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(54) HEAT EXCHANGE UNIT FOR AIR CONDITIONING DEVICE

(57) A heat exchange unit of an air conditioning apparatus provided with a heat exchanger having a plurality of heat transfer tubes and heat transfer fins, and a casing having a support part on which the heat exchanger is placed, wherein crushing of the heat transfer fins in a lower end of the heat exchanger is suppressed.

A heat exchange unit (2) has a heat exchanger (23) having a plurality of heat transfer tubes (61) and heat transfer fins (64), and a casing (51) having a support part (52) on which the heat exchanger is placed. The heat exchange unit further has a spacer member (71, 72, 73) and a fin crushing prevention member (80). The spacer member is disposed between the heat exchanger and the support part. The fin crushing prevention member is disposed between the spacer member and a lowest-row heat transfer tube (61a), which is the lowest heat transfer tube of the plurality of heat transfer tubes, the fin crushing prevention member having higher rigidity than the heat transfer fins.

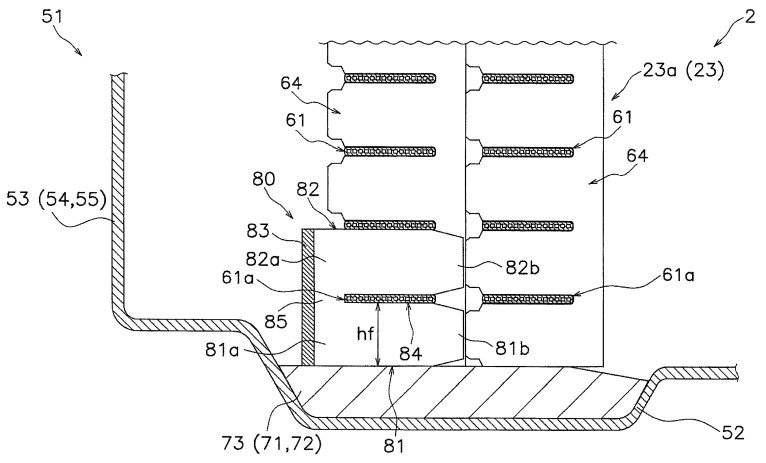

FIG. 10

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Description

TECHNICAL FIELD

[0001] The present invention relates to a heat exchange unit of an air conditioning apparatus, and particularly relates to a heat exchange unit of an air conditioning apparatus provided with a heat exchanger having a plurality of heat transfer tubes and heat transfer fins, and a casing having a support part on which the heat exchanger is placed.

BACKGROUND ART

[0002] The prior art includes a heat exchanger which has a plurality of heat transfer tubes that are disposed along a vertical direction and that extend horizontally, and a plurality of heat transfer fins that are disposed horizontally at intervals and that extend vertically, as shown in Patent Literature 1 (Japanese Laid-open Patent Publication No. H9-276940). This heat exchanger is used as being placed on a bottom plate (support part) of a casing configuring an outdoor unit or the like (heat exchange unit) of an air conditioning apparatus. This heat exchanger is also bent as appropriate in accordance with an arrangement of devices within the casing, in which case the mandrel used for bending is designed so as to ensure the heat transfer fins are not crushed during the bending of the heat exchanger.

SUMMARY OF THE INVENTION

[0003] However, even if crushing of the heat transfer fins during the bending of the heat exchanger could be prevented by a measure such as the design of the mandrel used for bending in the aforementioned Patent Literature 1, when the heat exchanger is placed on the support part of the heat exchange unit, there would be a risk that the heat transfer fins would be crushed in a lower end of the heat exchanger by vibration and/or falling during transportation of the heat exchange unit or vibration during operation. Particularly, when a structure is employed in which the heat exchanger is placed on the support part with a spacer member therebetween whereby a large part of the heat exchanger is lifted off the support part for purposes such as improving water drainage from the heat exchanger and suppressing the growth of ice (ice-up) in the lower end of the heat exchanger, the weight (load) of the heat exchanger concentrates in one part thereof due to the effect of, *inter alia,* the center of gravity of the heat exchanger being displaced, and there is a risk that the heat transfer fins would be readily crushed in the lower end of the part where this load concentrates.

