collection tube 35. The brazing of the bracket 50 to the header collection tube 35 is, for example, performed by forming a brazing filler metal on the surface of the header collection tube 35 beforehand and, in a state in which the bracket 50 has been temporarily fastened to the header collection tube 35, placing everything in a furnace in a state in which the heat transfer fins 32 made of aluminum and the multi-hole flat tubes 33 made of aluminum have been put together as shown in FIG. 5 and FIG. 6.

(2-2-4) Resin Cover

[0054] The bracket 50 is made of aluminum, so if the bracket 50 is brought into direct contact with the blower chamber-side side panel 23 made of sheet steel, corrosion of the bracket 50 is promoted by the contact between

the iron and the aluminum. Therefore, the resin cover 60 shown in FIGS. 11(a) and 11(b) and FIGS. 12(a) and 12(b) is attached to the bracket 50, and the bracket 50 is attached to the blower chamber-side side panel 23 in a state in which the resin cover 60 is interposed between the blower chamber-side side panel 23 and the bracket 50. FIG. 11(a) is a left side view of the resin cover, and FIG. 11(b) is a bottom view of the resin cover. FIG. 12(a) is a back view of the resin cover, and FIG. 12(b) is a right side view of the resin cover.

[0055] The resin cover 60 is, for example, formed by one-time injection molding. A body portion 61 of the resin cover 60 has a right side wall 61 a, a left side wall 61 b, an upper wall 61 c, and a front wall 61d for forming an insertion portion 62 for attaching the attachment piece 53 of the bracket 50. The attachment piece 53 is inserted into the insertion portion 62. In order to position the bracket 50 and the resin cover 60, a fitting projection 63 that projects from part of the top surface of the insertion portion 62 is disposed in the insertion portion 62. This fitting projection 63 fits into the fitting counterpart 53b of the attachment piece 53 of the bracket 50 to thereby define the positional relationship between the bracket 50 and the resin cover 60 in the front and rear direction. Furthermore, the length from the lower end of the oval hole 53a in the attachment piece 53 of the bracket 50 to the lower edge of the attachment piece 53 is shorter than the length from lower ends of oval holes 61aa and 61ba in the resin cover 60 to the lower edge of the resin cover 60. Because of this configuration, even if the resin cover 60 shifts upward relative to the attachment piece 53, the lower edge of the attachment piece 53 does not contact the blower chamber-side side panel 23 in the opening portion 233g. The right and left side surfaces, the upper edge, and the front edge of the attachment piece 53 inserted into the insertion portion 62 of the resin cover 60 become covered by the resin cover 60. For that reason, the resin cover 60 becomes interposed between the blower chamber-side side panel 23 positioned on a side surface side of the resin cover 60 and the attachment piece 53, and the bracket 50 can be fixed to the blower chamber-side side panel 23 without the bracket 50 made of aluminum directly touching the blower chamber-side side panel 23.

[0056] The right side wall 61a and the left side wall 61b form the right and left side surfaces of the insertion portion 62. Oval holes 61aa and 61ba are formed in the left side wall 61b in positions corresponding to the through hole 53a in the attachment piece 53. The shape of each of the through holes 61aa and 61bb is n1 $\times$m1 and is long in the vertical direction whereas the oval hole 53a has a shape that is long in the horizontal direction. The dimension of the oval holes 61aa and 61ba (hole outer shape) is greater than the outer diameter d of the male screw 41. That is, there is the relationship: outer diameter d < hole diameters m1, n1. Because of the configurations of the through hole 53a and the oval holes 61aa and 61ba, the end portions of the oval holes 61aa and 61ba in the resin cover 60 get in the way so that the male screw 41 does not contact the front side of the through hole 53a. For that reason, corrosion of the front side of the through hole 53a caused by the aluminum and the iron contacting one another is prevented.

[0057] A protruding portion 65 is formed on the back surface side of the right side wall 61a, and a flange portion 64 is formed on the end portion on the back surface side of the left side wall 61b.

(2-2-5) Attachment of Bracket and Resin Cover

[0058] FIG. 13 shows a state in which an assembly comprising the bracket 50 made of aluminum covered by the resin cover 60 has been attached to the blower chamber-side side panel 23. The male screw 41 is screwed into the screw hole 233e in the blower chamber-side side panel 23, but the oval holes 61aa and 61ba are wider in width in the front and rear direction than the outer diameter of the male screw 41. Moreover, it is wider in width in the front and rear direction than the oval holes 61aa and 61ba, and a non-contact state in which the male screw 41 made of iron does not contact the bracket made of aluminum is maintained by the resin cover 60.

[0059] Furthermore, because of the projecting portion 65, the resin cover 60 is fitted into the opening portion 233g without any clearance in between. In a state in which the resin cover 60 has been fitted into the opening portion 233g in this way, the flange portion 64 is interposed between the end portion of the second end surface 233b and the base of the attachment piece 53 of the bracket 50. For that reason, the attachment piece 53 of the bracket 50 does not contact the end portion of the second end surface 233b of the blower chamber-side side panel 23. Of course, the attachment piece 53 and the second end surface 233b do not contact one another because the left side wall 61b of the resin cover 60 is sandwiched between the attachment piece 53 and the second end surface 233b. In this way, the bracket 50 made of aluminum and the blower chamber-side side panel 23 made of sheet steel are maintained in a non-contact state by the resin cover 60.

(3) Characteristics of Outdoor Unit

(3-1)

[0060] In the outdoor unit 2 of the refrigeration apparatus described above, the clamping pieces 52 (an example of securing portion) of the bracket 50 made of aluminum are attached directly to the outdoor heat exchanger 13 made of aluminum, and the attachment piece 53 (an example of a fixing portion) of the bracket 50 made of aluminum is fixed to the blower chamber-side side panel 23 made of sheet steel (casing made of a non-aluminum metal). The blower chamber-side side panel 23 made of sheet steel has the opening portion 233g through which the attachment piece 53 of the bracket 50 made of aluminum passes. The attachment piece 53 of the

bracket 50 made of aluminum passes through the opening portion 233g and is fixed. The resin cover 60 (an example of a non-metal component) is interposed between the bracket 50 made of aluminum and the blower chamber-side side panel 23 made of sheet steel and forms a predetermined space between them.

[0061] As a result, the state in which the bracket 50 made of aluminum and the blower chamber-side side panel 23 made of sheet steel do not contact one another is maintained by the resin cover 60, so corrosion of the bracket 50 caused by corrosion occurring between the non-aluminum metal and the aluminum metal is prevented. Moreover, the attachment piece 53 of the bracket 50 passes through the opening portion 233g and emerges on the outside from the blower chamber S1. For that reason, the bracket 50 and the resin cover 60 can be fastened by the male screw 41 to the blower chamber-side side panel 23 from the outside of the blower chamber-side side panel 23 of the outdoor unit 2. In this way, the fixing of the bracket 50 made of aluminum for attaching the outdoor heat exchanger 13 made of aluminum and the blower chamber-side side panel 23 made of sheet steel can be performed from the outside of the blower chamber-side side panel 23, and corrosion of the bracket 50 made of aluminum can be prevented.

[0062] The left side wall 61b and the protruding portion 65 (an example of a first space maintaining portion) of the resin cover 60 are disposed around the bracket 50 made of aluminum in order to dispose a clearance between the opening portion 233g of the blower chamber-side side panel 23 made of sheet steel and the bracket 50 made of aluminum. The clearance between the area around the attachment piece 53 of the bracket 50 and the opening portion 233g of the blower chamber-side side panel 23 is formed by the left side wall 61b and the protruding portion 65, so even in the neighborhood of the opening portion 233g, contact between the non-aluminum metal and the aluminum metal is prevented, corrosion caused by contact between these can be prevented from occurring in the bracket 50 made of aluminum, and the effect of preventing corrosion is improved.

[0063] In the above embodiment, a resin member such as the resin cover 60 is taken as an example and described as a non-metal component, but the non-metal component may also be a member comprising a polymer material, such as a rubber member, or a member comprising a non-metal inorganic material, such as a ceramic member. Of course, the non-metal component here is a member configured by a material that does not promote corrosion between it and aluminum or aluminum alloy as much as a non-aluminum metal. Furthermore, the through hole (the through hole 53 a) in the fixing portion also includes a hole having a cutout in which a part thereof reaches the end portion of the fixing portion (the attachment piece 53).

(3-2)

[0064] The male screw 41 (an example of an anchoring part) made of iron fastens the resin cover 60 to the blower chamber-side side panel 23 made of sheet steel in a state in which the attachment piece 53 of the bracket 50 made of aluminum is inserted into the resin cover 60. The resin cover 60 can be fastened by the male screw 41 made of iron, that is, a screw made of iron can be used, so the fastening of the bracket 50 made of aluminum and the blower chamber-side side panel 23 made of sheet steel can be performed at a low cost while ensuring the necessary strength, these can be strongly fixed, and the strength of the outdoor unit 2 can be improved.

(3-3)

[0065] The through hole 53a larger than the male screw 41 made of iron is formed in the attachment piece 53 of the bracket 50 made of aluminum, and the male screw 41 made of iron passes through the through hole 53a in such a way as to not contact the bracket 50 made of aluminum and fastens the resin cover 60 to the blower chamber-side side panel 23 made of sheet steel.

