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(54) OUTDOOR UNIT FOR REFRIGERATION APPARATUS

(57) To prevent corrosion of a bracket made of aluminum for attaching a heat exchanger made of aluminum. A bracket (40) made of aluminum is cooperatively fastened by a male screw (80) made of iron and an attachment plate (70) made of iron and is fixed to a blower chamber-side side panel (23) made of sheet steel. The outer diameter of the male screw (80) is smaller than the dimension of a through hole (43a) in the bracket (40). The bracket (40) made of aluminum is fastened via a resin cover (60) to the blower chamber-side side panel (23), and the bracket (40) made of aluminum is maintained by the resin cover (60) in a non-contact state in which the bracket (40) also does not contact the male screw (80) made of iron passing through the through hole (43a) in an attachment piece (43).

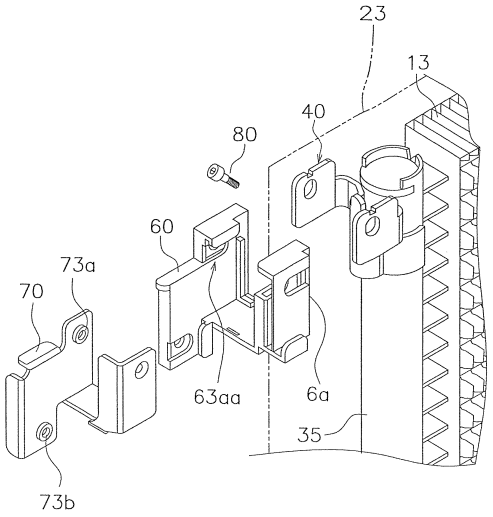


FIG. 16

EP 2 799 788 A1

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 it is common for a non-aluminum metal different from aluminum or aluminum alloy, such as sheet steel for example, to be used for the casing.

[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 prevent corrosion of a bracket made of aluminum or aluminum alloy for attaching a heat exchanger 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 is an outdoor unit of a refrigeration apparatus comprising a heat exchanger made of aluminum or aluminum alloy, a bracket made of aluminum or aluminum alloy that has a securing portion that is attached directly to the heat exchanger and a fixing portion that has a through hole for fixing the bracket to a structural part made of a non-aluminum metal, and a non-metal component that is interposed between the fixing portion of the bracket and the structural part that are fixed to one another and is for placing both in a non-contact state, the outdoor unit of the refrigeration apparatus further comprising: an anchoring part made of a non-aluminum metal that has an outer shape that is smaller than the through hole in the fixing portion; and an anchored structure that cooperates with the anchoring part to fasten the fixing portion of the bracket to the structural part via the non-metal component, wherein the non-metal component maintains, in a state in which the anchoring part is passing through the through hole in the fixing portion, a non-contact state between the bracket made of aluminum or aluminum alloy and the anchoring part 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, in a state in which the bracket made of aluminum or aluminum alloy is fixed to, and without contacting, the structural part made of a non-aluminum metal via the non-metal component, the non-metal component can maintain the anchoring part, whose outer shape is smaller than the outer shape of the through hole, in a non-contact state relative to the bracket made of aluminum or aluminum alloy. Because the anchoring part made of a non-aluminum metal does not contact the bracket made of aluminum or aluminum alloy, corrosion of the bracket caused by corrosion occurring between the non-aluminum metal and the aluminum metal is prevented.

[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, further comprising a casing made of a non-aluminum metal for housing the heat exchanger made of aluminum or aluminum alloy, wherein the casing made of a non-aluminum metal is the structural part made of a non-aluminum metal.

[0010] In the outdoor unit of the refrigeration apparatus pertaining to the second aspect, the bracket made of aluminum or aluminum alloy can fix the casing made of a non-aluminum metal via the non-metal component.

[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, wherein the non-metal component has a sandwiching structure that sandwiches from both sides the fixing portion of the bracket made of aluminum or aluminum alloy, and the anchoring part and the anchored structure fasten together the sandwiching structure of the non-metal component and the fixing portion

of the bracket made of aluminum or aluminum alloy.

[0012] In the outdoor unit of the refrigeration apparatus pertaining to the third aspect, the fixing portion of the bracket is fastened in a state in which it is sandwiched by the sandwiching structure of the non-metal component, so the bracket can be strongly fixed by the non-metal component, and the fixing of the heat exchanger can be strengthened.

[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 of the third aspect, wherein the anchoring part is a male screw made of a non-aluminum metal, and the anchored structure is a nut separate from the structural part and capable of anchoring the male screw, an attachment plate having a screw hole capable of anchoring the male screw, or a female-threaded portion in the non-metal component capable of anchoring the male screw.

[0014] In the outdoor unit of the refrigeration apparatus pertaining to the fourth aspect, by using the male screw made of a non-aluminum metal, an anchoring part having the necessary strength can be obtained at a low cost.

[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 fourth aspect, wherein the screw hole in the attachment plate is burred.

[0016] In the outdoor unit of the refrigeration apparatus pertaining to the fifth aspect, the screw hole is burred, so the male screw can be tightened in just the attachment plate, and the number of parts can be reduced.

[0017] An outdoor unit of a refrigeration apparatus pertaining to a sixth aspect of the present invention is any of the outdoor units of the refrigeration apparatus of any of the first aspect to the fifth aspect, wherein the bracket made of aluminum or aluminum alloy has a plurality of the fixing portions.

[0018] In the outdoor unit of the refrigeration apparatus pertaining to the sixth aspect, the fixing of the bracket can be performed at plural places using the plural fixing portions, so the stability of the fixing of the heat exchanger can be improved.

<Advantageous Effects of Invention>

[0019] In the outdoor unit of the refrigeration apparatus pertaining to the first aspect, corrosion of the bracket made of aluminum or aluminum alloy for attaching the heat exchanger made of aluminum or aluminum alloy can be prevented, and problems such as a poor outer appearance and looseness occurring in the attachment of the heat exchanger due to such corrosion or the like can be prevented from being triggered.

[0020] In the outdoor unit of the refrigeration apparatus pertaining to the second aspect, it becomes easier to make the outdoor unit compact.

[0021] In the outdoor unit of the refrigeration apparatus pertaining to the third aspect, the fixing of the heat exchanger can be strengthened by the sandwiching structure of the non-metal component, and the effect of preventing the occurrence of problems such as looseness of the attachment of the heat exchanger can be improved.

[0022] In the outdoor unit of the refrigeration apparatus pertaining to the fourth aspect, the outdoor unit can be provided at a low cost because an anchoring part having the necessary strength can be obtained at a low cost.

[0023] In the outdoor unit of the refrigeration apparatus pertaining to the fifth aspect, the number of parts can be reduced and the manufacturing cost of the outdoor unit can be reduced.

[0024] In the outdoor unit of the refrigeration apparatus pertaining to the sixth aspect, the fixing of the heat exchanger becomes stable, so problems such as the occurrence of noise resulting from rattling of the heat exchanger can be prevented.

BRIEF DESCRIPTION OF DRAWINGS

[0025]

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 is an enlarged side view of a blower chamber-side side panel;
FIG. 8(a) is a perspective view showing one aspect of a bracket made of aluminum, FIG. 8(b) is a plan view of the bracket, FIG. 8(c) is a front view of the bracket, and FIG. 8(d) is a side view of the bracket;
FIG. 9 is a partially enlarged perspective view showing the bracket brazed to a header collection tube;
FIG. 10(a) is a perspective view showing another aspect of a bracket made of aluminum, FIG. 10(b) is a plan view of the bracket, FIG. 10(c) is a front view of the bracket, and FIG. 10(d) is a side view of the bracket;
FIG. 11 (a) is a plan view of a resin cover, FIG. 11 (b) is a front view of the resin cover, and FIG. 11(c) is a bottom view of the resin cover;
FIG. 12(a) is a left side view of the resin cover, FIG. 12(b) is a back view of the resin cover, and FIG. 12(c) is a right side view of the resin cover;
FIG. 13(a) is a sectional view taken along line I-I of FIG. 12(b) as seen from the direction of the arrows, FIG. 13(b) is a sectional view taken along line II-II of

FIG. 12(b) as seen from the direction of the arrows, and FIG. 13(c) is a sectional view taken along line III-III of FIG. 12(c) as seen from the direction of the arrows;
FIG. 14(a) is a plan view of an attachment plate, and FIG. 14(b) is a front view of the attachment plate;
FIG. 15(a) is a left side view of the attachment plate, and FIG. 15(b) is a right side view of the attachment plate;
FIG. 16 is an exploded assembly diagram of the bracket and the resin cover;
FIG. 17 is a perspective view showing a state in which the bracket, the resin cover, and the attachment plate are attached; and
FIG. 18 is a perspective view showing a state of the outdoor unit in which panels of a unit casing other than a bottom panel have been removed.

DESCRIPTION OF EMBODIMENT

(1) Overall Configuration of Air Conditioning Apparatus

[0026] 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.

[0027] 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.

[0028] 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.

[0029] 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 discharge 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

[0030] 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

[0031] 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 S1. 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 refriger-

ant-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.

[0032] 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 S1. 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.

[0033] The outdoor unit 2 is configured to suck outdoor air into the blower chamber S1 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.

[0034] 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

[0035] 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 31 a, 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.

[0036] 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.

[0037] 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.

[0038] 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.

[0039] 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.

[0040] 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 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.

[0041] 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.

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

[0042] FIG. 7 is an enlarged side view of the blower chamber-side side panel 23. Screw holes 23a and 23b are formed on the front side of the air inlet 20b in the blower chamber-side side panel 23 made of sheet steel. Brackets 40 and 50 made of aluminum are fixed to the blower chamber-side side panel 23 by male screws 80 or the like made of iron (see FIG. 16) that are screwed into the screw holes 23a and 23b, whereby the header collection tube 35 made of aluminum brazed to the brackets 40 and 50 made of aluminum is fixed.

(2-2-3) Brackets Made of Aluminum

[0043] FIGS. 8(a) to 8(d) show the bracket 40 made of aluminum for attaching the outdoor heat exchanger 13 to the blower chamber-side side panel 23. FIG. 8(a) is a perspective view of the bracket 40 made of aluminum, FIG. 8(b) is a plan view of the bracket 40, FIG. 8(c) is a front view of the bracket 40, and FIG. 8(d) is a side view of the bracket 40.

[0044] The bracket 40 is, for example, formed by pressing a single aluminum sheet. Two clamping pieces 42 that are attached to the header collection tube 35 of the outdoor heat exchanger 13 extend from a body portion 41 of the bracket 40. The clamping pieces 42 are each formed in a circular arc shape so as to conform to the outer periphery of the cylindrical header collection tube 35. Two attachment pieces 43 extend from the side of the bracket 40 opposite the side with the clamping pieces 42. A through hole 43a for allowing a screw to pass through when attaching the bracket 40 to the blower chamber-side side panel 23 is disposed in each of the attachment pieces 43. The through holes 43a are m1 $\times$n1 elongated holes. In order to position the bracket 40 and a resin cover 60, fitting counterparts 43b formed as a result of parts of the upper edge end portions of the attachment pieces 43 being cut out are disposed in the attachment pieces 43. A sensor retaining portion 44 formed in a concave shape is disposed in the body portion 41. The shape of the sensor retaining portion 44 can be seen as forming a tubular hole 44a and a 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.

[0045] FIG. 9 shows a state in which the bracket 40

made of aluminum has been brazed to the header collection tube 35. The brazing of the bracket 40 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 40 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.

[0046] The bracket 40 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 40 and the header collection tube 35 is formed slightly smaller than the outer dimension of a case 54 of a temperature sensor 19 (see FIG. 9). By strongly pressing the temperature sensor 19 into the case 54, the temperature sensor 19 is fixed in the cylindrical hole.