[0004] An object of the present invention is to suppress crushing of heat transfer fins in a lower end of a heat exchanger, in a heat exchange unit of an air conditioning apparatus provided with the heat exchanger having a plurality of heat transfer tubes and heat transfer fins, and a casing having a support part on which the heat exchanger is placed.

[0005] A heat exchange unit of an air conditioning apparatus according to a first aspect has a heat exchanger and a casing having a support part on which the heat exchanger is placed. The heat exchanger has a plurality of heat transfer tubes that are disposed along a vertical direction and that extend horizontally, and a plurality of heat transfer fins that are disposed horizontally at intervals and that extend vertically. In this aspect, the heat exchange unit further has a spacer member and a fin crushing prevention member. The spacer member is disposed between the heat exchanger and the support part. The fin crushing prevention member is disposed between the spacer member and a lowest-row heat transfer tube, which is the lowest heat transfer tube of the plurality of heat transfer tubes, and the fin crushing prevention member has higher rigidity than the heat transfer fins.

[0006] In this aspect, the weight (load) of the heat exchanger exerted on the heat transfer fins can be dispersed to the fin crushing prevention member; therefore, the heat transfer fins can be protected, and the crushing of the heat transfer fins in the lower end of the heat exchanger can be suppressed.

[0007] A heat exchange unit of an air conditioning apparatus according to a second aspect is the heat exchange unit of the air conditioning apparatus according to the first aspect, wherein the fin crushing prevention member is separate from the spacer member.

[0008] In this aspect, with the fin crushing prevention member disposed between the lowest-row heat transfer tube and the spacer member, the horizontal position of the heat exchanger on the support part can be finely adjusted, and the ease of assembling the heat exchange unit can therefore be improved from the standpoint of positional adjustment.

[0009] A heat exchange unit of an air conditioning apparatus according to a third aspect is the heat exchange unit of the air conditioning apparatus according to the first aspect, wherein the fin crushing prevention member is integrated with the spacer member.

[0010] In this aspect, the work of placing the heat exchanger on the support part with the spacer member therebetween and the work of disposing the fin crushing prevention member between the lowest-row heat transfer tube and the spacer member can be performed simultaneously, and the ease of assembling the heat exchange unit can therefore be improved from the standpoint of the number of man-hours.

[0011] A heat exchange unit of an air conditioning apparatus according to a fourth aspect is the heat exchange unit of the air conditioning apparatus according to any of the first through third aspects, wherein the fin crushing prevention member has a first fin insertion part extending vertically and horizontally, and the fin crushing prevention member is disposed between the lowest-row heat transfer tube and the spacer member by inserting the first fin insertion part between the heat transfer fins.

[0012] In this aspect, the first fin insertion part is inserted between the heat transfer fins, whereby the fin crushing prevention member can easily be disposed between the lowest-row heat transfer tube and the spacer member.

[0013] A heat exchange unit of an air conditioning apparatus according to a fifth aspect is the heat exchange unit of the air conditioning apparatus according to the fourth aspect, wherein a vertical height dimension of the first fin insertion part is equal to or greater than the height from a lower end of the lowest-row heat transfer tube to a lower end of the heat transfer fins.

[0014] In this aspect, the weight (load) of the heat exchanger exerted on the heat transfer fins can be reliably dispersed to the fin crushing prevention member.

[0015] A heat exchange unit of an air conditioning apparatus according to a sixth aspect is the heat exchange unit of the air conditioning apparatus according to the fourth or fifth aspect, wherein the fin crushing prevention member is disposed between the lowest-row heat transfer tube and the spacer member by horizontally inserting the first fin insertion part between the heat transfer fins.

[0016] A heat exchange unit of an air conditioning apparatus according to a seventh aspect is the heat exchange unit of the air conditioning apparatus according to the sixth aspect, wherein the fin crushing prevention member further has a fin insertion base extending in a horizontal direction intersecting an insertion direction of the first fin insertion part from an insertion frontal end part, which is the end part of the first fin insertion part on the front side in the insertion direction.