[0066] The male screw 41 made of iron passes through the through hole 53a in the bracket 50, so the bracket can be strongly fastened by the anchoring part via the resin cover 60, and therefore the bracket can be strongly fastened in little space. The male screw 41 made of iron does not contact the bracket 50 made of aluminum, so corrosion of the bracket caused by contact between the non-aluminum metal and the aluminum can be prevented, and the fixing of the outdoor heat exchanger 13 made of aluminum can be strongly performed.

(3-4)

[0067] The through hole 53a larger than the male screw 41 made of iron is formed in the attachment piece 53 of the bracket 50 made of aluminum. The screw hole 233e (an example of an anchored structure made of a non-aluminum metal) formed in the blower chamber-side side panel 23 made of sheet steel by burring fastens, in cooperation with the male screw 41 made of iron that passes through the through hole 53a in such a way as to not contact the bracket 50 made of aluminum, the attachment piece 53 of the bracket 50 to the blower chamber-side side panel 23 made of sheet steel via the resin cover 60. The attachment piece 53 of the bracket 50 is fastened, via the resin cover 60, by the male screw 41 made of iron and the blower chamber-side side panel 23 made of sheet steel. For that reason, corrosion of the bracket 50 caused by contact between the aluminum and the non-aluminum metal resulting from the male screw 41 made of iron can be prevented, and the fixing of the outdoor heat exchanger 13 made of aluminum can be strongly performed by the cooperation between the male screw 41 and the screw hole 233e in the blower chamber-

side side panel 23.

(3-5)

[0068] The blower chamber-side side panel 23 is bent in such a way as to extend in a direction substantially orthogonal to the body portion 231 (an example of a direction intersecting a side surface configured by the side panel) as seen in a plan view to thereby form the first end surface 233a (an example of a first bent surface). The opening portion 233g is formed in the first end surface 233a. Additionally, the second end surface 233b of the blower chamber-side side panel 23 is disposed after the first end surface 233a and is bent and formed in such a way as to extend in a direction substantially orthogonal to (an example of a direction intersecting) the first end surface 233a. The resin cover 60 is fastened to the second end surface 233b by the male screw 41 that is screwed into the screw hole 233e. In this way, the resin cover 60 is fastened to the second end surface 233b, so the attachment piece 53 of the bracket 50 can be inserted and removed in a direction substantially parallel to the second end surface 233b. For that reason, the assembly and maintenance of the outdoor unit 2 become easy, and costs associated with manufacturing and maintenance can be reduced.

(3-6)

[0069] As shown in FIG. 8(b), the bent end surface 25b of the blower chamber-side front panel 25 made of sheet steel covers the second end surface 233b of the blower chamber-side side panel 23. The resin cover 60 has the right side wall 61 a and the front wall 61 d (an example of a second space maintaining portion) interposed between the bent end surface 25b and the attachment piece 53 of the bracket 50 made of aluminum. For that reason, even if the blower chamber-side front panel 25 has a section or the like that projects toward the bracket 50, contact between the blower chamber-side front panel 25 and the bracket 50 made of aluminum is prevented by the right side wall 61a and the front wall 61d. The bracket 50 and the resin cover 60 can be covered by the bent end surface 25b of the blower chamber-side front panel 25 made of sheet steel, so the outer appearance of the outdoor unit can be beautifully finished with a small number of parts, and the design can be improved and costs can be reduced.

(4) Example Modifications

(4-1) Example Modification A

[0070] In the above embodiment, a case was described where members made of aluminum were used for the outdoor heat exchanger 13 and so forth, but the members made of aluminum can also be replaced with members made of aluminum alloy; for example, an outdoor heat exchanger made of aluminum alloy can be used instead of the outdoor heat exchanger 13 made of aluminum, and a bracket made of aluminum alloy can be used instead of the bracket 50 made of aluminum.

(4-2) Example Modification B

[0071] In the above embodiment, a case was described where the anchored structure anchored by the male screw 80 was the blower chamber-side side panel 23 in which the screw hole 233e is formed. However, as shown in FIG. 14 for example, the anchored structure may also be something like a wing nut 45 anchored to a male screw 48 that passes through the resin cover 60 and the bracket 50 passed through the opening portion 233g. The male screw 48 (an example of anchoring part) may also be fitted into and anchored in an opening portion 233j. Even with this configuration, the attachment of the wing nut 45 can be performed from the outside of the blower chamber-side side panel 23. In this case, a recessed portion 66 for positioning the wing nut 45 may also be formed in the resin cover 60. In this case, as shown in FIGS. 15(a) and 15(b) for example, a fitting portion 61e and a fitting counterpart 53c for fixing the up and down positional relationship between the resin cover 60 and the bracket 50 may also be disposed. In this case, it is preferred that the resin cover 60 and the bracket 50 be configured in such a way that the fitting counterpart 53c contacts the fitting portion 61e to thereby reliably ensure a clearance between the lower edge of the attachment piece 53 of the bracket 50 and the blower chamber-side side panel 23 in the opening portion 233g, such as, for example, making the up and down length of the convex fitting portion 61e longer than the up and down length of the cut out fitting counterpart 53c.

(4-3) Example Modification C

[0072] In the above embodiment, a case was described where iron and steel were used as the non-aluminum metal, but another metal such as copper or copper alloy may also be used.

(4-4) Example Modification D

[0073] In the above embodiment, the sensor retaining portion 44 formed in a concave shape is disposed in the body portion 51. The shape of the sensor retaining portion 44 can be seen as forming the tubular hole 44a and the slit 44b. The slit 44b formed on the side opposing the header collection tube 35 is for allowing a temperature sensor retained in the sensor retaining portion 44 to contact the header collection tube 35.

[0074] The bracket 50 is attached to the header collection tube 35 in the area around the inside space 35a shown in FIG. 5. The inner dimension of a cylindrical hole formed by the sensor retaining portion 44 of the bracket 50 and the header collection tube 35 is formed slightly

smaller than the outer dimension of a case 54 of a temperature sensor 19. In such an instance as that, by strongly pressing the temperature sensor 19 into the case 54, the case 54 becomes deformed a little so that the temperature sensor 19 is fixed in the cylindrical hole formed by the sensor retaining portion 44.

REFERENCE SIGNS LIST

[0075]

1	Air Conditioning Apparatus
2	Outdoor Unit
3	Indoor Unit
13	Outdoor Heat Exchanger
20	Unit Casing
32	Heat Transfer Fins
33	Multi-hole Flat Tubes
34, 35	Header Collection Tubes
50	Bracket
60	Resin Cover

CITATION LIST

<Patent Literature>

[0076]

Patent Document 1: JP-ANo. H7-234088

Claims

1. An outdoor unit of a refrigeration apparatus comprising:

a heat exchanger (13) made of aluminum or aluminum alloy;
a bracket (50) made of aluminum or aluminum alloy that has a fixing portion (53) and a securing portion (52) that is attached directly to the heat exchanger made of aluminum or aluminum alloy;
a side panel (23) made of a non-aluminum metal that has an opening portion (233g) through which the fixing portion of the bracket made of aluminum or aluminum alloy passes, with the side panel being fixed to the fixing portion of the bracket made of aluminum or aluminum alloy disposed through the opening portion; and
a non-metal component (60) that is interposed between the bracket made of aluminum or aluminum alloy and the side panel made of a non-aluminum metal and forms a predetermined space between the bracket made of aluminum or aluminum alloy and the side panel made of a non-aluminum metal.

2. The outdoor unit of the refrigeration apparatus according to claim 1, wherein the non-metal component has first space maintaining portion (61b, 65) that is disposed around the bracket made of aluminum or aluminum alloy in order to dispose a clearance between the opening portion of the side panel made of a non-aluminum metal and the bracket made of aluminum or aluminum alloy.

3. The outdoor unit of the refrigeration apparatus according to claim 2, further comprising the anchoring part (41) made of a non-aluminum metal for fastening the non-metal component to the side panel made of a non-aluminum metal in a state in which the fixing portion of the bracket made of aluminum or aluminum alloy is inserted into the non-metal component.

4. The outdoor unit of the refrigeration apparatus according to claim 3, wherein
a through hole (53a) larger than the anchoring part made of a non-aluminum metal is formed in the fixing portion of the bracket made of aluminum or aluminum alloy, and
the anchoring part made of a non-aluminum metal passes through the through hole in such a way as to not contact the bracket made of aluminum or aluminum alloy and fastens the non-metal component to the side panel made of a non-aluminum metal.

5. The outdoor unit of the refrigeration apparatus according to claim 3, wherein
a through hole (53a) larger than the anchoring part made of a non-aluminum metal is formed in the fixing portion of the bracket made of aluminum or aluminum alloy, and
the outdoor unit further comprises an anchored structure (233e, 45) made of a non-aluminum metal for fastening, in cooperation with the anchoring part made of a non-aluminum metal that passes through the through hole in such a way as to not contact the bracket made of aluminum or aluminum alloy, the fixing portion of the bracket to the side panel made of a non-aluminum metal via the non-metal component.

6. The outdoor unit of the refrigeration apparatus according to any one of claims 3 to 5, wherein
the side panel has a first bent surface (233a), which is bent in such a way as to extend in a direction intersecting a side surface configured by the side panel as seen in a plan view and in which the opening portion is formed, and a second bent surface (233b), which is disposed after the first bent surface and is bent in such a way as to extend in a direction intersecting the first bent surface, and
the non-metal component is fastened to the second bent surface by the anchoring part.