[0047] FIGS. 10(a) to 10(d) show the bracket 50 made of aluminum, with FIG. 10(a) being a perspective view, FIG. 10(b) being a plan view, FIG. 10(c) being a front view, and FIG. 10(d) being a side view. Like the bracket 40, the bracket 50 is also, for example, formed by pressing a single aluminum sheet. The bracket 50 differs in shape from the bracket 40 but has the same configuration as that of the bracket 40 in that it has a body portion 51, clamping pieces 52, and attachment pieces 53. Furthermore, a through hole 53a is also formed in each of the attachment pieces 53, but the positions where the through holes 53a are formed differ from those of the through holes 43a in the attachment pieces 43. The through holes 53a are also m1 $\times$n1 elongated holes. In order to position the bracket 40 and the resin cover 60, fitting counterparts 53b formed as a result of parts of the end portions of the attachment pieces 53 being cut out are disposed in the attachment pieces 53. The temperature sensor 19 is not attached to the bracket 50, so a configuration like that of the sensor retaining portion 44 is not formed in the bracket 50.

(2-2-4) Resin Cover

[0048] The brackets 40 and 50 are made of aluminum, so if the brackets 40 are brought into direct contact with the blower chamber-side side panel 23 made of sheet steel, corrosion of the brackets 40 and 50 is promoted by the contact between the iron and the aluminum, which are metals with different ionization tendencies. Therefore, the resin cover 60 shown in FIGS. 11(a) to 11(c), FIGS. 12(a) to 12(c), and FIGS. 13(a) to 13(c) is attached to the brackets 40 and 50, and the brackets 40 and 50 are 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 brackets 40 and 50. FIG. 11 (a) is a plan view of the resin cover, FIG. 11(b) is a front view of the resin cover, and FIG. 11(c) is a bottom view of the resin cover. FIG. 12(a) is a left side view of the resin cover, FIG. 12(b) is a back view of the resin cover, and FIG. 12(c) is a right side view of the resin cover. Furthermore, FIG. 13(a) is a sectional view taken along line I-I of FIG. 12(b) as seen from the direction of the arrows, FIG. 13(b) is a sectional view taken along line II-II of FIG. 12(b) as seen from the direction of the arrows, and FIG. 13(c) is a partially enlarged sectional view taken along line III-III of FIG. 12(c) as seen from the direction of the arrows.

[0049] The resin covers 60 are used for the two brackets 40 and 50 even though the shapes of the brackets 40 and 50 differ from one another. For that reason, the shape of the resin cover 60 is complex, but the resin cover 60 can, for example, be formed by one-time injection molding. A body portion 61 of the resin cover 60 has an insertion portion 62 and an insertion portion 63 for attaching the attachment pieces 43 and 53 of the brackets 40 and 50. Among the attachment pieces 43 and 53 of which the brackets 40 and 50 have two each, respectively, the attachment pieces 43 and 53 whose shapes are the same as one another are inserted into the insertion portion 62. A recess 65 in the front of the body portion 61 has a shape conforming to the shape of the body portion 41 of the bracket 40 and is processed in this shape in order to attach the temperature sensor 19.

[0050] In order to position the bracket 40 and the resin cover 60, fitting projections 62c and 63c that project from parts of the top surfaces of the insertion portions 62 and 63 are disposed in the insertion portions 62 and 63. The fitting projections 62c and 63c fit into the fitting counterparts 43b and 53b of the attachment pieces 43 and 53 of the brackets 40 and 50 to thereby define the positional relationship between the brackets 40 and 50 and the resin cover 60 in the front and rear direction. The attachment pieces 43 and 53 whose shapes differ from one another between the brackets 40 and 50 are inserted into the insertion portion 63, whose upper surface, back surface, and right and left side surfaces are enclosed. By leaving the insertion portion 63 open in the two places of its front surface and its bottom surface, the Attachment pieces 43 and 53 whose shapes with respect to the outside differ can be accommodated. Additionally, the right and left side surfaces of the attachment pieces 43 and 53 inserted into the insertion portion 62 and the insertion portion 63 become covered by the resin cover 60. For this 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 pieces 43 and 53, and the brackets 40 and 50 can be fixed to the blower chamber-side side panel 23 without the brackets 40 and 50 made of aluminum directly touching the blower chamber-side side panel 23.

[0051] An inner wall 62a and an outer wall 62b form the right and left side surfaces of the insertion portion 62. Open portions 62aa and 62ba are formed in the outer wall 62b in positions corresponding to the through holes 43a and 53a in the attachment pieces 43 and 53. The shape of the overlapping section between the open por-

tion 62aa and the open portion 62ba as seen in a side view is a shape that is substantially the same as that of an m1×n1 elongated hole of the same size as the through holes 43a and 53a but has a further part cut out.

[0052] An inner wall 63a and an outer wall 63b form the left and right side surfaces of the insertion portion 63. The positions of the through holes 43a and 53a in the attachment pieces 43 and 53 with the different shapes are different, so two open portions 63ba and 63bb are formed in the outer wall 63b. Open portions 63aa and 63ab that are larger than the open portions 63ba and 63bb are also formed in the inner wall 63a in positions corresponding to the open portions 63ba and 63bb. Openings passing completely through from the inner walls 62a and 63a to the outer walls 62b and 63b are formed by the open portion 62ba, the open portion 62aa, the open portions 63ba and 63bb, and the open portions 63aa and 63ab. The shape of the overlapping section between the open portion 63aa and the open portion 63ba as seen in a side view is a shape that is substantially the same as that of an m1×n1 elongated hole of the same size as the through holes 43a and 53a but has a further part cut out. Furthermore, the shape of the overlapping section between the open portion 63ab and the open portion 63bb as seen in a side view is a shape that is the same as that of an m1×n1 elongated hole of the same size as the through holes 43a and 53a.

[0053] Furthermore, looking at FIG. 12(b), an insertion portion 64 having an opening on the back surface side is formed in the outer wall 62b. A side plate portion 72 of a later-described attachment plate 70 is inserted into the insertion portion 64. Because the insertion portion 64 is formed inside the outer wall 62b, a resin partition 63bc exists between the brackets 40 and 50 made of aluminum inserted into the insertion portion 62 and the attachment plate 70 made of iron inserted into the insertion portion 64.

(2-2-5) Attachment Plate

[0054] An attachment plate 70 is fitted into the resin cover 60 in order for the brackets 40 and 50 and the resin cover 60 to be fastened with male screws to the blower chamber-side side panel 23. FIGS. 14(a) and 14(b) and FIGS. 15(a) and 15(b) show the attachment plate 70, with FIG. 14(a) being a plan view, FIG. 14(b) being a front view, FIG. 15(a) being a left side view, and FIG. 15(b) being a right side view.

[0055] Side plate portions 72 and 73 that extend vertically from left and right end edges of a horizontal flat plate-like base portion 71 are formed in the attachment plate 70. The base portion 71 has a substantially rectangular shape with a recess 71c in front. The width of the base portion 71 is substantially equal to the distance between the inner walls 62a and 63a of the resin cover 60. For that reason, when the attachment plate 70 is fitted into the resin cover 60 in a state in which a front end portion 71 a of the base portion 71 has been brought into contact with front stoppers 61a of the body portion 61 of the resin cover 60, the side plate portion 72 of the attachment plate 70 is inserted into the insertion portion 63 of the resin cover 60, and the side plate 73 is in contact with and is along the inner wall 63a of the resin cover 60. A contact portion 73c of the side plate 73 contacts the area around the back surface side of the insertion portion 64, and the front end portion 71a of the base portion 71 contacts the front stoppers 61 a, so that the attachment plate 70 does not shift forward relative to the resin cover 60. In a state in which the attachment plate 70 does not shift forward in this way, the attachment plate 70. also does not move toward the rear of the resin cover 60 because a rear end portion 71b of the base portion 71 contacts a rear stopper 61 b of the body portion 61 of the resin cover 60.

[0056] Screw holes 72a and 73a formed in the side plate portions 72 and 73 coincide, as seen in a side view, with the open portion 62aa of the inner wall 62a of the resin cover 60, the open portions 63aa and 63ab of the inner wall 63a, the open portion 62ba of the outer wall 62b, and the open portions 63ba and 63bb of the outer wall 63b. Moreover, the outer dimension of later-described male screws that are screwed into the screw holes 72a, 73a, and 73b is smaller than the inner dimensions of the overlapping section between the open portions 62aa and 62ba, the overlapping section between the open portions 63aa and 63ab, and the overlapping section between the open portions 63ba and 63bb as seen in a side view. Furthermore, the outer dimension of the male screws is smaller than the inner dimension of the through holes 43a and 53a in the brackets 40 and 50 made of aluminum. For that reason, in a state in which the attachment plate 70 is properly attached to the resin cover 60, the male screws can be fastened to the screw holes 72a, 73a, and 73b in the attachment plate 70 in such a way that the male screws are not brought into contact with the brackets 40 and 50 and the resin cover 60. The screw holes 72a, 73a, and 73b are formed by burring.

[0057] When the attachment plate 70 is attached to the resin cover 60, upward movement of the attachment plate 70 is suppressed as a result of the top portion of the side plate portion 72 contacting the top surface of the insertion portion 64.

(2-2-6) Assembly of Brackets, Resin Cover, and Attachment Plate

[0058] FIG. 16 shows a state of assembly in which the bracket 40 made of aluminum, the resin cover 60, and the attachment plate 70 made of iron are being fastened with the male screw 80 made of iron to the blower chamber side-side panel 23 made of sheet steel. Furthermore, FIG. 17 shows a state in which the bracket 40 made of aluminum, the resin cover 60, and the attachment plate 70 made of iron have been assembled in a state in which the blower chamber-side side panel 23 has been re-

moved. As shown in FIG. 17, one of the attachment pieces 43 of the bracket 40 is attached to an air blocking plate 100.

[0059] The attachment plate 70 made of iron is disposed inside the resin cover 60 in a state in which the attachment plate 70 is separated by the resin cover 60 from the bracket 40. The male screw 80 passing through the through hole 43a in the bracket 40 and the open portion 63aa etc. of the resin cover 60 fits into the screw hole 73b in the attachment plate 70.

[0060] Furthermore, as shown in FIG. 18, the header collection tube 34 of the outdoor heat exchanger 13 is fixed to the machine chamber-side side panel 24 and the partition panel 28 by brackets 90 made of aluminum, resin covers 92, and attachment plates 93 made of iron. The brackets 90 made of aluminum, the resin covers 92, and the attachment plates 93 made of iron have structures similar to those of the brackets 40 and 50, the resin cover 60, and the attachment plate 70, so description thereof will be omitted. The brackets 90 also have two attachment pieces each like the brackets 40 and 50, but the two attachment pieces are fixed to the machine chamber-side side panel 24 and the partition panel 28. Because their attachment places are different, the brackets 90 made of aluminum, the resin covers 92, and the attachment plates 93 made of iron may also have their structures changed from those of the brackets 40 and 50, the resin cover 60, and the attachment plate 70.

(3) Characteristics of Outdoor Unit

(3-1)

[0061] In the outdoor unit 2, the clamping pieces (a securing portion) as typified by the clamping pieces 42 and 52 of the bracket as typified by the brackets 40,50 and 90 made of aluminum is attached directly to the outdoor heat exchanger 13 made of aluminum, and the attachment pieces (a fixing portion) as typified by the attachment pieces 43 and 53 are fixed via the resin cover 60 or 92 to the blower chamber-side side panel 23 (a structural part made of a non-aluminum metal), the machine chamber-side side panel 24 (a structural part made of a non-aluminum metal), or the partition panel 28 made of sheet steel (a structural part made of a non-aluminum metal), so the aluminum and the sheet steel do not contact one another. The bracket 40 or 50 made of aluminum is cooperatively fastened by the male screw 80 (an anchoring part) made of iron (made of a non-aluminum metal) and the attachment plate 70 (an anchored structure) made of iron and is fixed to the blower chamber-side side panel 23 made of sheet steel. Furthermore, the bracket 90 made of aluminum is also cooperatively fastened by a male screw (not shown in the drawings) made of iron and the attachment plate 93 (an anchored structure) made of iron and is fixed to the (machine chamber-side side panel 24 and the partition panel 28 made of sheet steel.