[0017] In this aspect, the fin insertion base is pressed in the insertion direction of the first fin insertion part, whereby the first fin insertion part can be easily inserted between the heat transfer fins.

[0018] A heat exchange unit of an air conditioning apparatus according to an eighth aspect is the heat exchange unit of the air conditioning apparatus according to the seventh aspect, wherein the fin crushing prevention member has a plurality of first fin insertion parts, and the insertion frontal end parts of the first fin insertion parts are joined to each other via the fin insertion base.

[0019] In this aspect, the fin insertion base is pressed in the insertion direction of the first fin insertion parts, whereby the plurality of first fin insertion parts can be inserted all together between the heat transfer fins, and the degree to which the weight (load) of the heat exchanger exerted on the heat transfer fins is dispersed can be increased.

[0020] A heat exchange unit of an air conditioning apparatus according to a ninth aspect is the heat exchange unit of the air conditioning apparatus according to the seventh or eighth aspect, wherein, when the first fin insertion part has been inserted between the heat transfer fins, a gap for preventing the fin insertion base from coming into contact with end parts of the heat transfer fins on a side near the insertion frontal end part is ensured between the fin insertion base and the end parts of the heat transfer fins on the side near the insertion frontal end part.

[0021] In this aspect, water can be prevented from remaining adhered to the fin insertion base, the end part of the heat transfer fin on the side near the insertion frontal end part, and the vicinities thereof by the gap between the fin insertion base and the end parts of the heat transfer fins on the side near the insertion frontal end part; therefore, water drainage from the heat exchanger can be ensured, and ice growth (ice-up) in the lower end of the heat exchanger can be suppressed.

[0022] A heat exchange unit of an air conditioning apparatus according to a tenth aspect is the heat exchange unit of the air conditioning apparatus according to any of the sixth through ninth aspects, wherein the fin crushing prevention member further has, higher than the lowest-row heat transfer tube, a second fin insertion part horizontally inserted between the heat transfer fins.

[0023] In this aspect, the first fin insertion part can be impeded from coming loose from between the heat transfer fins by inserting the second fin insertion part between the heat transfer fins along with the first fin insertion part.

[0024] A heat exchange unit of an air conditioning apparatus according to an eleventh aspect is the heat exchange unit of the air conditioning apparatus according to any of the sixth through tenth aspects, wherein the casing has a rectangular parallelepiped shape, the support part forms a bottom surface of the casing, and the heat exchanger is disposed inside the casing so as to run along a peripheral surface of the casing, excluding a top surface and the bottom surface of the casing. The fin crushing prevention member is disposed between the lowest-row heat transfer tube and the spacer member by horizontally inserting the first fin insertion part between the heat transfer fins from a side near the peripheral surface of the heat exchanger.

[0025] A heat exchange unit of an air conditioning apparatus according to a twelfth aspect is the heat exchange unit of the air conditioning apparatus according to any of the sixth through tenth aspects, wherein the casing has a rectangular parallelepiped shape, the support part forms a bottom surface of the casing, and the heat exchanger is disposed inside the casing so as to run along a peripheral surface of the casing, excluding a top surface and the bottom surface of the casing. The fin crushing prevention member is disposed between the lowest-row heat transfer tube and the spacer member by horizontally inserting the first fin insertion part between the heat transfer fins from a side far from the peripheral surface of the heat exchanger.

[0026] A heat exchange unit of an air conditioning apparatus according to a thirteenth aspect is the heat exchange unit of the air conditioning apparatus according to the fourth or fifth aspect, wherein the fin crushing prevention member is disposed between the lowest-row heat transfer tube and the spacer member by vertically inserting the first fin insertion part between the heat transfer fins.

[0027] A heat exchange unit of an air conditioning ap-

paratus according to a fourteenth aspect is the heat exchange unit of the air conditioning apparatus according to the thirteenth aspect, wherein the casing has a rectangular parallelepiped shape, the support part forms a bottom surface of the casing, and the heat exchanger is disposed inside the casing so as to run along a peripheral surface of the casing, excluding a top surface and the bottom surface of the casing. The fin crushing prevention member is disposed between the lowest-row heat transfer tube and the spacer member by vertically inserting the first fin insertion part between the heat transfer fins from a side near the bottom surface of the heat exchanger.