7. The outdoor unit of the refrigeration apparatus according to claim 6, further comprising a front panel (25) made of a non-aluminum metal that has a bent end surface (25b) that covers the second bent surface of the side panel, wherein the non-metal component further has second space maintaining portion (61a, 61d) that is interposed between the bent end surface and the fixing portion of the bracket made of aluminum or aluminum alloy.

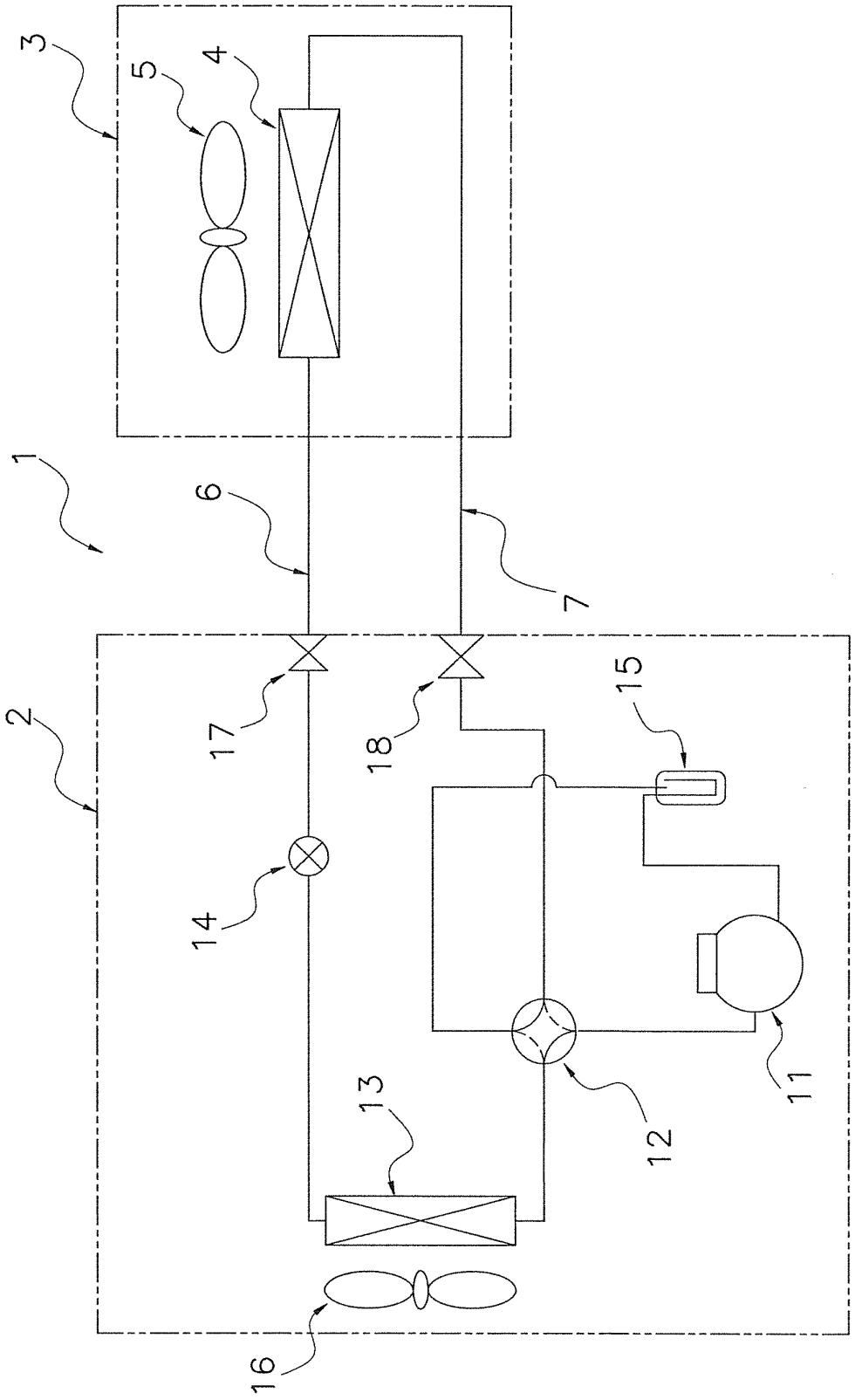


FIG. 1

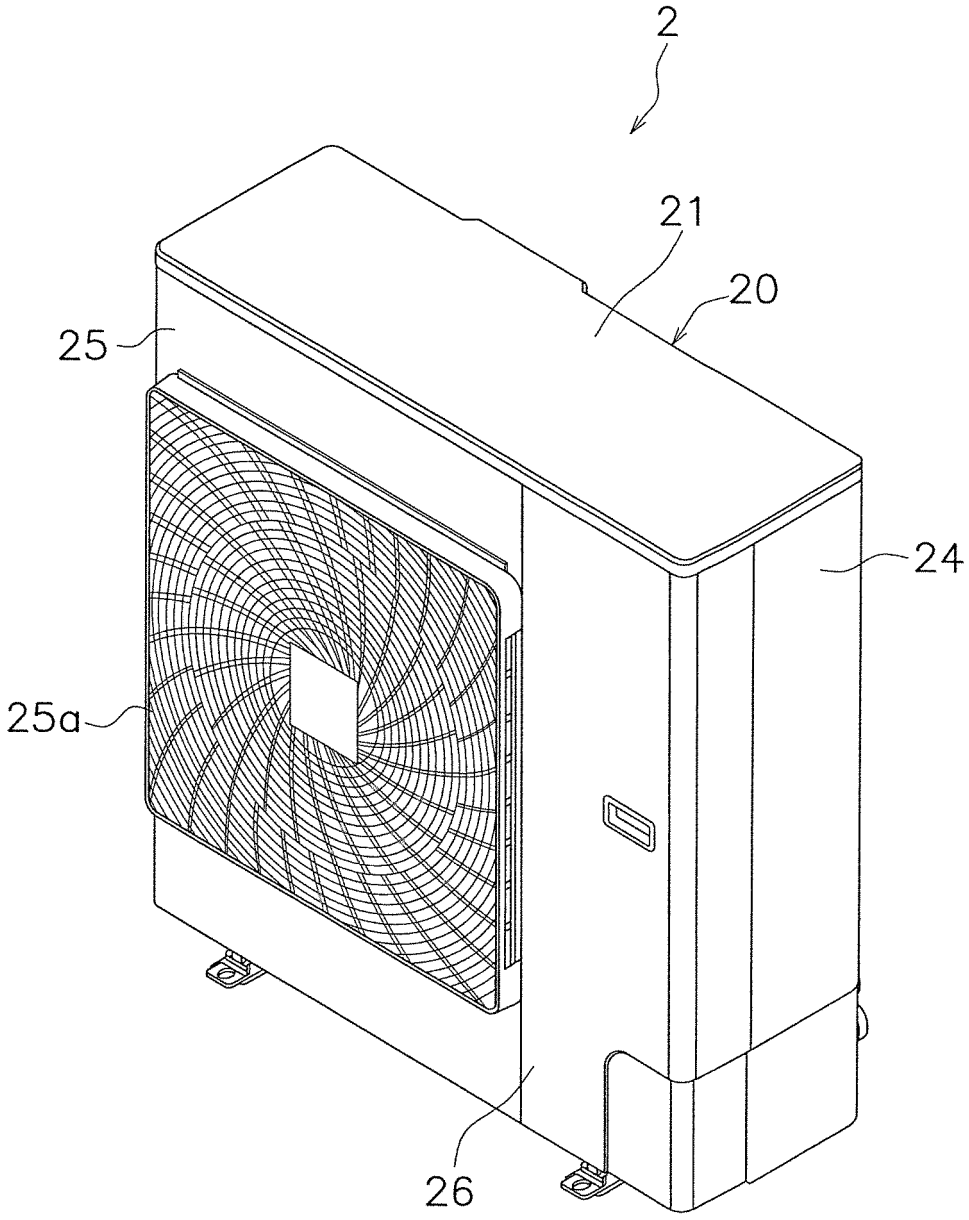


FIG. 2

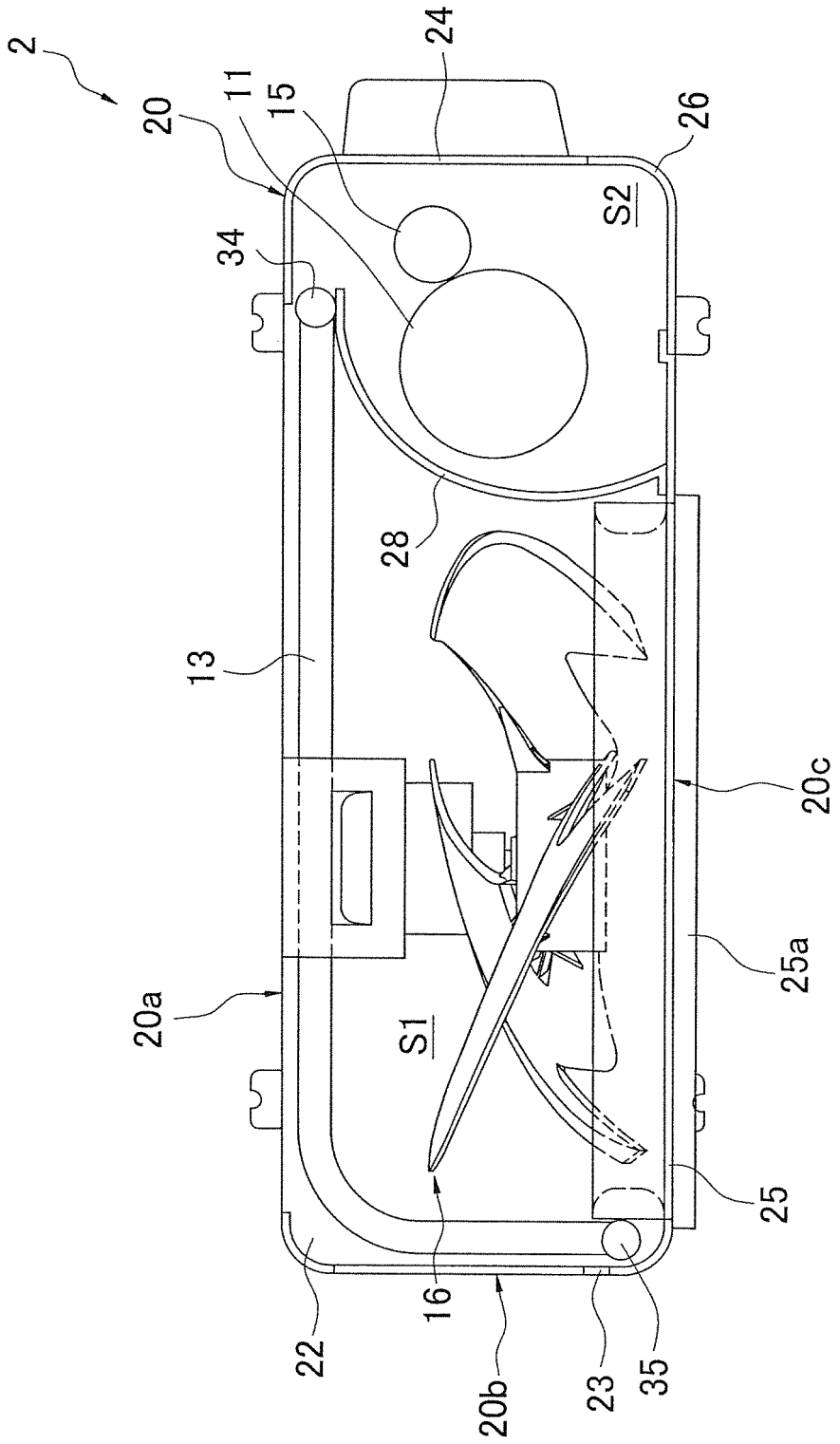


FIG. 3

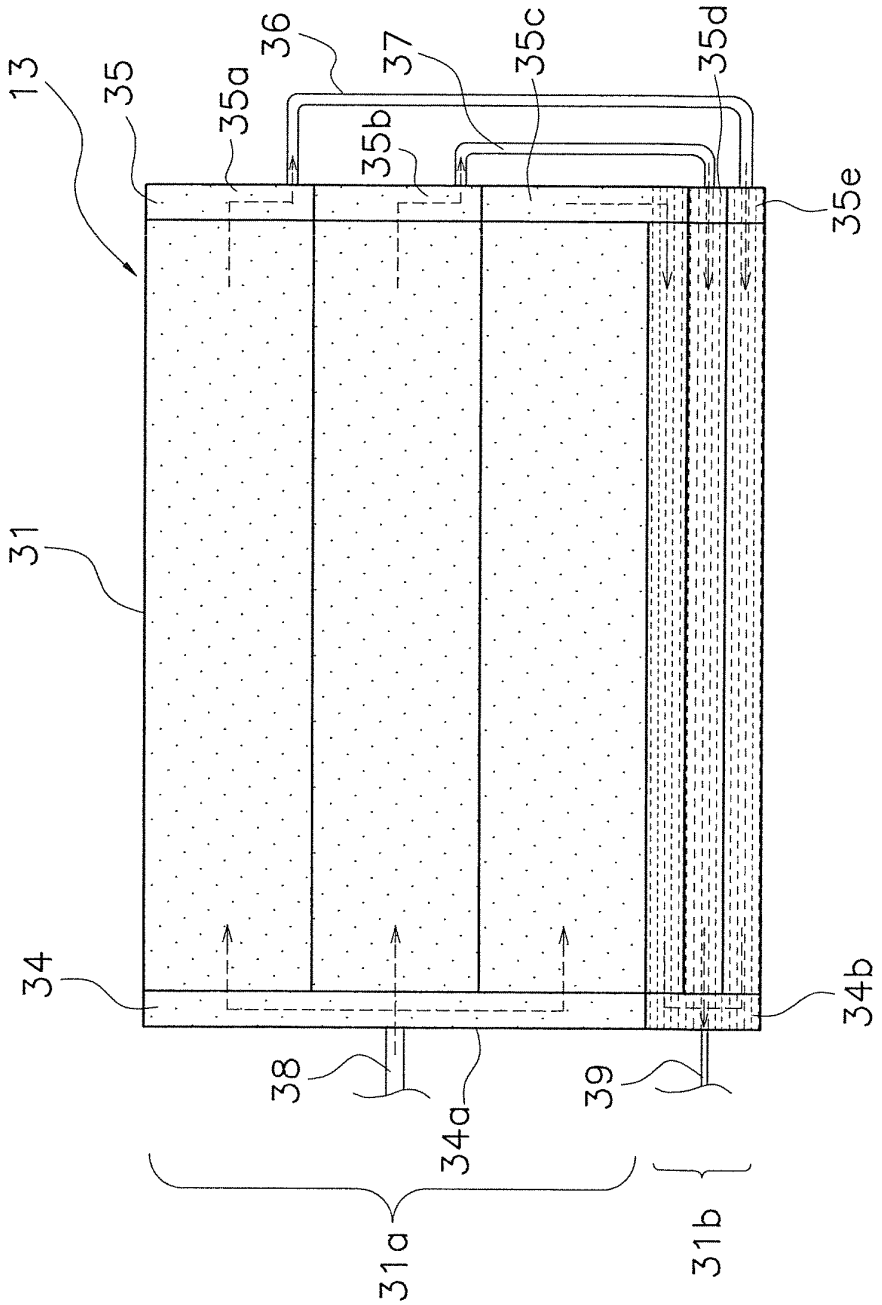
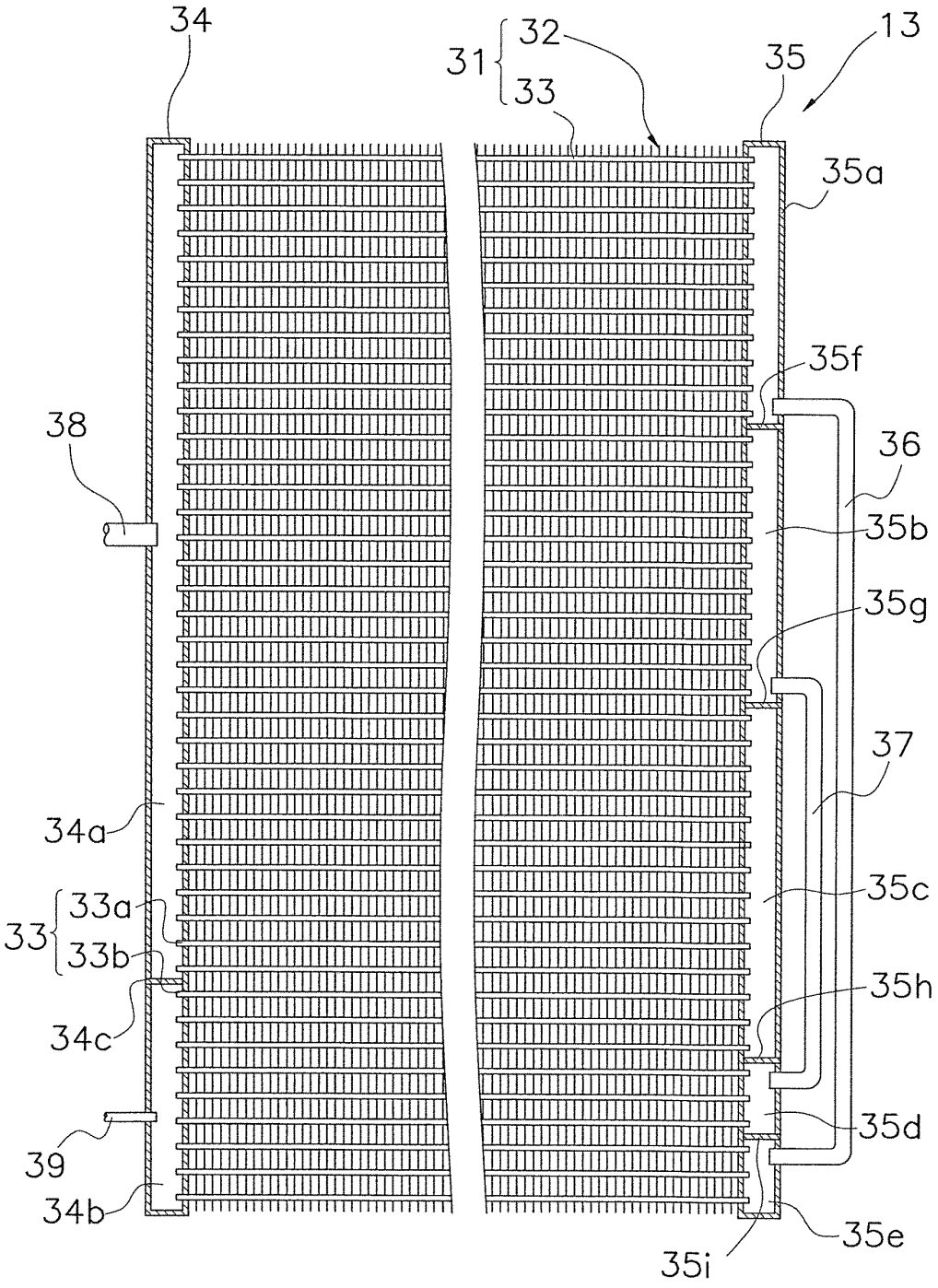