[0062] However, an outer diameter d (outer shape) of the male screw 80 (an anchoring part) is smaller than the dimension (hole outer shape) of the through hole 43a or 53a in the bracket 40 or 50. That is, there is the relationship: an outer diameter as typified by outer diameter d < a hole diameter as typified by hole diameters m1, n1. Additionally, the bracket 40, 50, or 90 made of aluminum is fastened via the resin cover 60 (a non-metal component) and the resin cover 92 (a non-metal component) to a structural part as typified by the blower chamber-side side panel 23, the machine chamber-side side panel 24, and the partition panel 28, and the bracket 40, 50, or 90 made of aluminum is maintained by the resin cover (a non-metal component) as typified by the resin covers 60 and 92 in a non-contact state in which the bracket 40, 50, or 90 also does not contact the male screw 80 made of iron (made of a non-aluminum metal) passing through the through hole 43a or 53a in the attachment pieces (fixing portions) as typified by the attachment pieces 43 and 53. The through hole 43a or 53a in the fixing portion may also be a hole having a cutout in which a part thereof reaches the end portion of the fixing portion (as typified by the attachment pieces 43 and 53).

[0063] In this way, the male screw 80 made of iron does not contact the bracket 40, 50, or 90 made of aluminum, so corrosion of the brackets caused by corrosion occurring between the iron (a non-aluminum metal) and the aluminum metal is prevented. Corrosion in the neighborhoods of the attachment pieces 43 and 53 of the brackets 40, 50 and 90 made of aluminum for attaching the outdoor heat exchanger 13 made of aluminum can be prevented, and problems such as looseness occurring in the attachment of the outdoor heat exchanger 13 due to such corrosion or the like can be prevented from being triggered.

[0064] Of course, the resin cover 60 or 92 is interposed between the attachment pieces 43 or 53 of the bracket 40, 50, or 90 and at least one among the blower chamber-side side panel 23, the machine chamber-side side panel 24, and the partition panel 28 and maintain both in a non-contact state. For that reason, the blower chamber-side side panel 23, the machine chamber-side side panel 24, and the partition panel 28 (examples of a structural part) made of sheet steel (made of a non-aluminum metal) do not contact the bracket as typified by the bracket 40, 50, and 90 made of aluminum, so corrosion of the bracket caused by corrosion occurring between the steel (non-aluminum metal) and the aluminum metal is also prevented between the brackets and structural parts.

[0065] In the above embodiment, resin members such as the resin covers 60 and 92 are 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.

[0066] The blower chamber-side side panel 23 and the machine chamber-side side panel 24 (examples of a structural part) made of sheet steel (made of a non-aluminum metal) are the unit casing 20 made of sheet steel (a casing made of a non-aluminum metal). The bracket 40, 50, or 90 made of aluminum is available for fixing via the resin cover 60 to the unit casing 20, and it becomes easier to make the outdoor unit 2 compact.

(3-2)

[0067] The resin cover 60 has the inner wall 62a or 63b and the outer wall 62b or 63b (a sandwiching structure) of the insertion portion 62 or 63 for sandwiching from both sides the attachment pieces 43 or 53 (a fixing portion) of the bracket 40 or 50 made of aluminum. Additionally, the male screw 80 (an anchoring part) and the attachment plate 70 (an anchored structure) fasten together the insertion portions 62 and 63 of the resin cover 60 and the attachment pieces 43 or 53 of the bracket 40 or 50 made of aluminum. The attachment pieces 43 or 53 of the bracket 40 or 50 is fastened in a state in which they are sandwiched by the inner walls 62a or 63b and the outer wall 62b or 63b of the resin cover 60, so the bracket 40 or 50 made of aluminum can be strongly fixed by the resin cover 60. As a result, the fixing of the outdoor heat exchanger 13 made of aluminum can be strengthened, and the effect of preventing the occurrence of problems such as looseness of the attachment of the outdoor heat exchanger 13 can be improved.

[0068] The bracket 90 made of aluminum has two attachment pieces like the attachment pieces 43 or 53 of the bracket 40 or 50 made of aluminum. The bracket 90 can be fixed at the two places of the machine chamber-side side panel 24 and the partition panel 28 using the two attachment pieces, so the stability of the fixing of the outdoor heat exchanger 13 can be improved, and problems such as the occurrence of noise resulting from rattling of the outdoor heat exchanger 13 can be prevented.

(3-3)

[0069] As described above, by fastening with the male screw 80 made of iron and the attachment plate 70 having the screw hole 72a, 73a, or 73b, the positioning of the attachment plate 70 and the resin cover 60 is easy and it becomes easier to handle them. Additionally, by using the male screw 80 made of iron, an anchoring part having the necessary strength can be obtained at a low cost, so the outdoor unit 2 can be provided at a low cost. Furthermore, the male screw 80 can be tightened in just the attachment plate 70 because the screw hole 72a, 73a, or 73b is burred, so the number of parts can be reduced and the manufacturing cost of the outdoor unit 2 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 bracket made of aluminum alloy can be used instead of the brackets 40, 50, or 90 made of aluminum.

(4-2) Example Modification B

[0071] 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.

(4-3) Example Modification C

[0072] In the above embodiment, a molded body of resin was used for the resin cover 60, but the molded body may also be formed of another material, such as a ceramic or prepreg composite member.

(4-4) Example Modification D

[0073] In the above embodiment, a case was described where the attachment plate 70 was used for the anchored structure anchored by the male screw 80, but the anchored structure may also be a nut made of iron and capable of anchoring the male screw 80 or a female-threaded portion made of resin molded in the resin cover 60 and capable of anchoring the male screw 80, and an anchoring member other than a screw and an anchored structure may also be used.

(4-5) Example Modification E

[0074] In the above embodiment, a case was described where the male screw 80 was attached to the attachment plate 70 (an anchored structure), but instead of the screws hole 72a, 73a, or 73b in the attachment plate 70, screw hole may also be formed in the blower chamber-side side panel 23, the machine chamber-side side panel 24, or the partition panel 28, and the male screw 80 may be screwed into the screw hole in the blower chamber-side side panel 23, the machine chamber-side side panel 24, or the partition panel 28 to fix the bracket 40, 50, or 90 made of aluminum and the resin cover 60 or 92. In this case, the screw hole in the blower chamber-side side panel 23, the machine chamber-side side panel 24, or the partition panel 28 become an anchored structure.

REFERENCE SIGNS LIST

[0075]

1	Air Conditioning Apparatus
2	Outdoor Unit
3	Indoor Unit
13	Outdoor Heat Exchanger
20	Unit Casing
34, 35	Header Collection Tubes
40, 50, 90	Brackets
60, 92	Resin Covers
70, 93	Attachment Plates

CITATION LIST

<Patent Literature>

[0076] Patent Document 1: JP-A No. H7-234088

Claims

1. An outdoor unit (2) of a refrigeration apparatus comprising
a heat exchanger (13) made of aluminum or aluminum alloy,
a bracket (40, 50, 90) made of aluminum or aluminum alloy that has a securing portion (42, 52) that is attached directly to the heat exchanger and a fixing portion (43, 53) that has a through hole (43a, 53a) for fixing the bracket to a structural part (23, 24, 28) made of a non-aluminum metal, and
a non-metal component (60, 92) that is interposed between the fixing portion of the bracket and the structural part that are fixed to one another and is for placing both in a non-contact state,
the outdoor unit of the refrigeration apparatus further comprising:

an anchoring part (80) made of a non-aluminum metal that has an outer shape that is smaller than the through hole in the fixing portion; and
an anchored structure (70, 93) that cooperates with the anchoring part to fasten the fixing portion of the bracket to the structural part via the non-metal component,
wherein the non-metal component maintains, in a state in which the anchoring part is passing through the through hole in the fixing portion, a non-contact state between the bracket made of aluminum or aluminum alloy and the anchoring part made of a non-aluminum metal.

2. The outdoor unit of the refrigeration apparatus according to claim 1, further comprising a casing (20) made of a non-aluminum metal for housing the heat exchanger made of aluminum or aluminum alloy, wherein the casing made of a non-aluminum metal is the structural part made of a non-aluminum metal.

3. The outdoor unit of the refrigeration apparatus according to claim 2, wherein
the non-metal component has a sandwiching structure (62a, 62b, 63a, 63b) that sandwiches from both sides the fixing portion of the bracket, and
the anchoring part and the anchored structure fasten together the sandwiching structure of the non-metal component and the fixing portion of the bracket made of aluminum or aluminum alloy.

4. The outdoor unit of the refrigeration apparatus according to claim 3, wherein
the anchoring part is a male screw (80) made of a non-aluminum metal, and
the anchored structure is a nut separate from the structural part and capable of anchoring the male screw, an attachment plate (70, 93) having a screw hole capable of anchoring the male screw, or a female-threaded portion in the non-metal component capable of anchoring the male screw.

5. The outdoor unit of the refrigeration apparatus according to claim 4, wherein the screw hole in the attachment plate is burred.

6. The outdoor unit of the refrigeration apparatus according to any one of claims 1 to 5, wherein the bracket (90) has a plurality of the fixing portions.