[0028] A heat exchange unit of an air conditioning apparatus according to a fifteenth aspect is the heat exchange unit of the air conditioning apparatus according to any of the eleventh, twelfth, and fourteenth aspects, wherein the heat exchanger has a heat exchange rounded part bent so as to run along a corner of the peripheral surface of the casing, and the spacer member is disposed between the heat exchange rounded part and the support part. The fin crushing prevention member is disposed between the spacer member and the lowest-row heat transfer tube configuring the heat exchange rounded part by inserting the first fin insertion part between the heat transfer fins configuring the heat exchange rounded part.

[0029] In this aspect, because the heat exchanger has the heat exchange rounded part and the spacer member is disposed between the heat exchange rounded part and the support part, the weight (load) of the heat exchanger readily concentrates in the heat transfer fins configuring the heat exchange rounded part. However, in this aspect, because the fin crushing prevention member is disposed between the spacer member and the lowest-row heat transfer tube configuring the heat exchange rounded part by inserting the first fin insertion part between the heat transfer fins configuring the heat exchange rounded part as described above, the heat transfer fins configuring the heat exchange rounded part can be protected, and crushing of the heat transfer fins in a lower end of the heat exchange rounded part can be suppressed.

[0030] A heat exchange unit of an air conditioning apparatus according to a sixteenth aspect is the heat exchange unit of the air conditioning apparatus according to the fifteenth aspect, wherein, after the heat exchange rounded part has been formed by bending the heat exchanger, the fin crushing prevention member is disposed between the lowest-row heat transfer tube and the spacer member.

[0031] In this aspect, the heat exchange rounded part can be formed more easily by bending the heat exchanger than in a case in which the fin crushing prevention member is disposed in advance so as to correspond to the lowest-row heat transfer tube configuring the heat exchange rounded part before the heat exchanger is bent.

[0032] A heat exchange unit of an air conditioning apparatus according to a seventeenth aspect is the heat exchange unit of the air conditioning apparatus according to any of the eleventh, twelfth, and fourteenth through sixteenth aspects, wherein the heat exchanger has a structure in which the heat transfer fins are aligned in a plurality of columns from a side near the peripheral surface of the casing to a side far from the peripheral surface. The first fin insertion part is inserted in all of the columns of the heat transfer fins aligned in the plurality of columns.

[0033] In this aspect, because the first fin insertion part is inserted in all of the columns in the heat exchanger structured with the heat transfer fins aligned in a plurality of columns, crushing of the heat transfer fins is suppressed throughout the entire space from the side near the peripheral surface of the casing to the side far from the peripheral surface.

[0034] A heat exchange unit of an air conditioning apparatus according to an eighteenth aspect is the heat exchange unit of the air conditioning apparatus according to any of the eleventh, twelfth, and fourteenth through sixteenth aspects, wherein the heat exchanger has a structure in which the heat transfer fins are aligned in a plurality of columns from a side near the peripheral surface of the casing to a side far from the peripheral surface. The first fin insertion part is inserted either only in the column that, of the heat transfer fins aligned in the plurality of columns, is on the side nearest to the peripheral surface, or only in the column that is on the side farthest from the peripheral surface.

[0035] In this aspect, because the first fin insertion part is inserted only in one column in the heat exchanger structured with the heat transfer fins aligned in the plurality of columns, the work of inserting the first fin insertion part between the heat transfer fins can be performed more easily than in cases in which the first fin insertion part is inserted in all of the columns.

[0036] A heat exchange unit of an air conditioning apparatus according to a nineteenth aspect is the heat exchange unit of the air conditioning apparatus according to any of the first through eighteenth aspects, wherein the heat exchanger is formed from a different type of metal than the support part.

[0037] In this aspect, because the heat exchanger and the support part are formed from different types of metals, there is a risk of electric corrosion when the entire heat exchanger is placed directly on the support part without the spacer member. However, in this aspect, as described above, a structure is employed in which the heat exchanger is placed on the support part with the spacer member therebetween, whereby a large part of the heat exchanger is lifted off the support part and the fin crushing prevention member is disposed between the lowest-row heat transfer tube and the spacer member; therefore, both electric corrosion and crushing of the heat transfer fins can be suppressed.