FIG. 4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32
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13
35a
35f
38
36
35b
35g
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34a
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33b
35c
35h
34c
35d
39
34b
35e
35i

FIG. 5

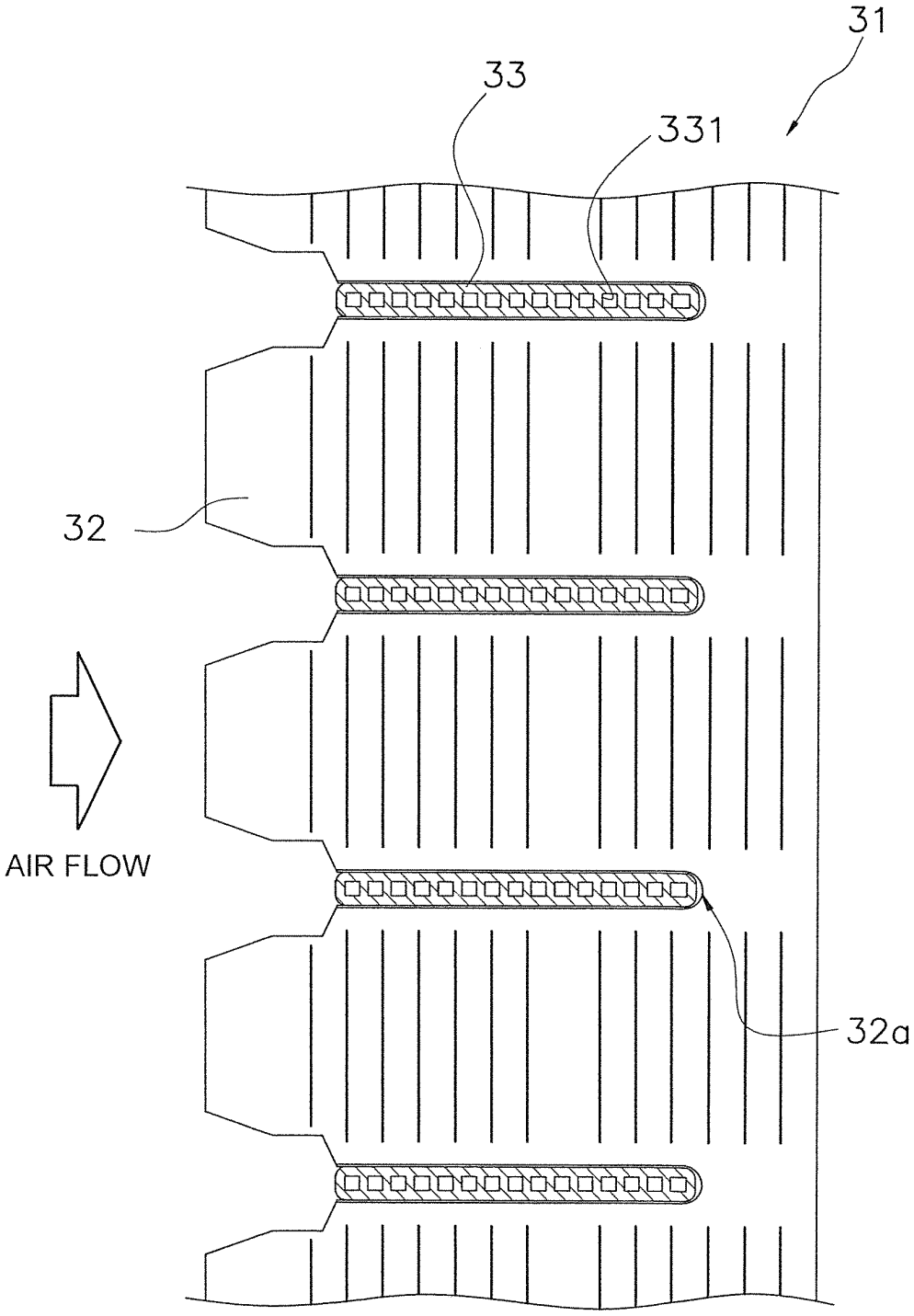
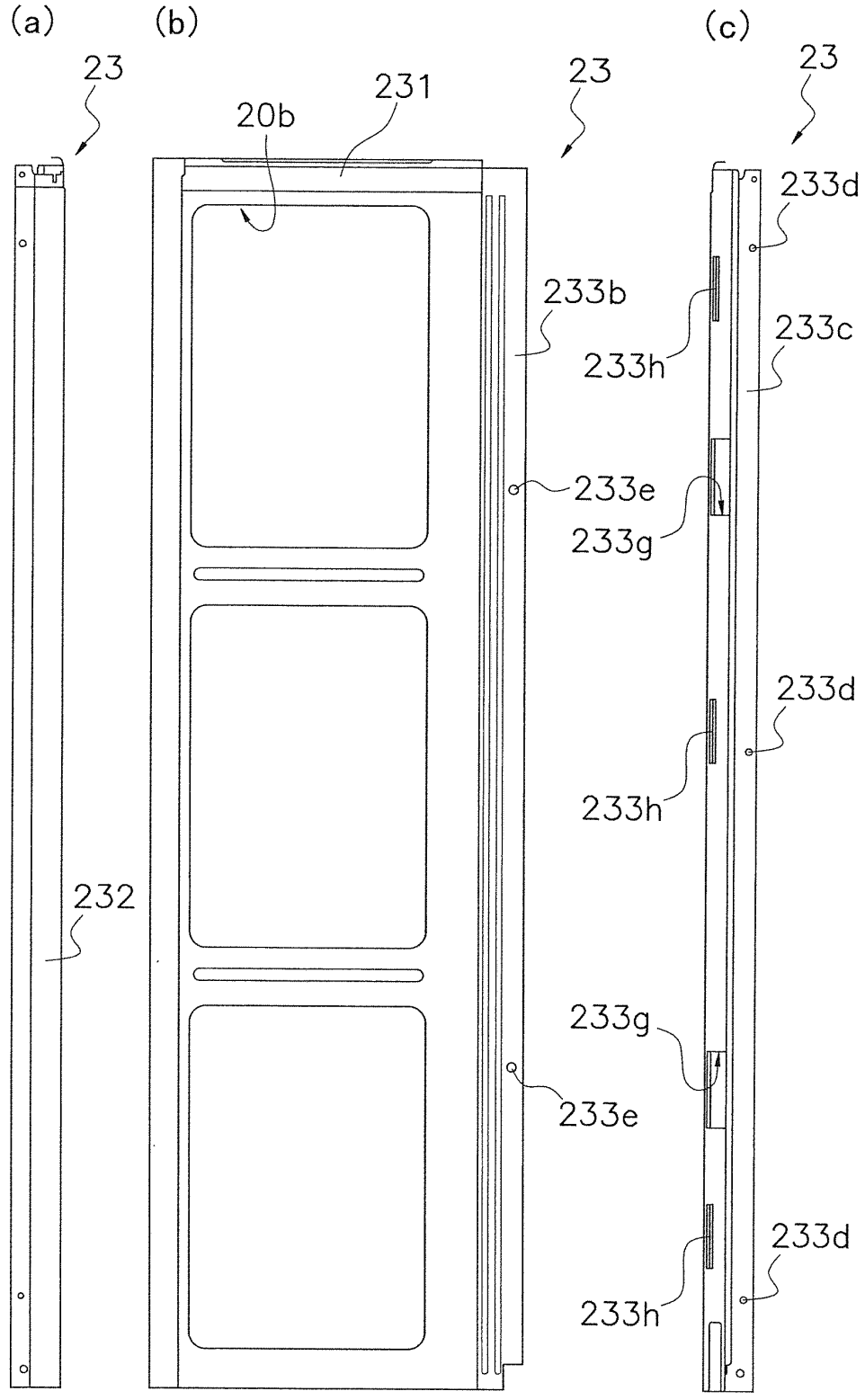