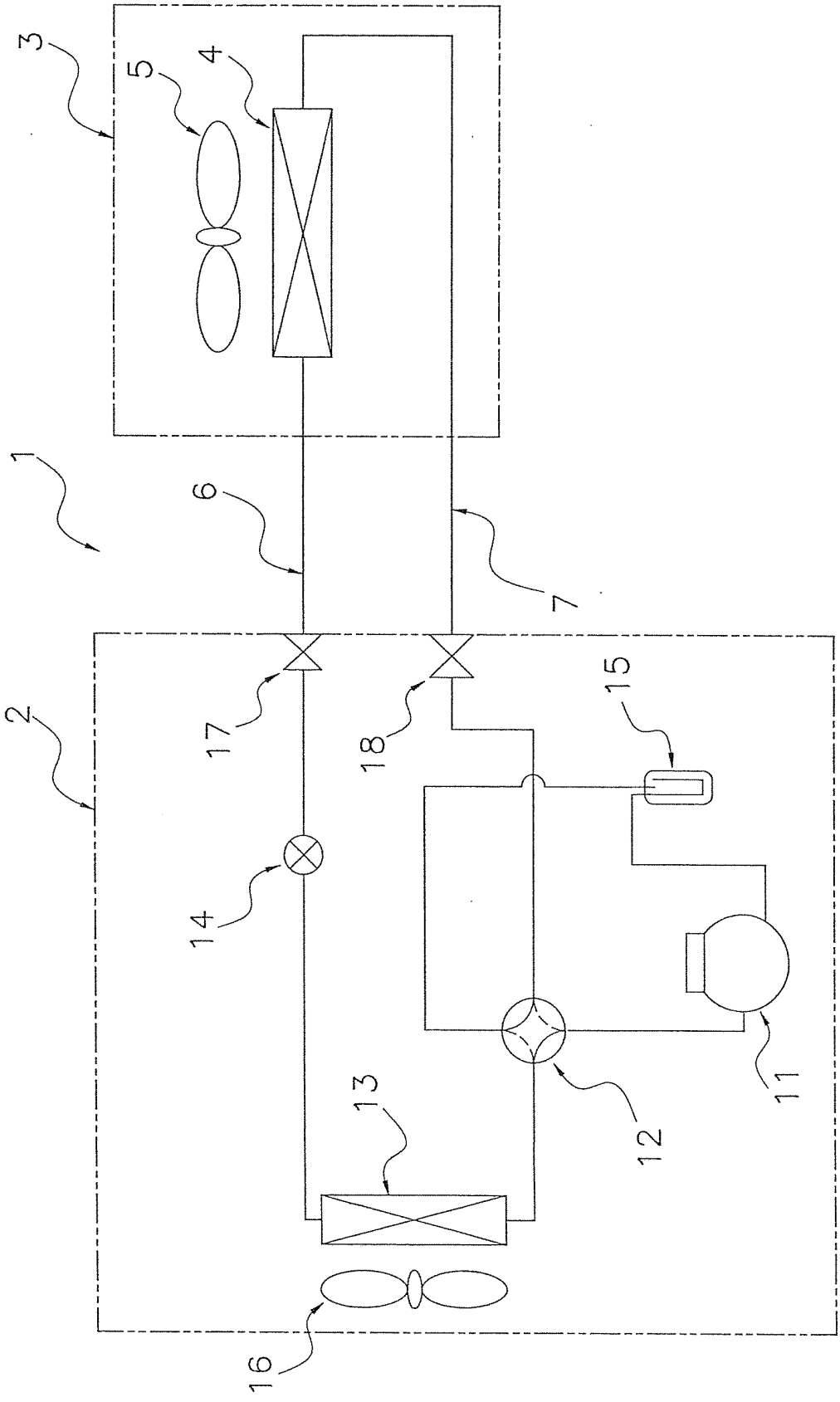


FIG. 1

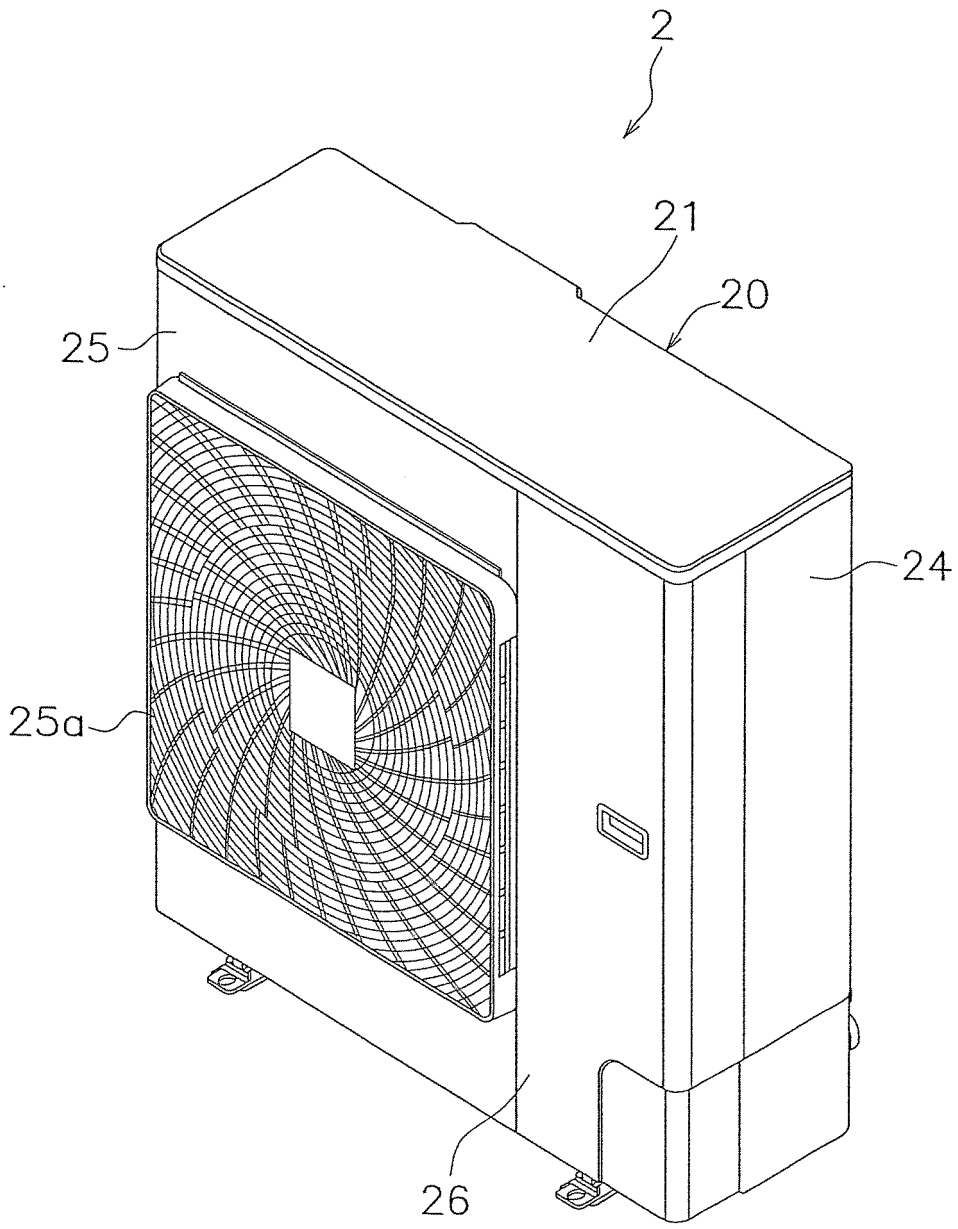


FIG. 2

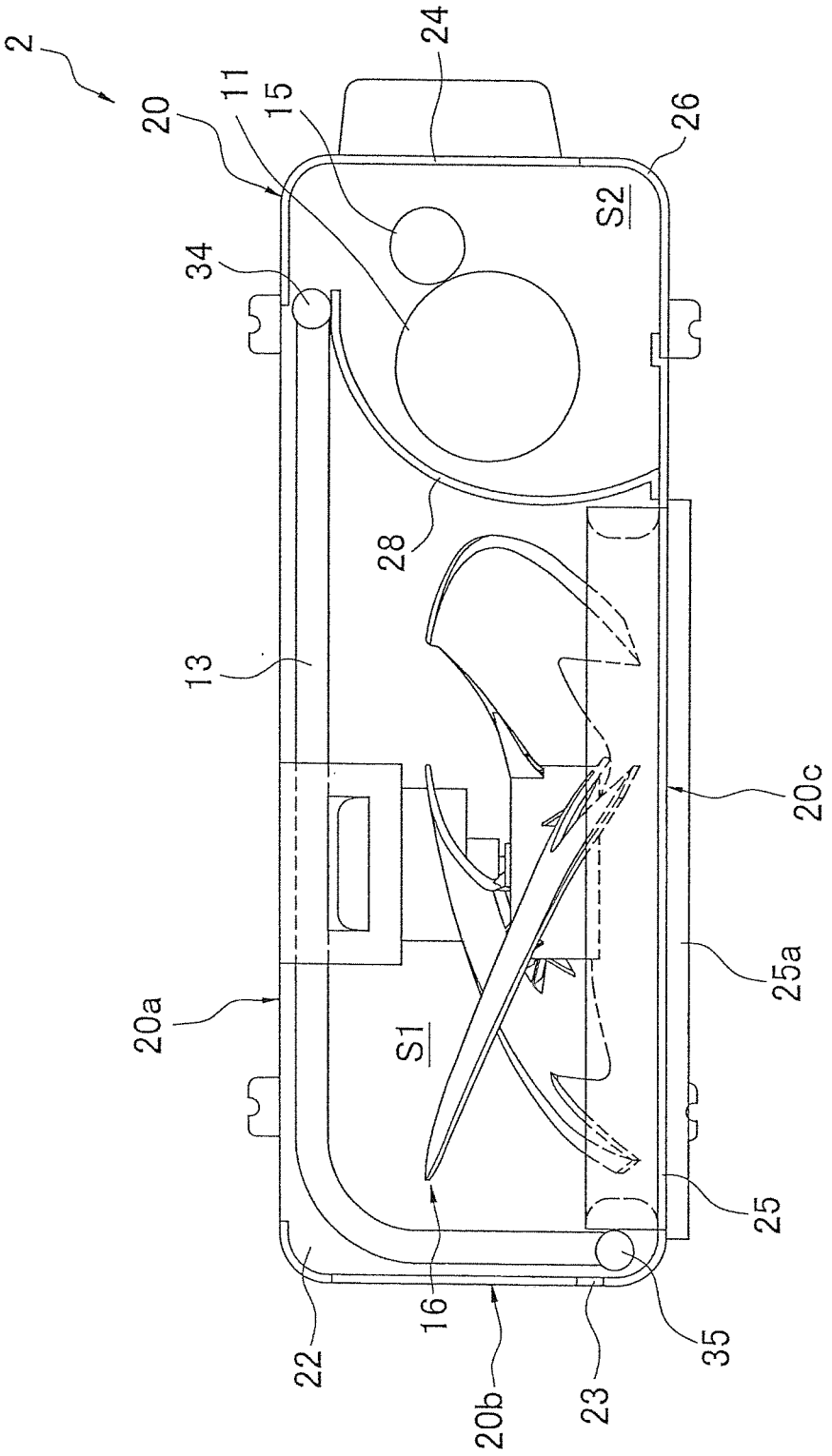


FIG. 3

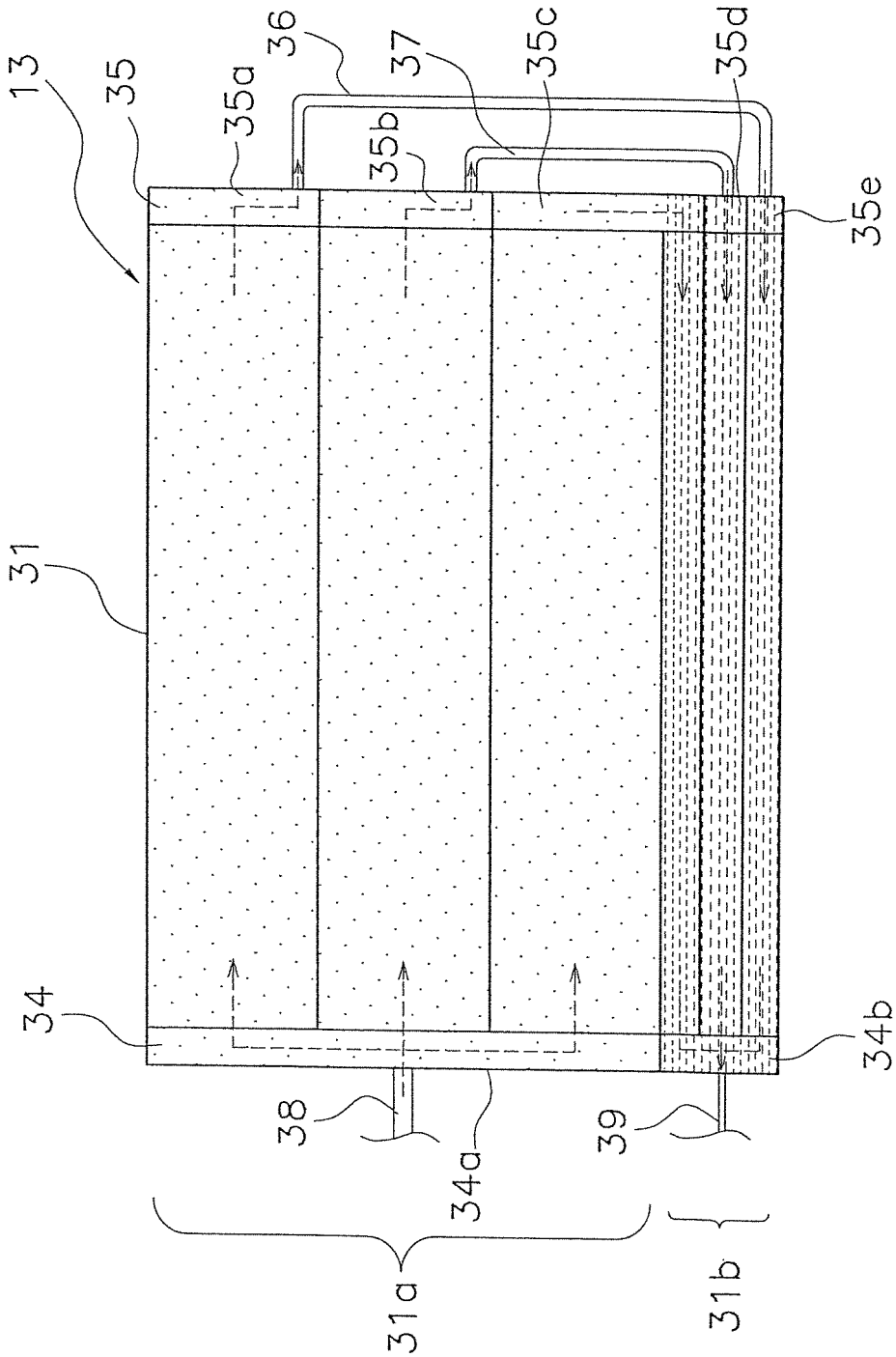
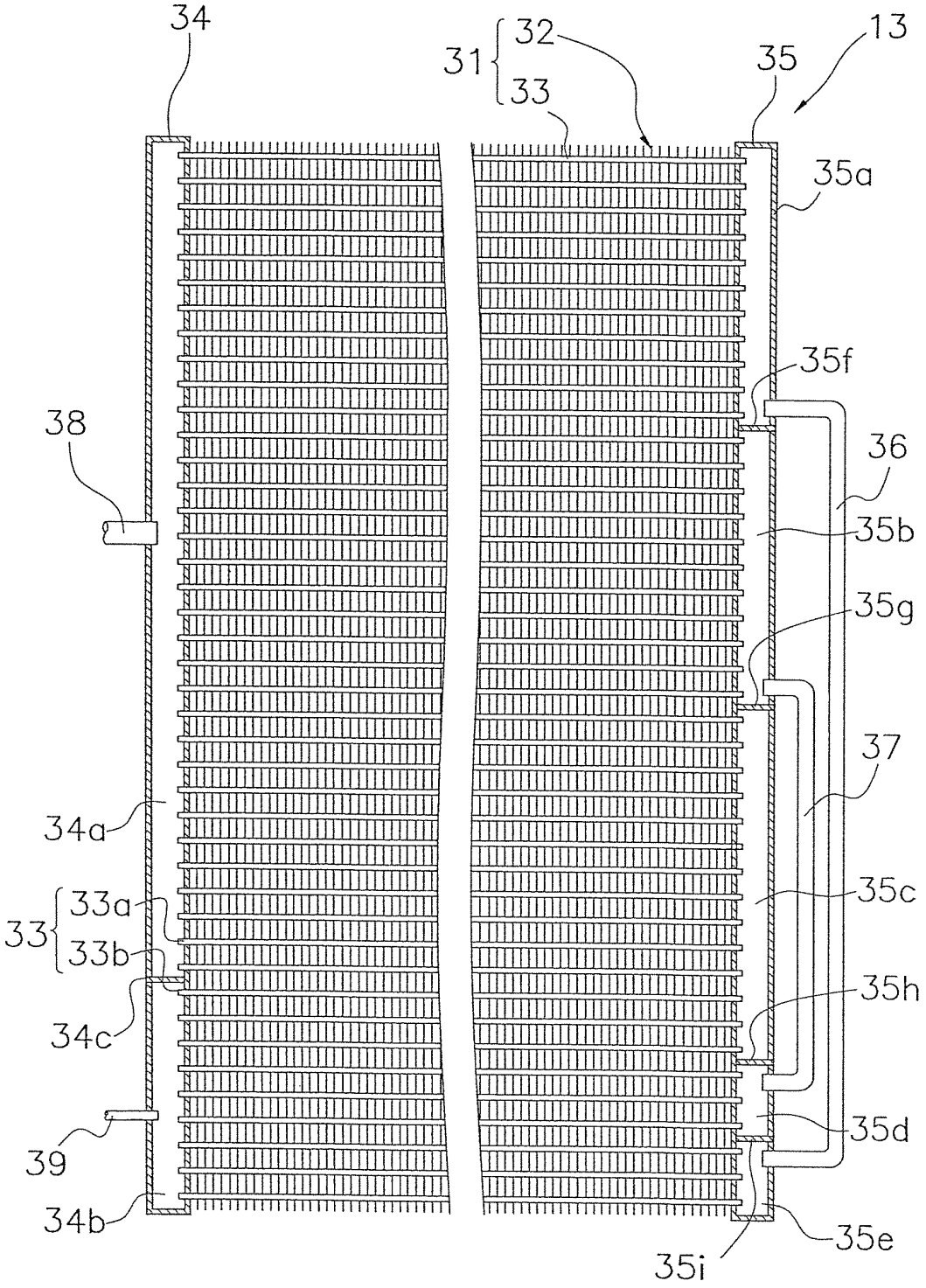