BRIEF DESCRIPTION OF THE DRAWINGS

[0038]

FIG. 1 is a schematic configuration diagram of an air conditioning apparatus that employs an outdoor unit as a heat exchange unit according to an embodiment of the present invention;
FIG. 2 is a perspective view showing an external view of the outdoor unit;
FIG. 3 is a plan view showing the outdoor unit with a top plate removed;
FIG. 4 is a perspective view showing the outdoor unit with the top plate, front plates, and side plates removed;
FIG. 5 is a schematic perspective view of an outdoor heat exchanger;
FIG. 6 is a partial enlarged perspective view of the outdoor heat exchanger;
FIG. 7 is an enlarged view of part A in FIG. 3;
FIG. 8 is a perspective view of a fin crushing prevention member;
FIG. 9 is a cross-sectional view (only a lower end of the outdoor heat exchanger) along line I-I of FIG. 7;
FIG. 10 is a cross-sectional view (only the lower end of the outdoor heat exchanger) along line II-II of FIG. 7;
FIG. 11, which corresponds to FIG. 10, shows an outdoor unit that serves as a heat exchange unit according to a modification;
FIG. 12, which corresponds to FIG. 10, shows an outdoor unit that serves as a heat exchange unit according to a modification;
FIG. 13, which corresponds to FIG. 10, shows an outdoor unit that serves as a heat exchange unit according to a modification;
FIG. 14, which corresponds to FIG. 8, shows a fin crushing prevention member according to a modification;
FIG. 15, which corresponds to FIG. 8, shows a fin crushing prevention member according to a modification;
FIG. 16, which corresponds to FIG. 8, shows a fin crushing prevention member according to a modification;
FIG. 17, which corresponds to FIG. 8, shows a fin crushing prevention member according to a modification; and
FIG. 18, which corresponds to FIG. 9, shows an outdoor unit that serves as a heat exchange unit according to a modification.

DESCRIPTION OF EMBODIMENTS

[0039] An embodiment and modifications of a heat exchange unit of an air conditioning apparatus according to the present invention are described below, on the basis of the drawings. The specific configuration of the heat exchange unit according to the present invention is not limited to the following embodiment and modifications, and can be changed within a range that does not deviate from the scope of the invention.

(1) Basic configuration of the air conditioning apparatus

[0040] FIG. 1 is a schematic configuration diagram of an air conditioning apparatus 1 that employs an outdoor unit 2 as a heat exchange unit according to an embodiment of the present invention.

[0041] The air conditioning apparatus 1 is capable of performing air-cooling and air-warming in a room of a building etc. by performing a vapor-compression refrigerating cycle. The air conditioning apparatus 1 is mainly composed of the outdoor unit 2 and an indoor unit 4 that are connected to each other. In this configuration, the outdoor unit 2 and the indoor unit 4 are connected via a liquid refrigerant communication pipe 5 and a gas refrigerant communication pipe 6. In other words, a vapor-compression refrigerant circuit 10 of the air conditioning apparatus 1 is configured by the outdoor unit 2 and the indoor unit 4 being connected together via the refrigerant communication pipes 5, 6.

<Indoor Unit>

[0042] The indoor unit 4 is disposed indoors and configures a portion of the refrigerant circuit 10. The indoor unit 4 mainly has an indoor heat exchanger 41.

[0043] The indoor heat exchanger 41 functions as an evaporator for refrigerant during air-cooling operation to cool indoor air, and functions as a radiator for refrigerant during air-warming operation to heat indoor air. A liquid side of the indoor heat exchanger 41 is connected to the liquid refrigerant communication pipe 5, and a gas side of the indoor heat exchanger 41 is connected to the gas refrigerant communication pipe 6.