FIG. 6


(a)
(b)
(c)
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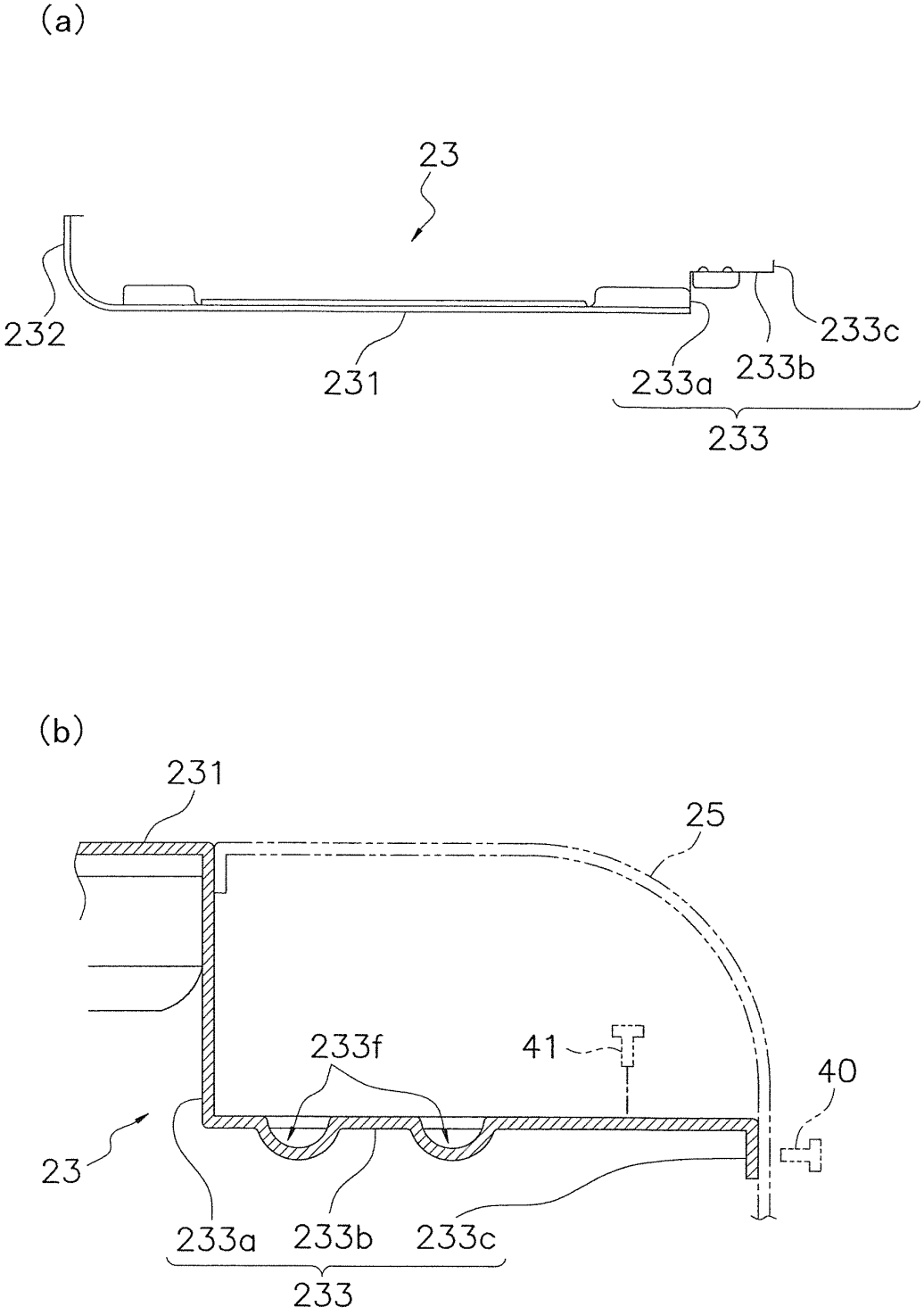
233h

FIG. 7


(a)
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232
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233a
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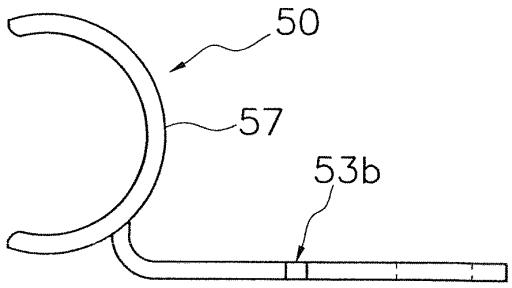
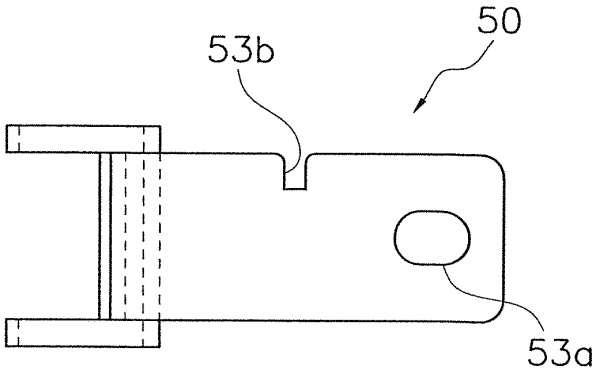
233c
233

FIG. 8

(a)



(b)



(c)