FIG. 4


34
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35a
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35b
35g
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35c
35h
34c
35d
39
34b
35e
35i

FIG. 5

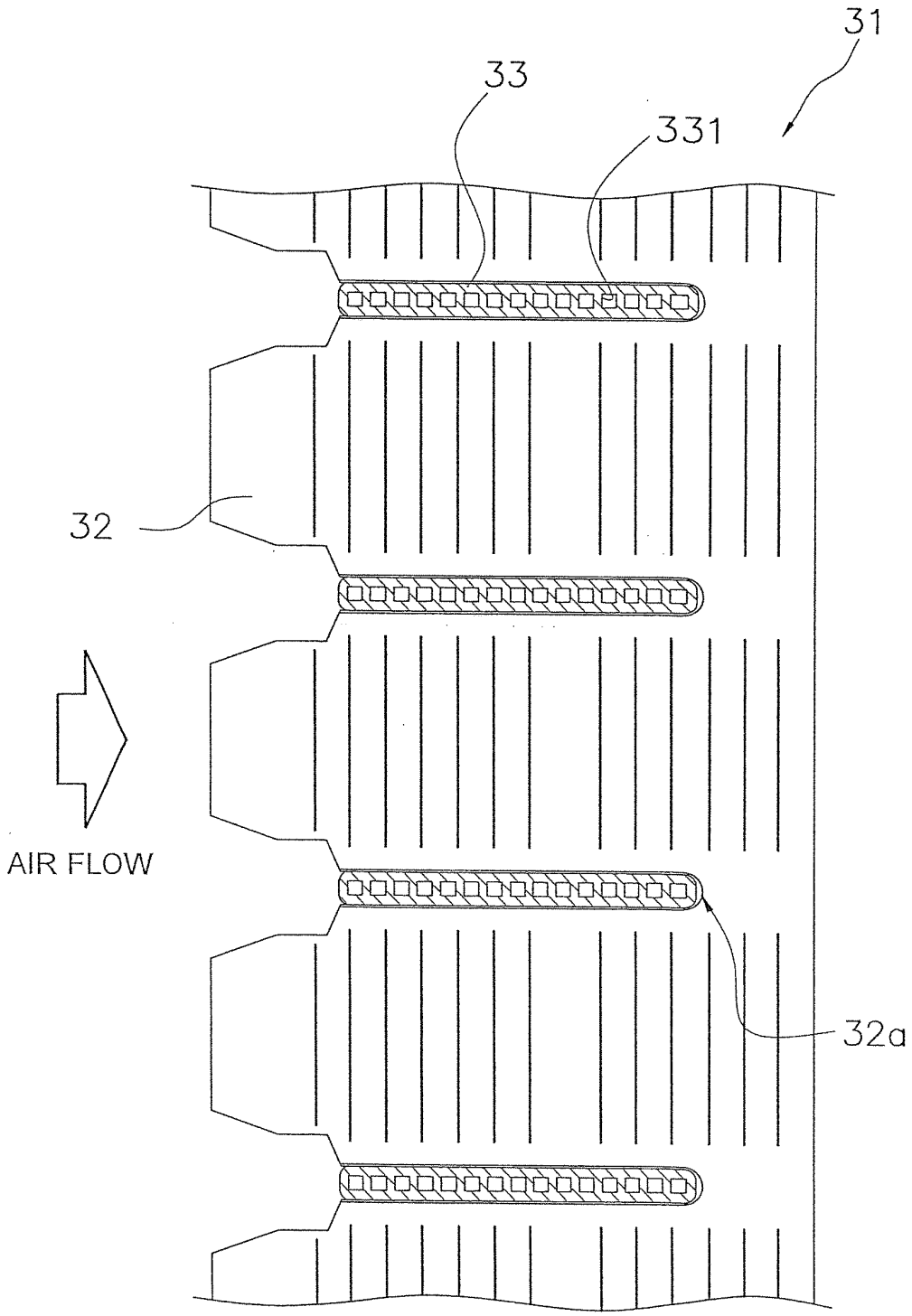


FIG. 6

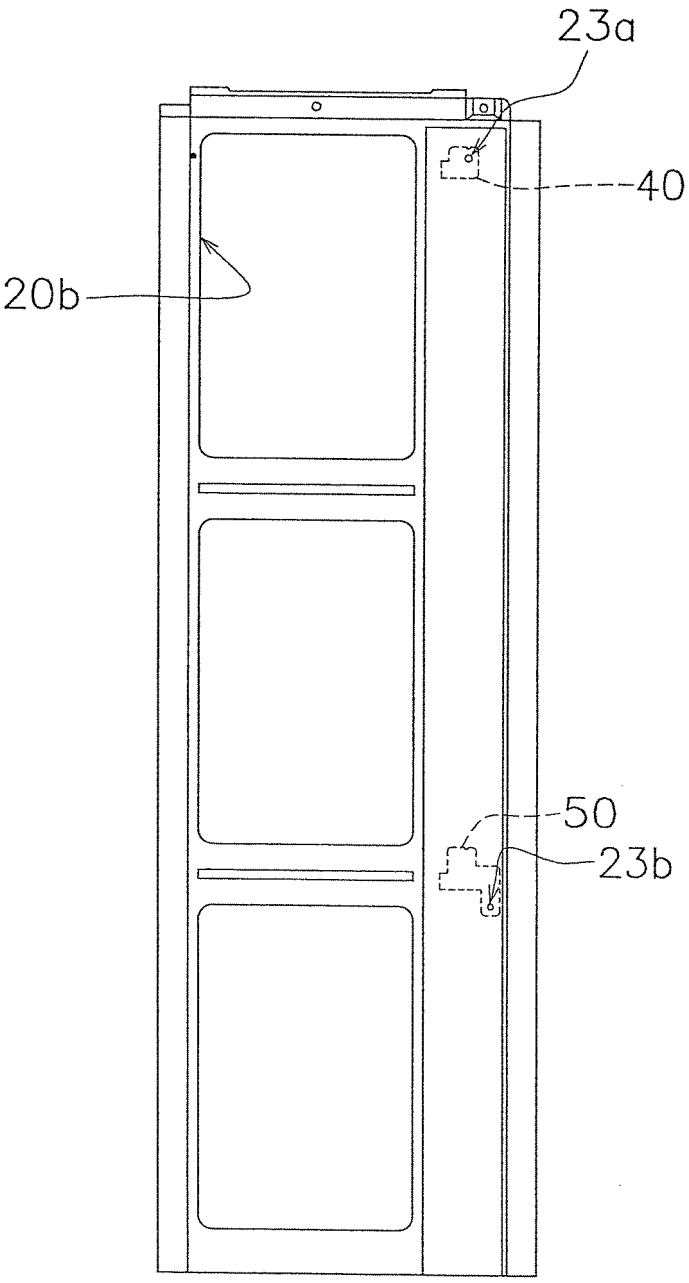
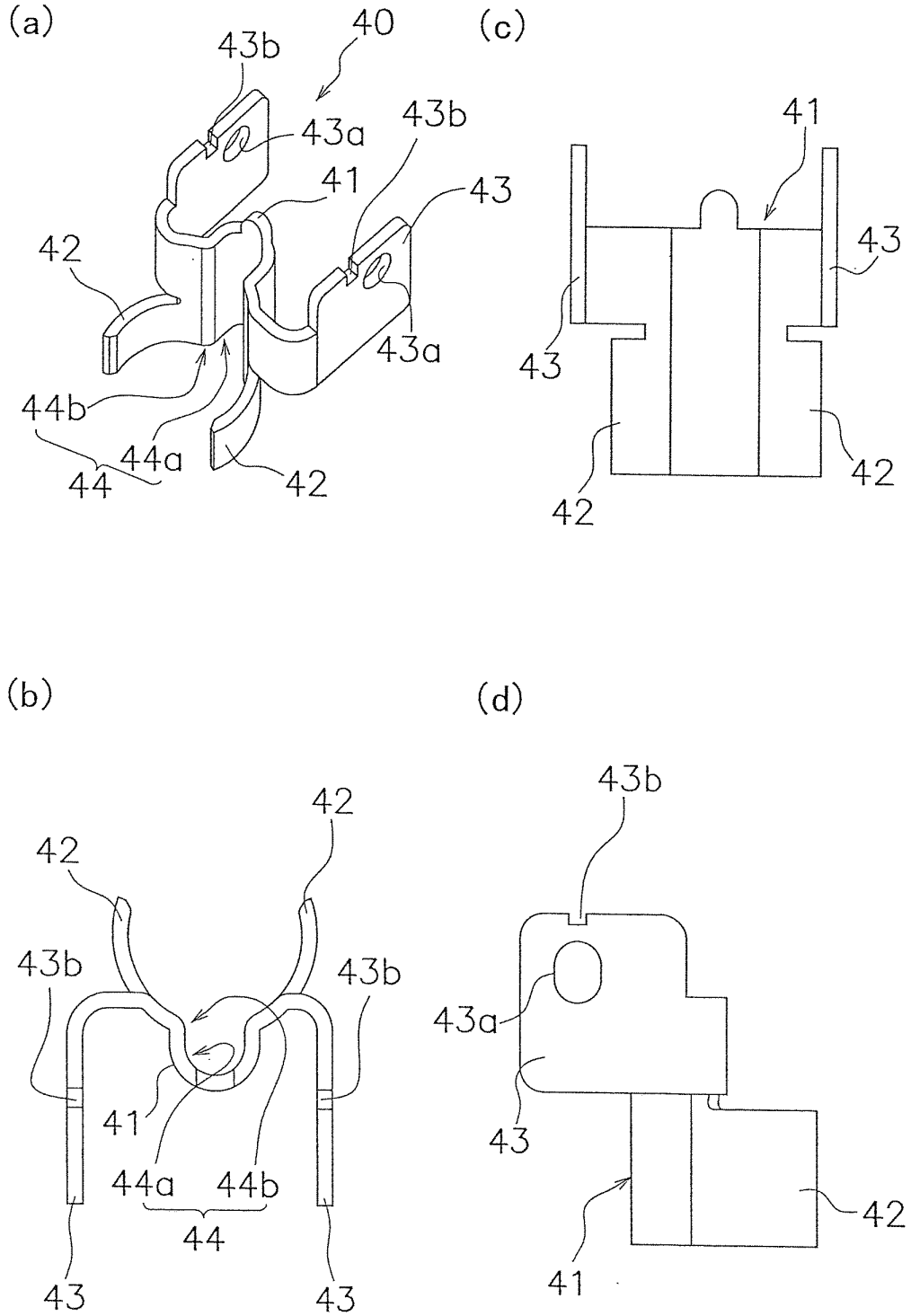


FIG. 7


(a)
40
43b
43a
43b
41
43
42
43a
44b
44a
44
42
(c)
41
43
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42
42
(b)
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44a
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43
(d)
43b
43a
43
42
41

FIG. 8

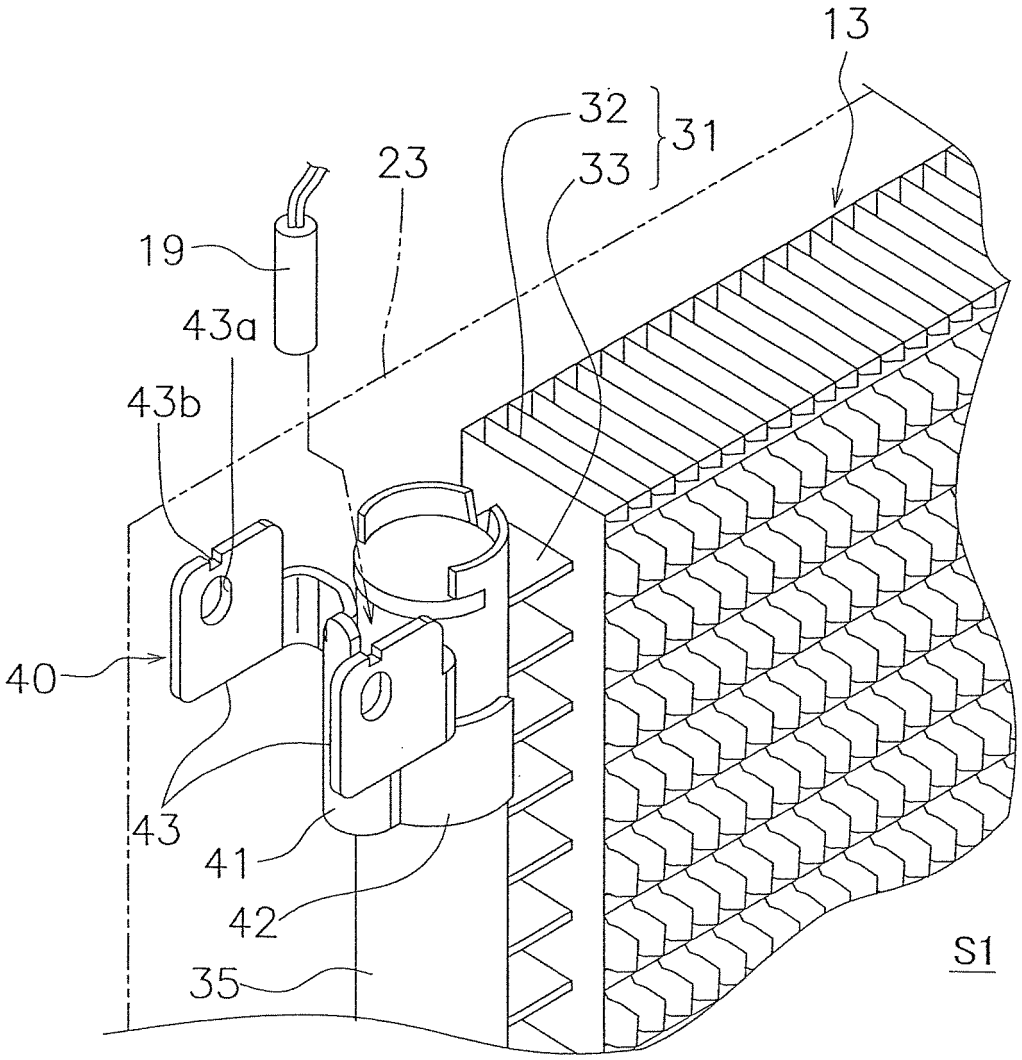


FIG. 9

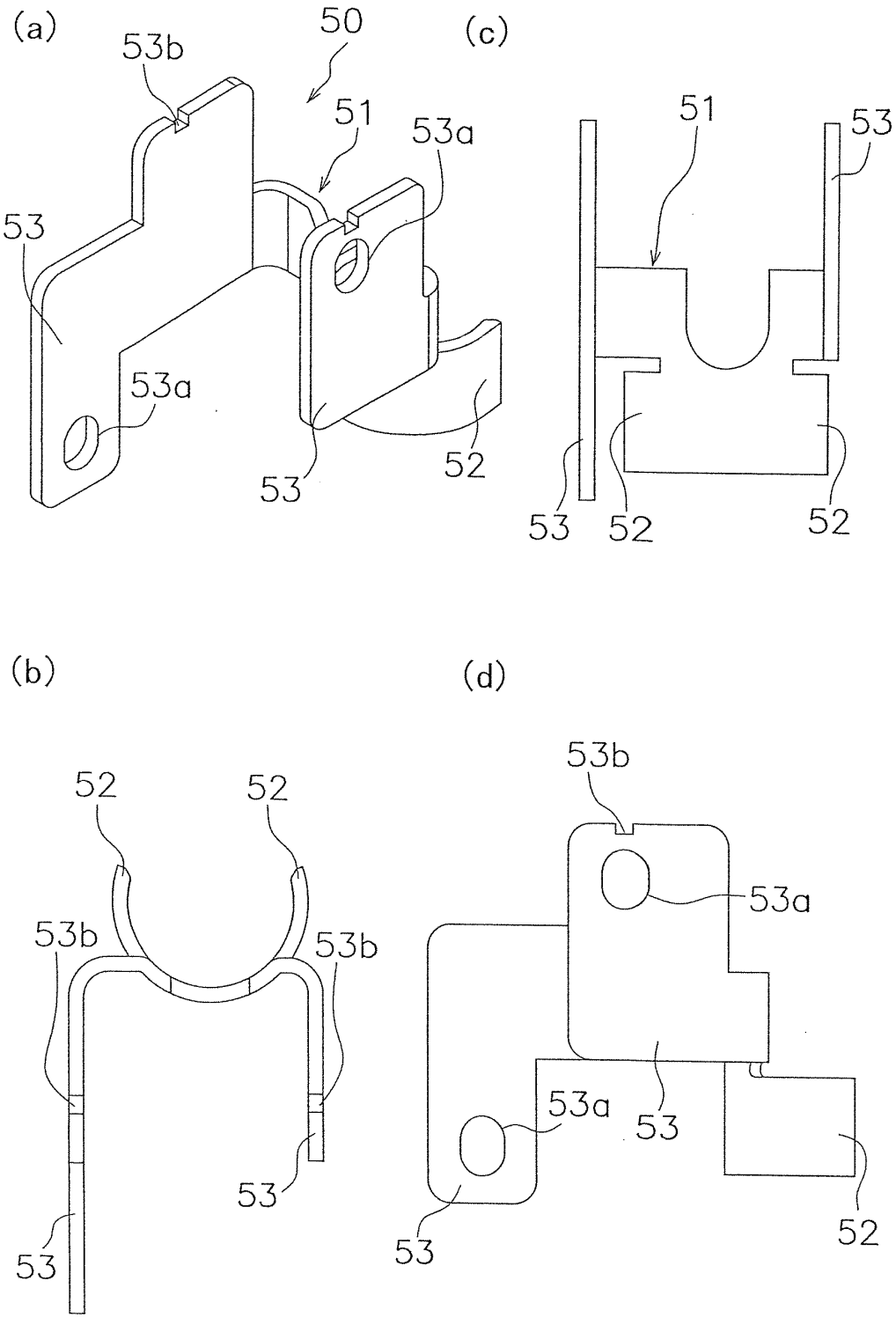
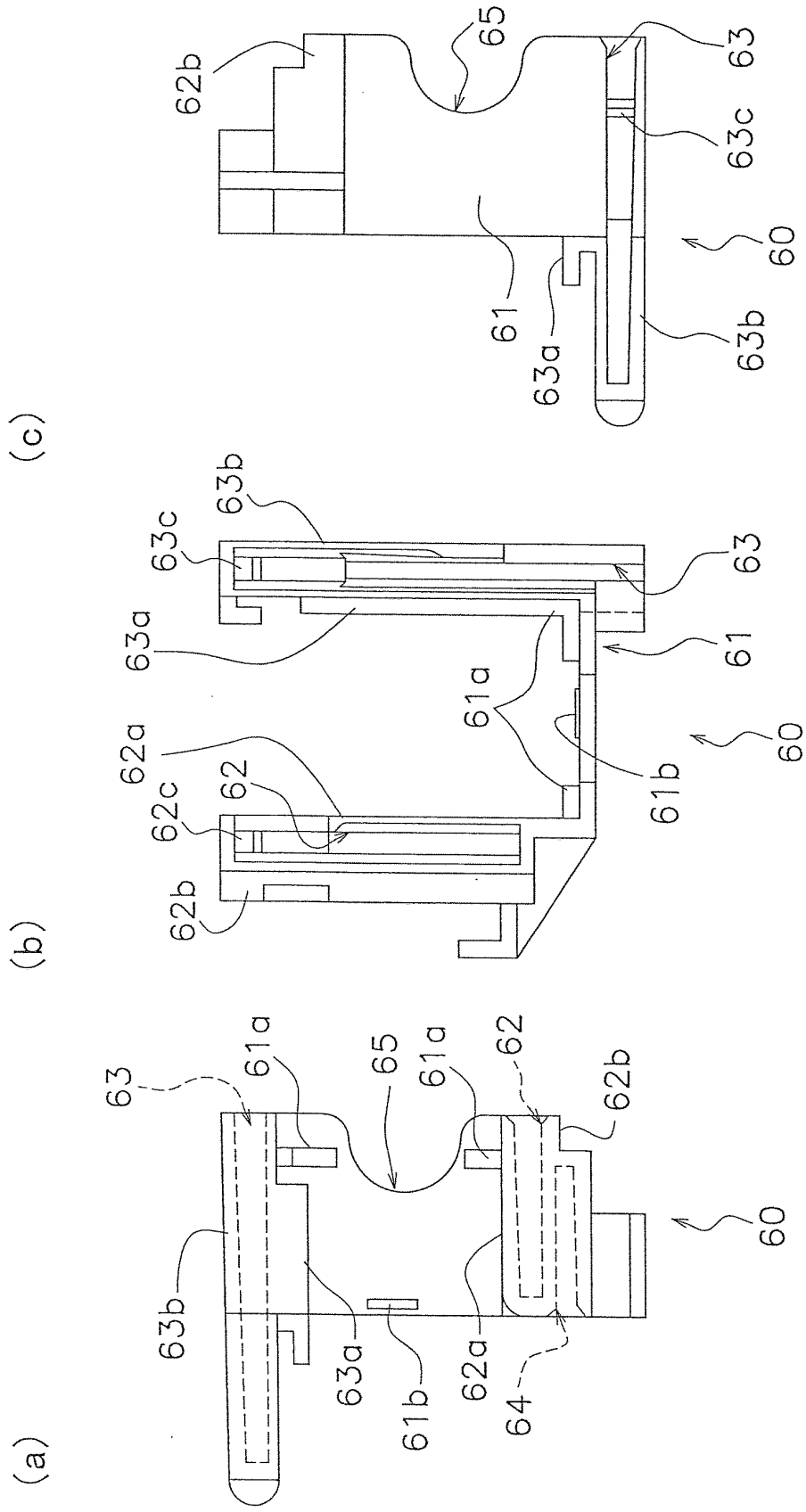