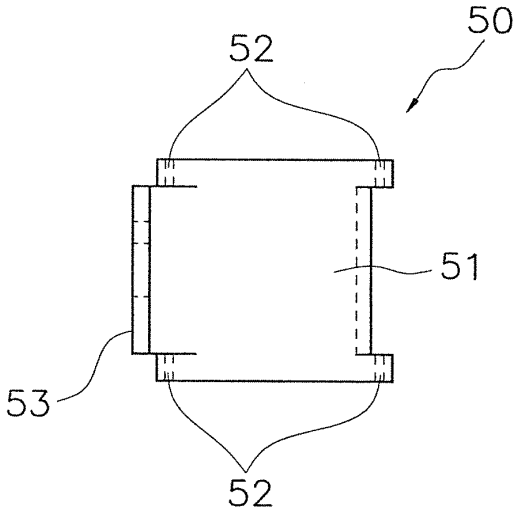


FIG. 9

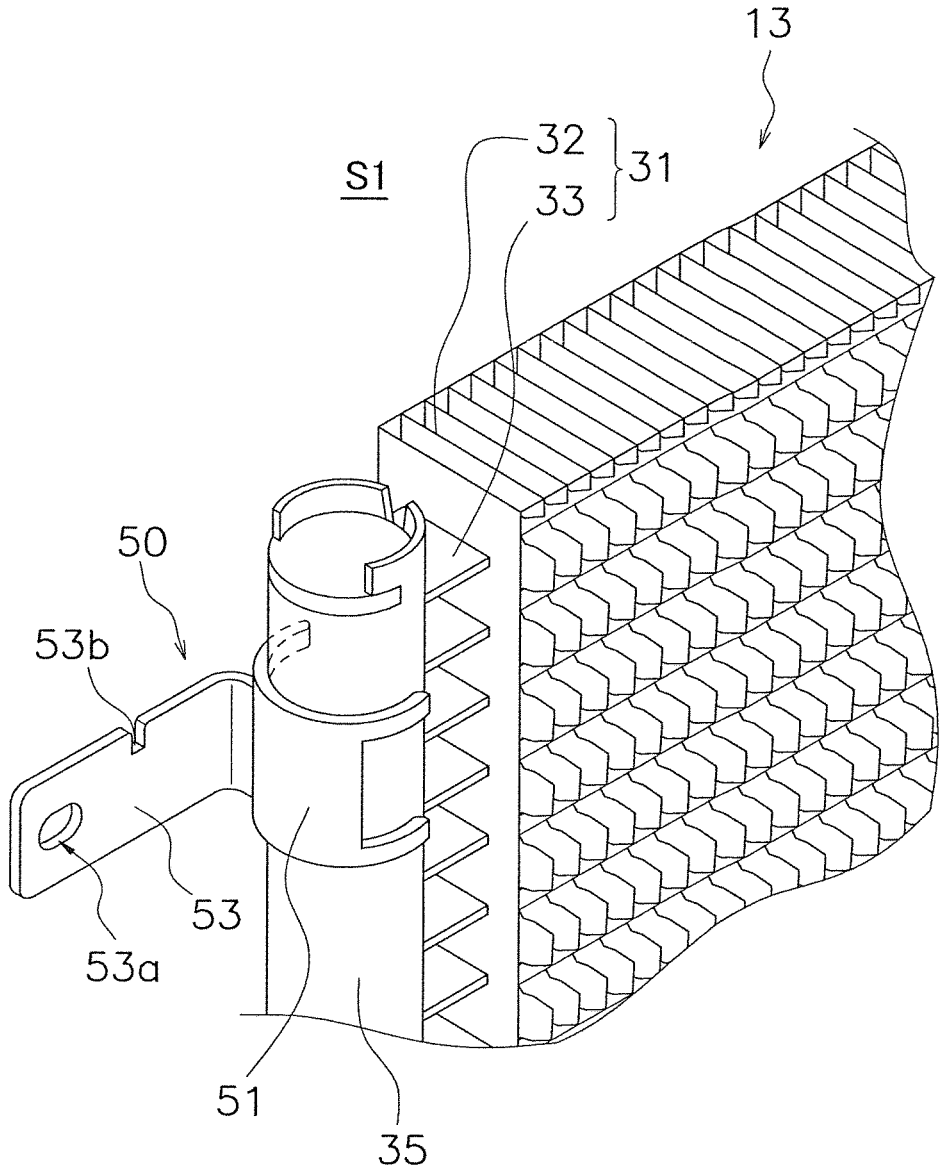


FIG. 10

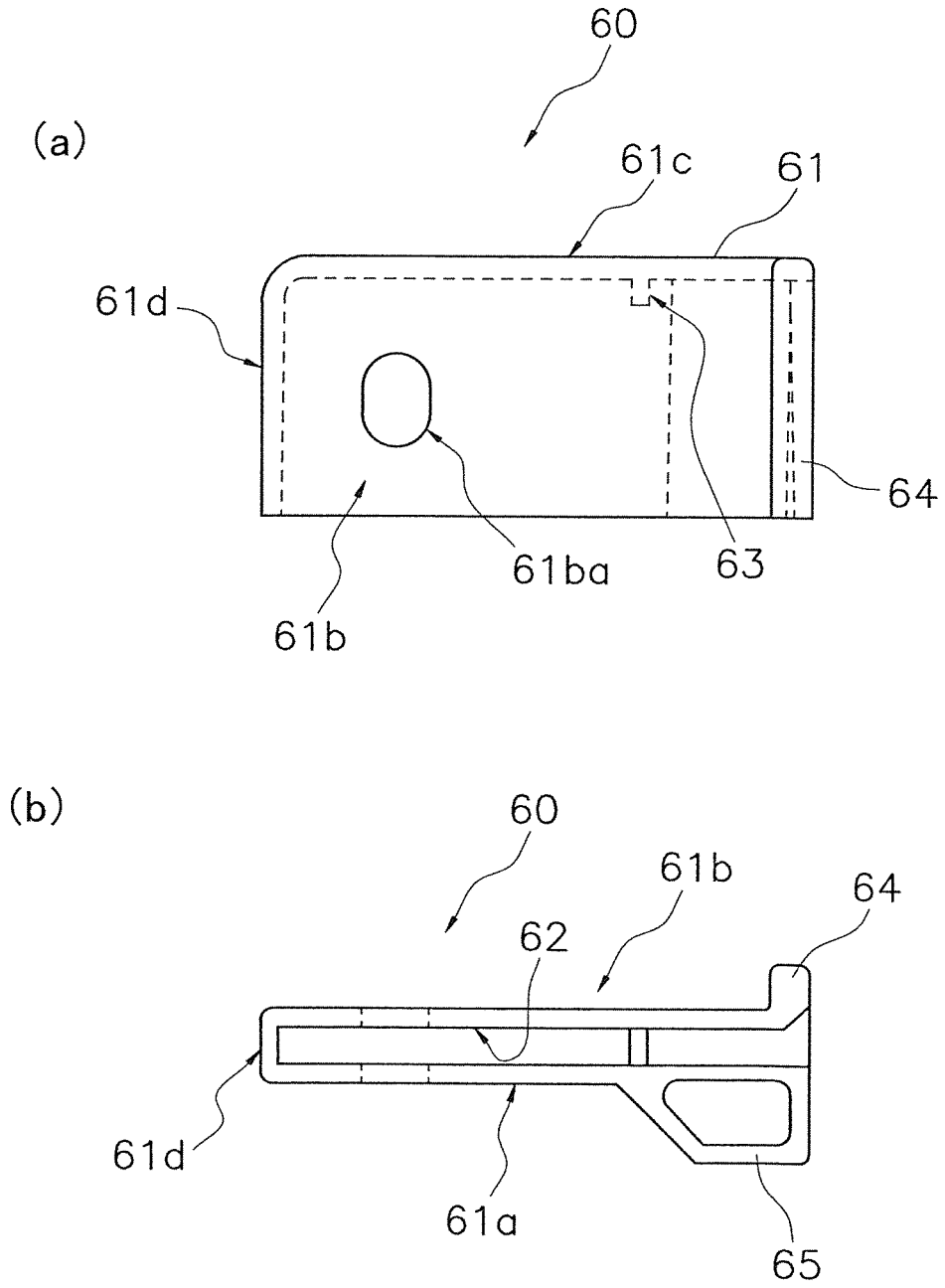


FIG. 11

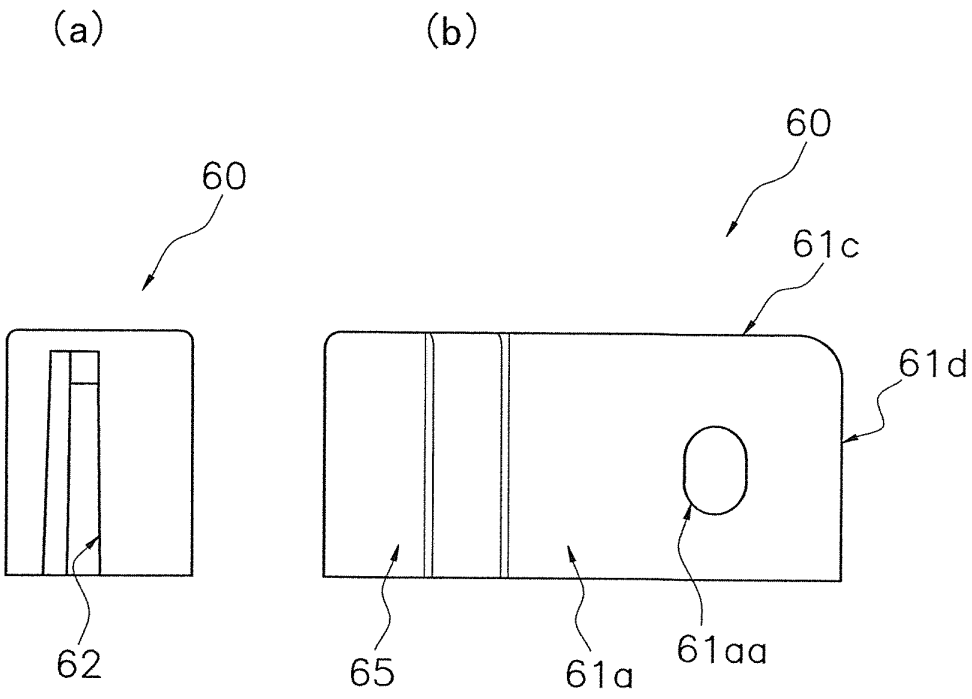


FIG. 12

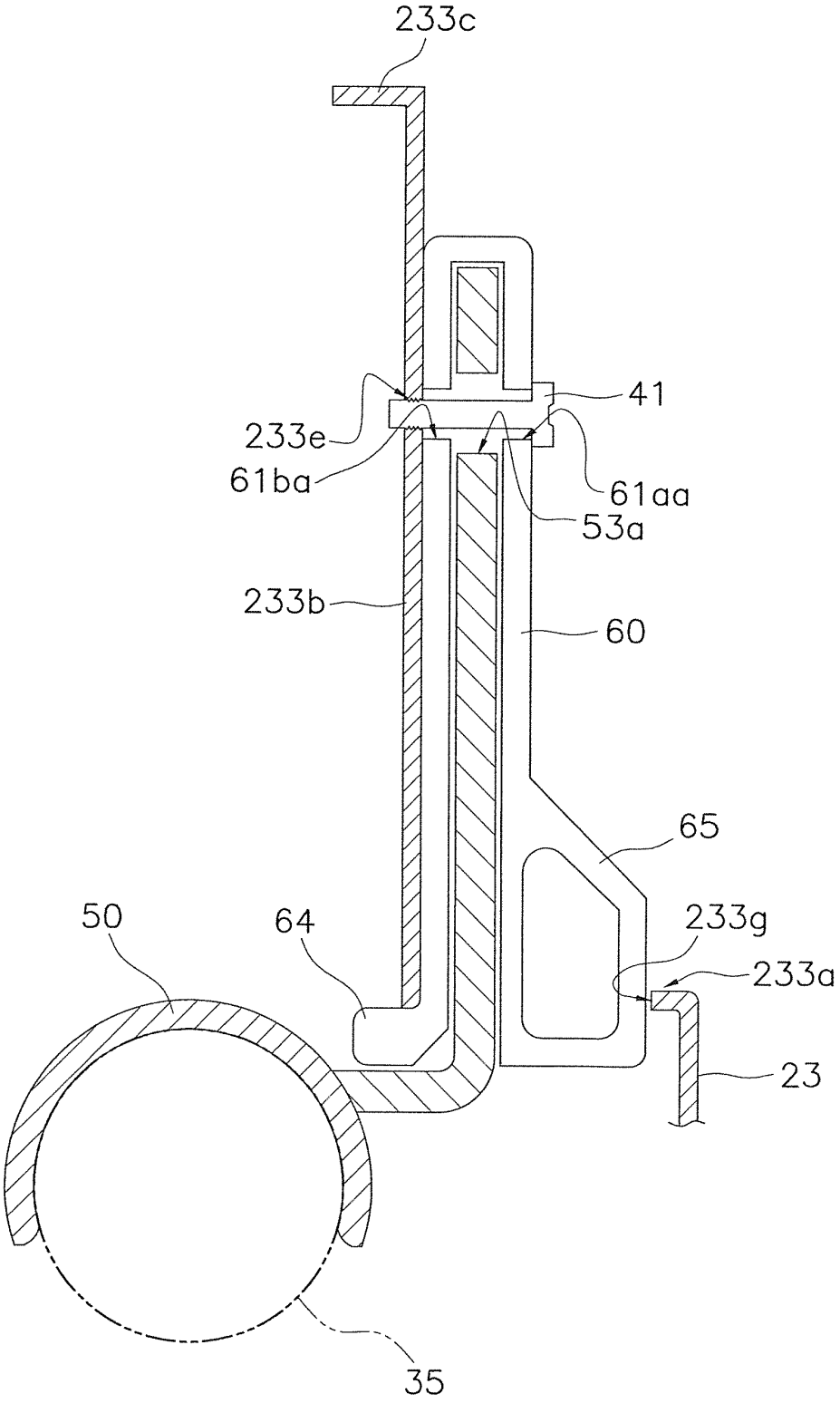


FIG. 13

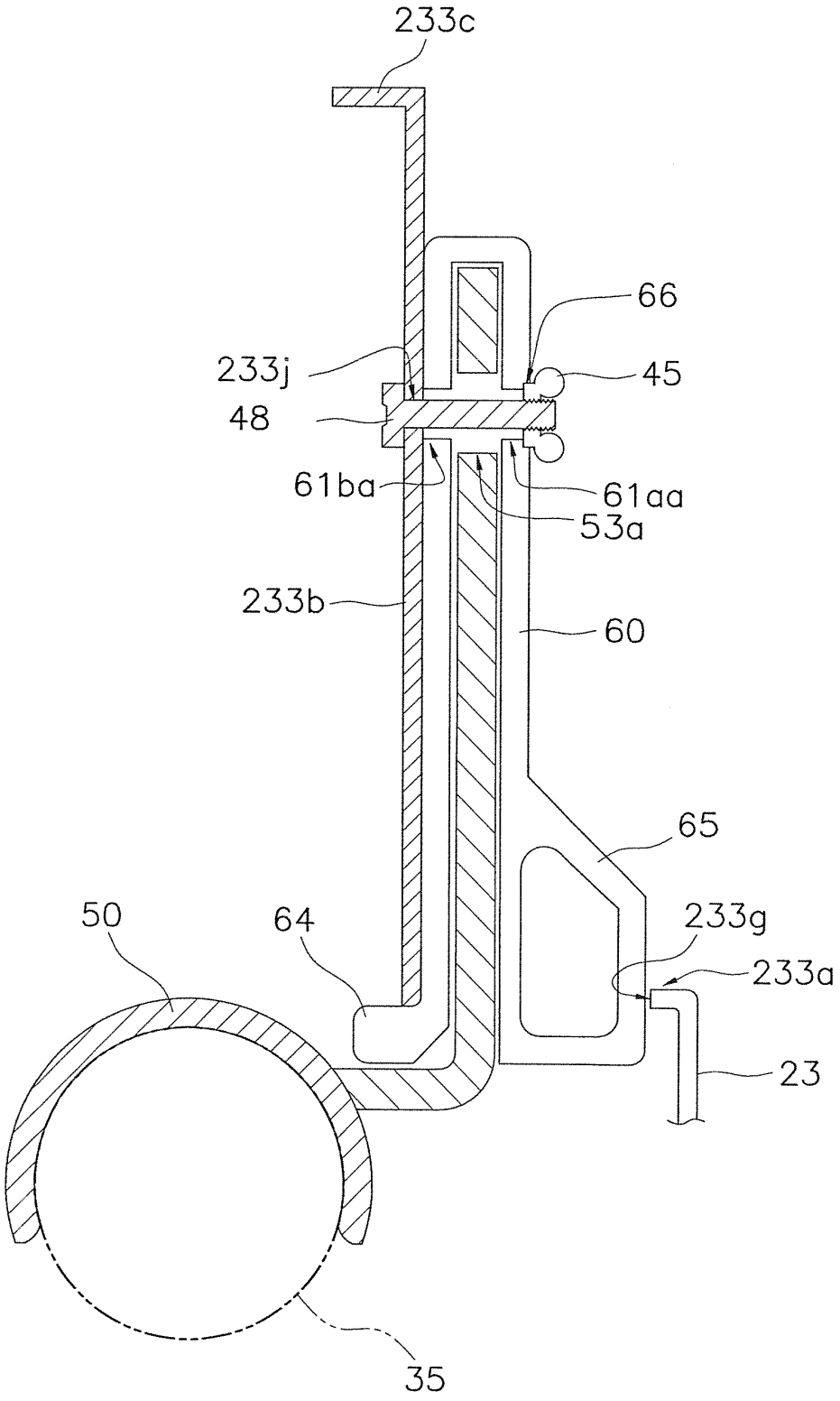
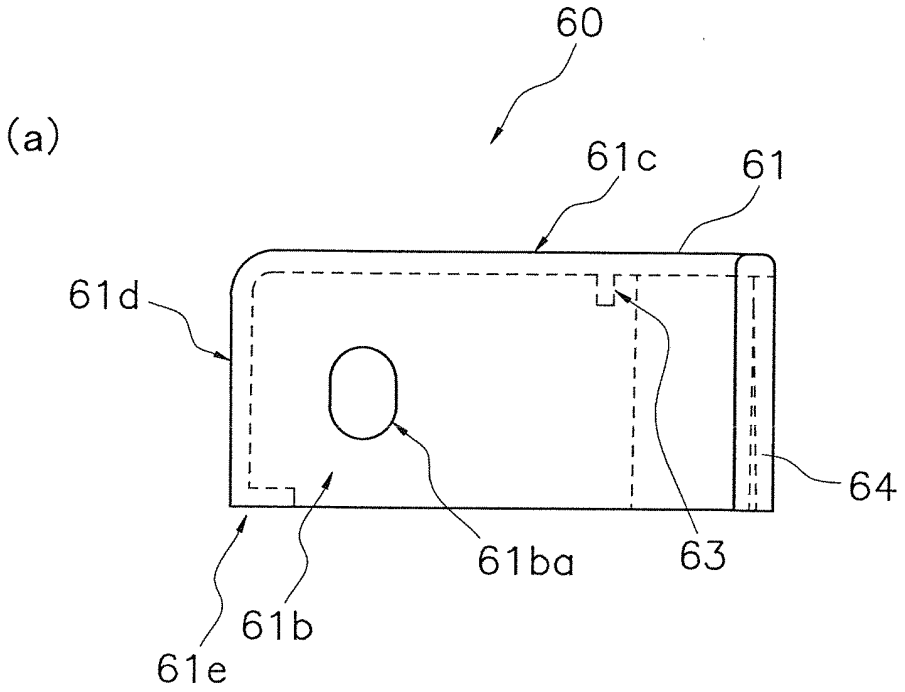


FIG. 14



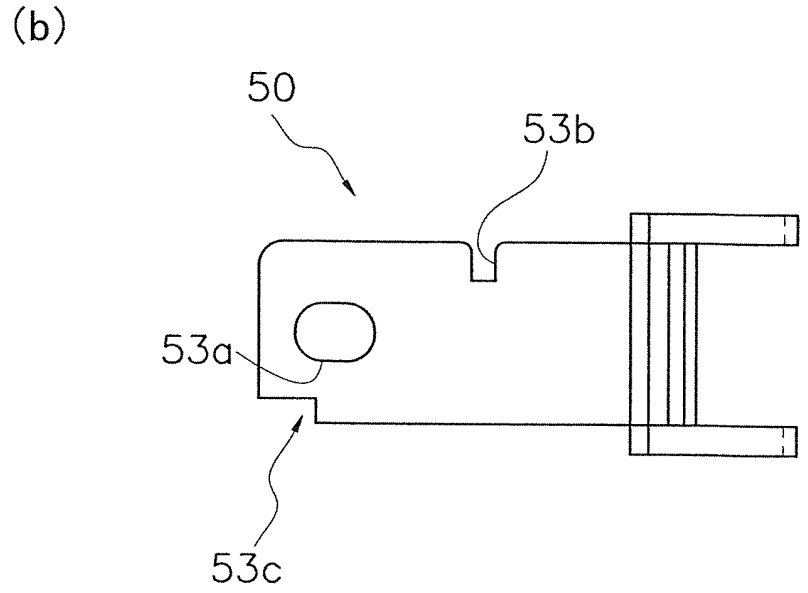


FIG. 15

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2012/083573

A. CLASSIFICATION OF SUBJECT MATTER
F24F1/16(2011.01)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)
F24F1/16

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 1996-2013
Kokai Jitsuyo Shinan Koho 1971-2013 Toroku Jitsuyo Shinan Koho 1994-2013

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.
A	JP 2010-253994 A (Denso Corp.), 11 November 2010 (11.11.2010), entire text; all drawings (Family: none)	1-7
A	JP 5-60484 A (Showa Aluminum Corp.), 09 March 1993 (09.03.1993), entire text; all drawings (Family: none)	1-7

☒ 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
22 March, 2013 (22.03.13)	02 April, 2013 (02.04.13)
Name and mailing address of the ISA/ Japanese Patent Office Facsimile No.	Authorized officer Telephone No.

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INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2012/083573

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	Microfilm of the specification and drawings annexed to the request of Japanese Utility Model Application No. 56238/1979(Laid-open No. 157672/1980) (Diesel Kiki Co., Ltd.), 12 November 1980 (12.11.1980), entire text; all drawings (Family: none)	1-7
A	Microfilm of the specification and drawings annexed to the request of Japanese Utility Model Application No. 46127/1986(Laid-open No. 157611/1987) (Nihon Radiator Co., Ltd.), 06 October 1987 (06.10.1987), entire text; all drawings (Family: none)	1-7
A	JP 2011-145029 A (Sharp Corp.), 28 July 2011 (28.07.2011), entire text; all drawings (Family: none)	1-7
A	JP 2005-114273 A (Matsushita Electric Industrial Co., Ltd.), 28 April 2005 (28.04.2005), entire text; all drawings (Family: none)	1-7

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REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- JP H7234088 A **[0003] [0076]**