(a)
50
53b
51
53a
53
53a
53
52
(c)
51
53
53
52
52
(b)
52
52
53b
53b
53
53
(d)
53b
53a
53a
53
53
52

FIG. 10


(a)
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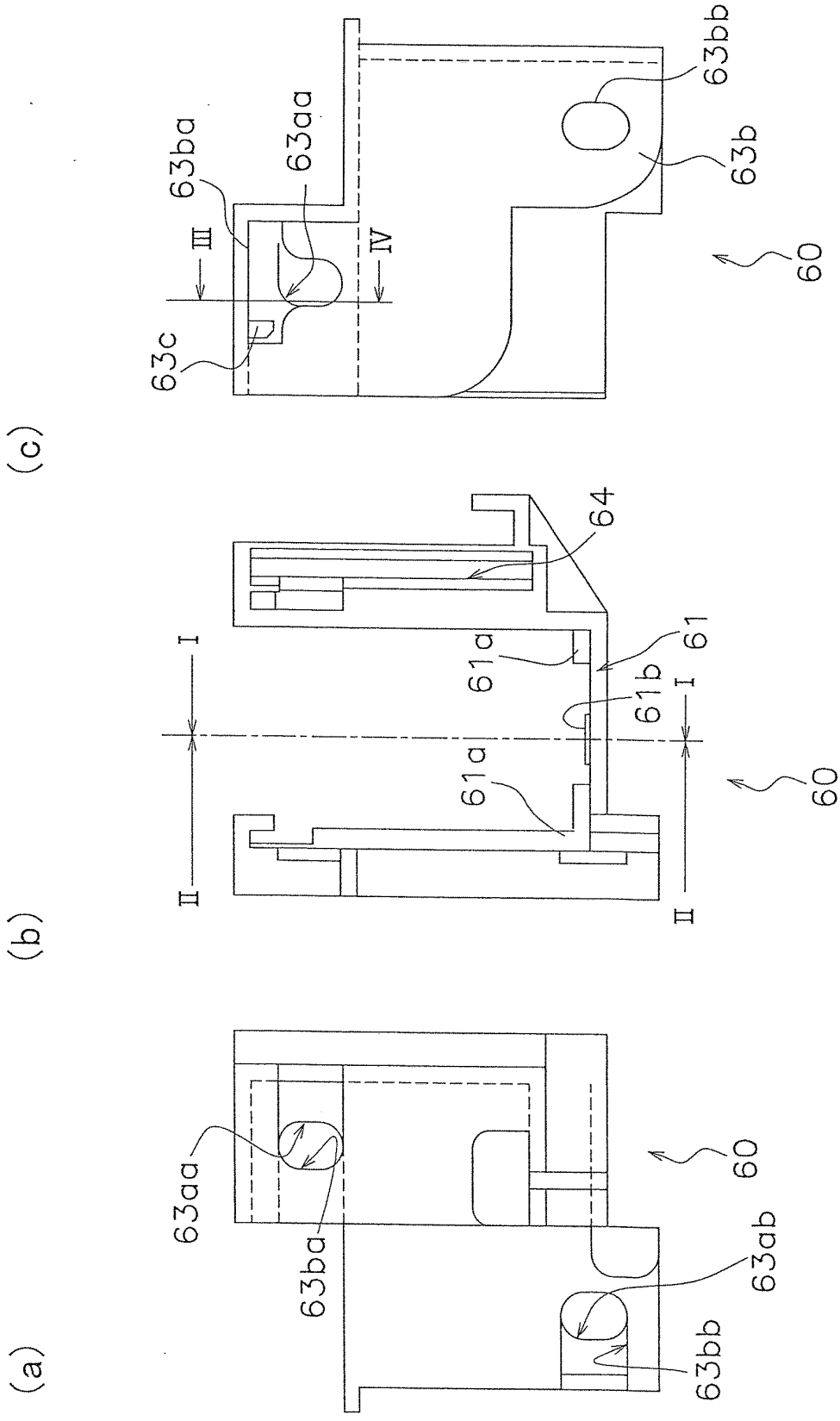
61a
62
62b
60
63b
63a
61b
62a
64
(b)
63b
63c
63
63a
61
61a
62a
62
62c
61b
60
62b
(c)
62b
65
63
63c
60
61
63a
63b

FIG. 11


(c)
63bb
63b
63ba
63aa
III
IV
63c
60
(b)
64
61
61a
61b
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II
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(a)
60
63aa
63ab
63ba
63bb

FIG. 12

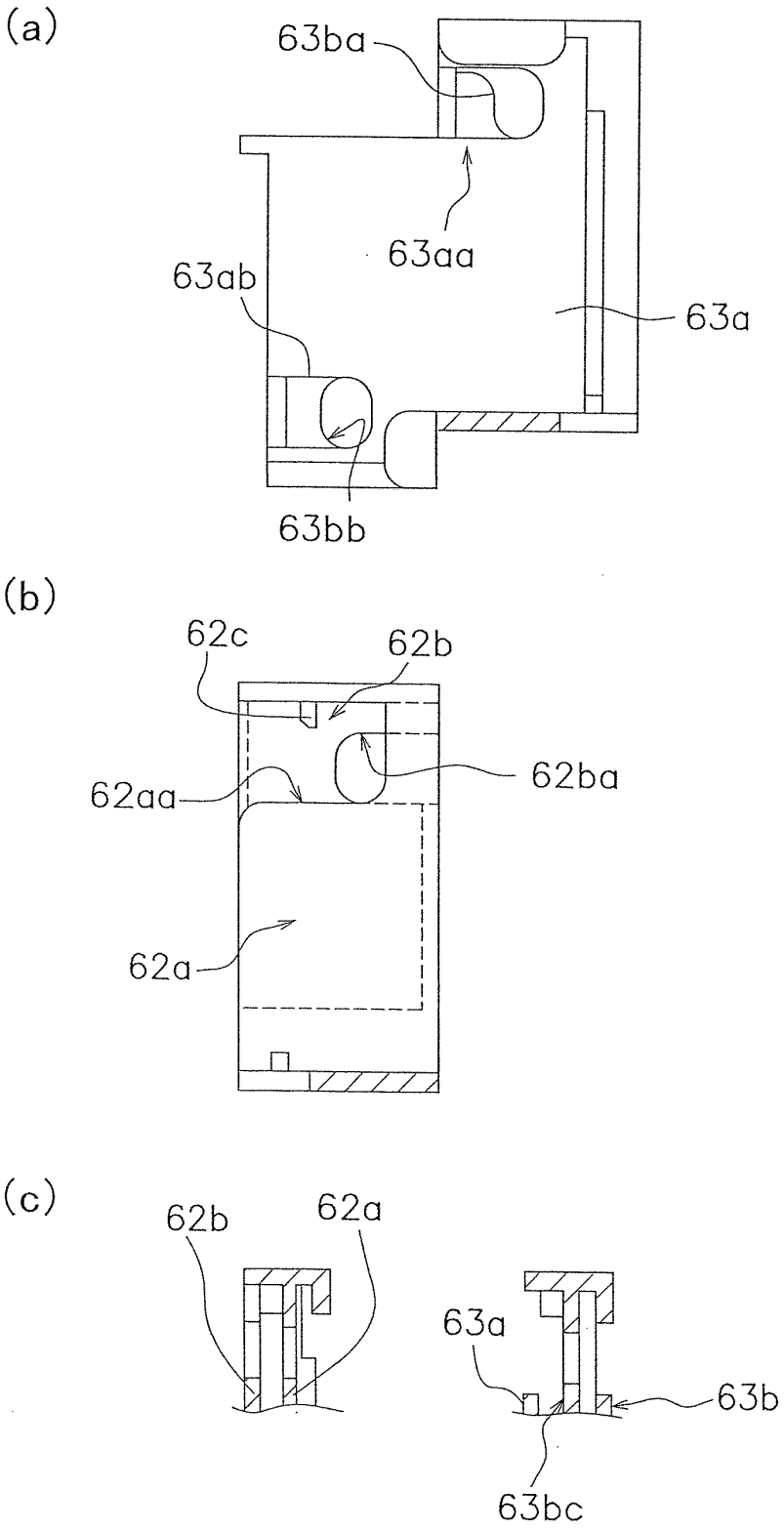
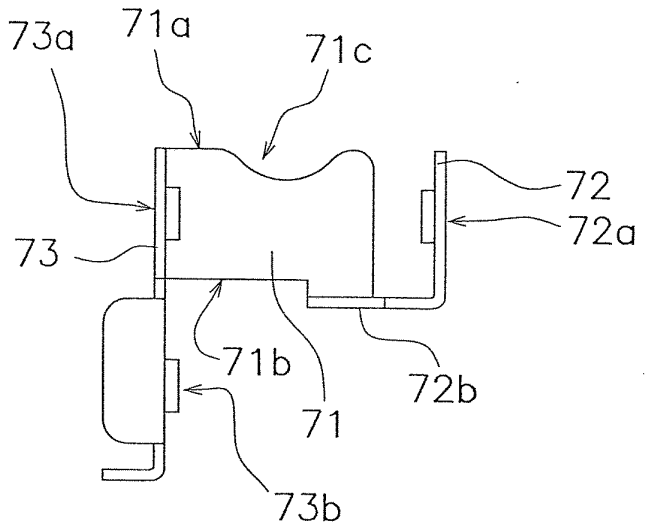

(a)
63ba
63aa
63ab
63a
63bb
(b)
62c
62b
62ba
62aa
62a
(c)
62b
62a
63a
63b
63bc

FIG. 13

(a)



(b)

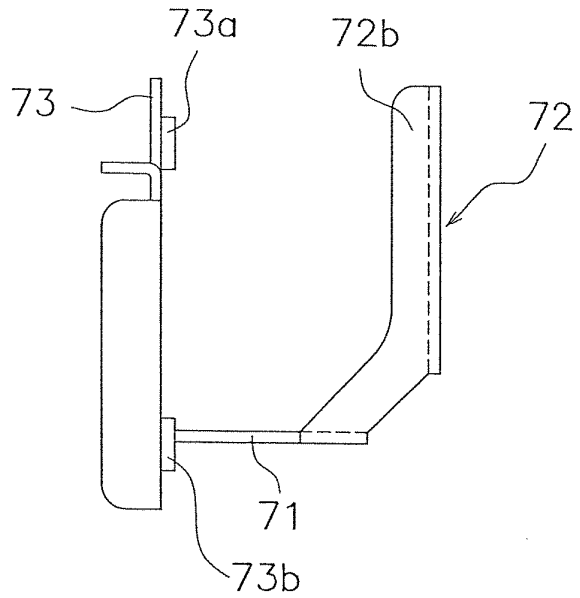
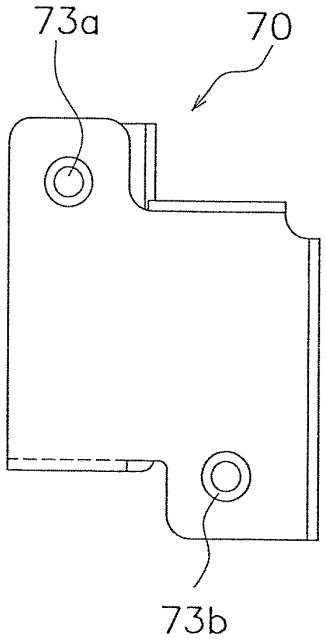


FIG. 14

(a)



(b)

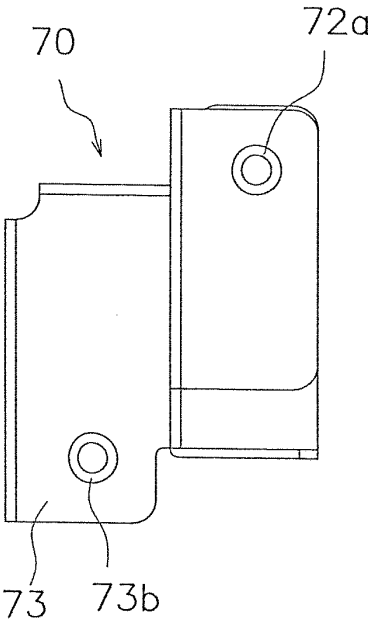


FIG. 15

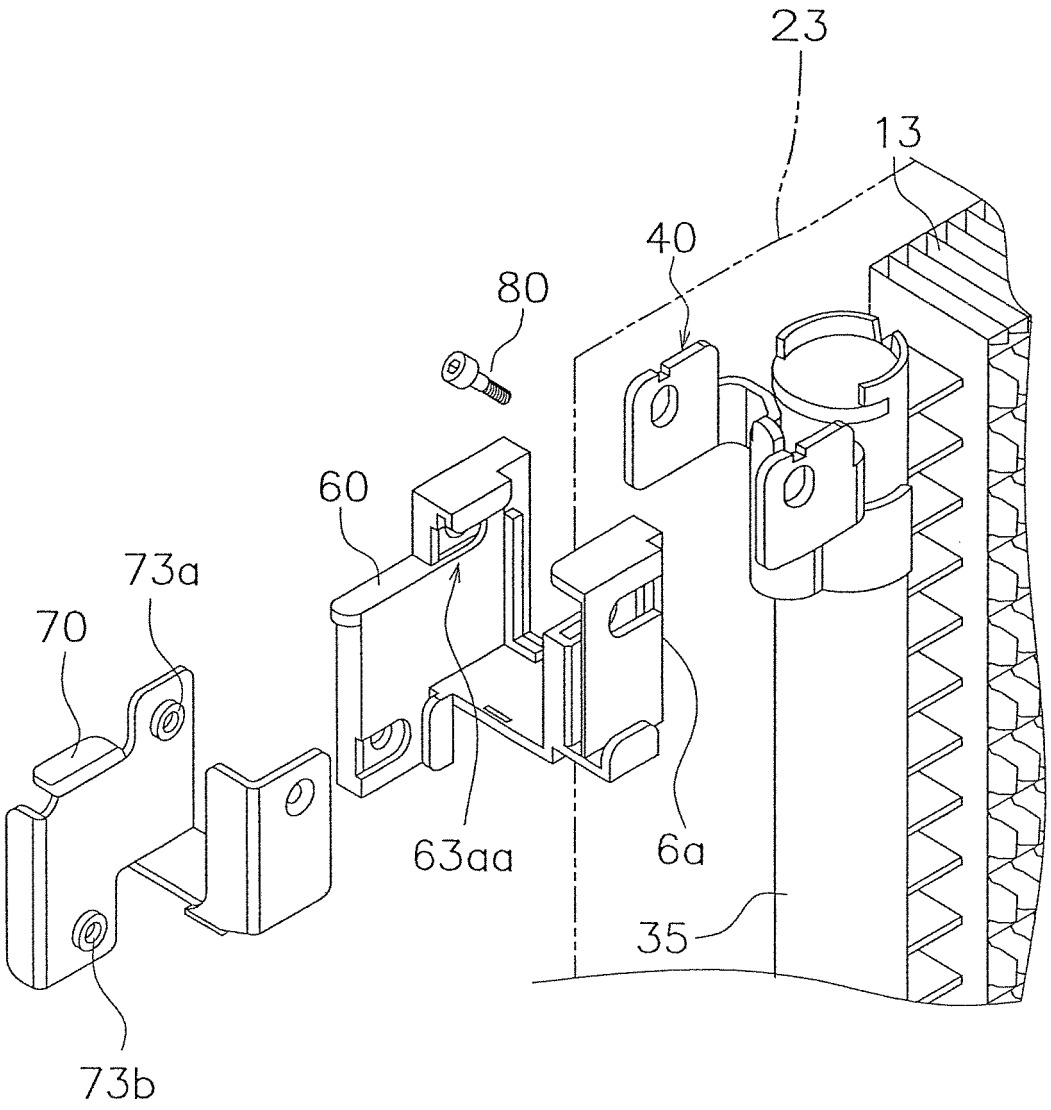


FIG. 16

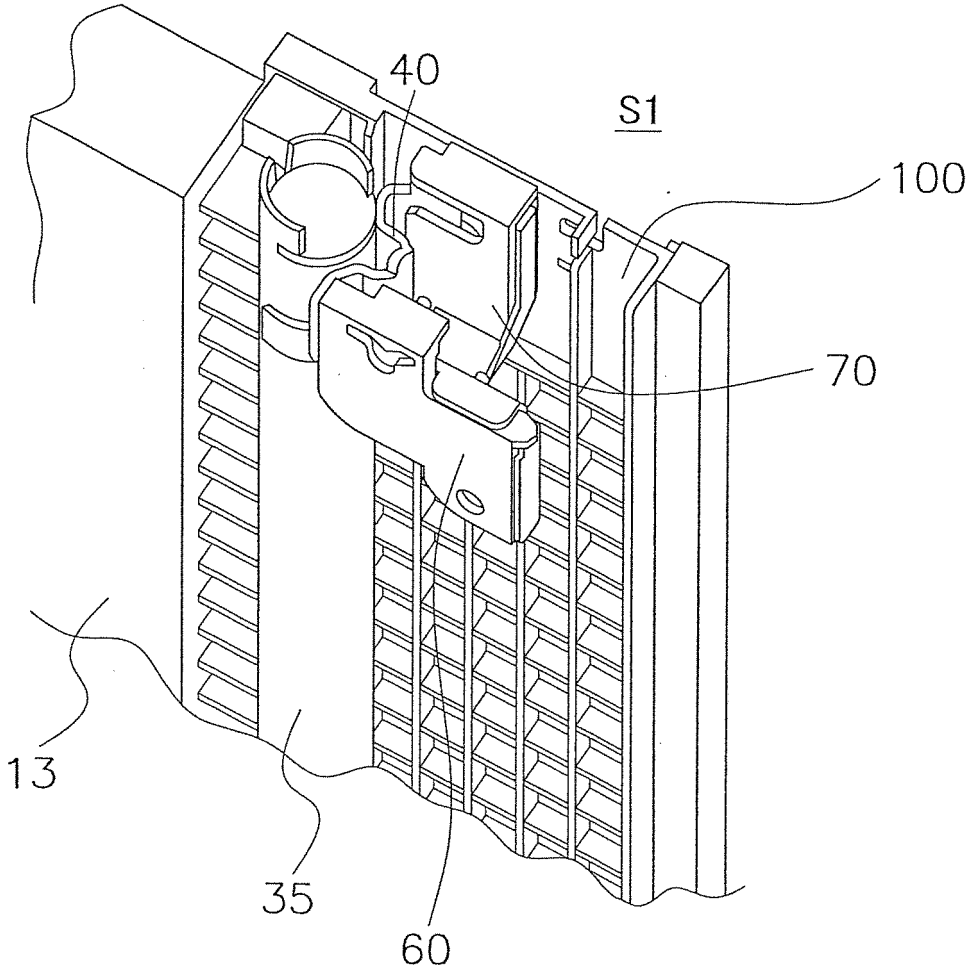


FIG. 17

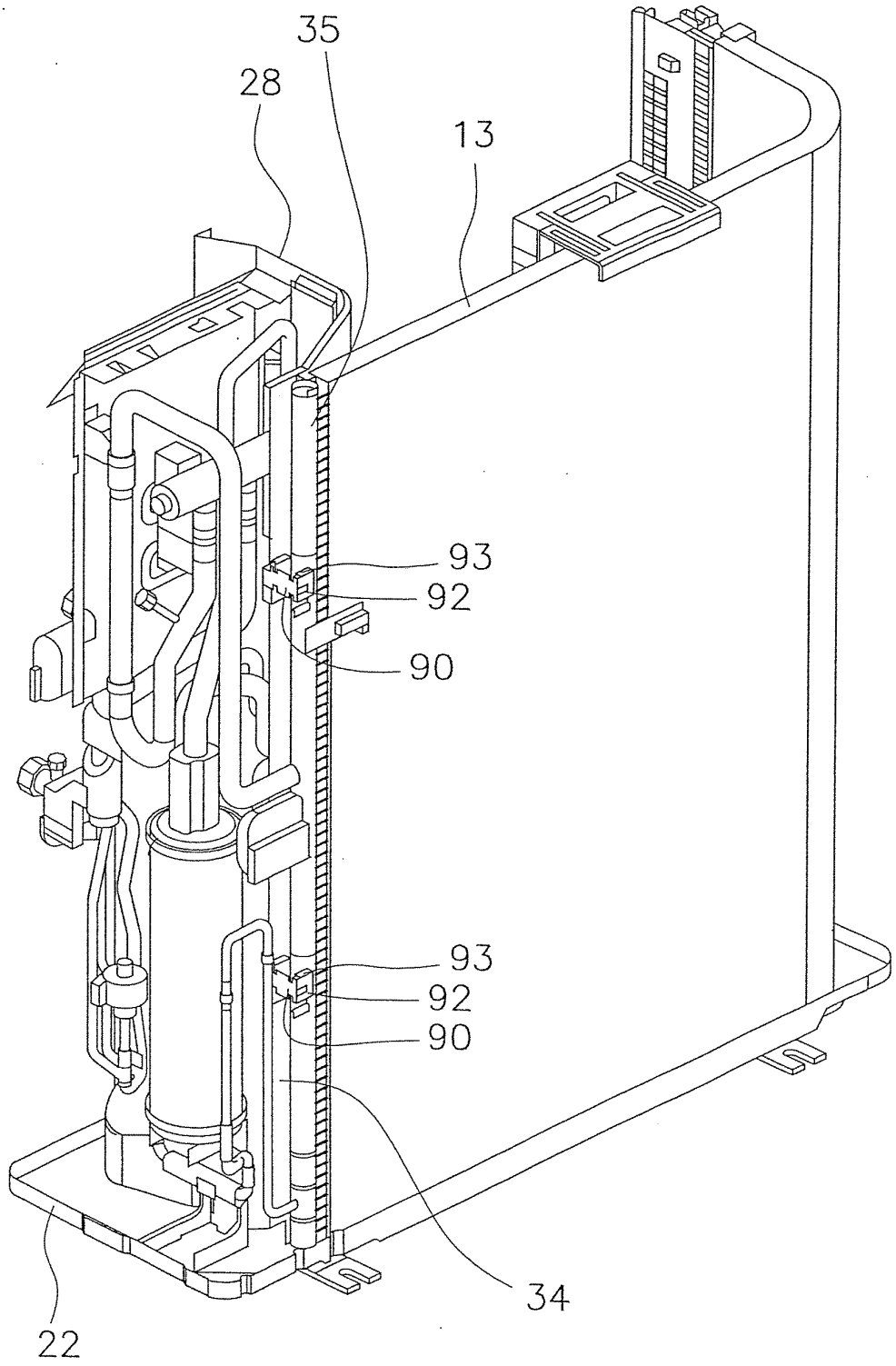


FIG. 18

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2012/083579

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)	1-6
A	JP 5-60484 A (Showa Aluminum Corp.), 09 March 1993 (09.03.1993), entire text; all drawings (Family: none)	1-6

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

* Special categories of cited documents:
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"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
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"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	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/JP2012/083579

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. 056238/1979(Laid-open No. 157672/1980) (Diesel Kiki Co., Ltd.), 12 November 1980 (12.11.1980), entire text; all drawings (Family: none)	1-6
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)	1-6
A	JP 2011-145029 A (Sharp Corp.), 28 July 2011 (28.07.2011), entire text; all drawings (Family: none)	1-6
A	JP 2005-114273 A (Matsushita Electric Industrial Co., Ltd.), 28 April 2005 (28.04.2005), entire text; all drawings (Family: none)	1-6

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REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- JP H7234088 A **[0003]**