[0044] The indoor unit 4 has an indoor fan 42 for drawing indoor air into the indoor unit 4, and supplying the air as supply air into the room after the air has undergone heat exchange with refrigerant in the indoor heat exchanger 41. In other words, the indoor unit 4 has the indoor fan 42 as a fan for supplying the indoor heat exchanger 41 with the indoor air used as a source for heating or cooling refrigerant flowing through the indoor heat exchanger 41. In the present embodiment, a centrifugal fan, a multi-blade fan, or the like, driven by an indoor fan motor 42a, is used as the indoor fan 42.

<Outdoor Unit>

[0045] The outdoor unit 2 as a heat exchange unit is installed outdoors and configures a portion of the refrigerant circuit 10. The outdoor unit 2 mainly has a compressor 21, a four-way switching valve 22, an outdoor heat exchanger 23, an expansion valve 24, a liquid-side shutoff valve 25, and a gas-side shutoff valve 26.

[0046] The compressor 21 is a device for compressing low-pressure refrigerant in the refrigerating cycle to produce high-pressure refrigerant. The compressor 21 is an airtight structure for rotatably driving a rotary-type, scroll-type, or other positive-displacement compression element (not shown) with the aid of a compressor motor 21a. The compressor 21 has an intake pipe 31 connected to an intake side and a discharge pipe 32 connected to a discharge side. The intake pipe 31 is a refrigerant pipe for connecting the intake side of the compressor 21 and the four-way switching valve 22. The discharge pipe 32 is a refrigerant pipe for connecting the discharge side of the compressor 21 and the four-way switching valve 22.

[0047] The four-way switching valve 22 switches a direction of a flow of refrigerant in the refrigerant circuit 10. During air-cooling operation, the four-way switching valve 22 switches to an air-cooling cycle state for causing the outdoor heat exchanger 23 to function as a radiator of refrigerant which has compressed in the compressor 21, and for causing the indoor heat exchanger 41 to function as an evaporator of refrigerant which has radiated heat in the outdoor heat exchanger 23. In other words, during air-cooling operation, the four-way switching valve 22 connects the discharge side (in this case, the discharge pipe 32) of the compressor 21 and the gas side (in this case, a first gas refrigerant pipe 33) of the outdoor heat exchanger 23 (see a solid line of the four-way switching valve 22 in FIG. 1). Also, the intake side (in this case, the intake pipe 31) of the compressor 21 and the gas refrigerant communication pipe 6 side (in this case, a second gas refrigerant pipe 34) are connected together (see a solid line of the four-way switching valve 22 in FIG. 1). During air-warming operation, the four-way switching valve 22 switches to an air-warming cycle state for causing the outdoor heat exchanger 23 to function as an evaporator of refrigerant which has radiated heat in the indoor heat exchanger 41, and for causing the indoor heat exchanger 41 to function as a radiator of refrigerant which has compressed in the compressor 21. In other words, during air-warming operation, the four-way switching valve 22 connects the discharge side (in this case, the discharge pipe 32) of the compressor 21 and the gas refrigerant communication pipe 6 side (in this case, the second gas refrigerant pipe 34) (see a broken line of the four-way switching valve 22 in FIG. 1). Also, the intake side (in this case, the intake pipe 31) of the compressor 21 and the gas side (in this case, the first gas refrigerant pipe 33) of the outdoor heat exchanger 23 are connected together (see a broken line of the four-way switching valve 22 in FIG. 1). The first gas refrigerant pipe 33 connects the four-way switching valve 22 and the gas side of the outdoor heat exchanger 23. The second gas refrigerant pipe 34 connects the four-way switching valve 22 and the gas-side shutoff valve 26.

[0048] The outdoor heat exchanger 23 functions as a refrigerant radiator using outdoor air as a cooling source during air-cooling operation, and functions as a refrigerant evaporator using outdoor air as a heating source during air-warming operation. The liquid side of the outdoor heat exchanger 23 is connected to a liquid refrigerant pipe 35, and the gas side is connected to the first gas refrigerant pipe 33. The liquid refrigerant pipe 35 is a refrigerant pipe connecting the liquid side of the outdoor heat exchanger 23 and the liquid refrigerant communication pipe 5 side.

[0049] During air-cooling operation, the expansion valve 24 decompresses high-pressure refrigerant in the refrigerating cycle which has radiated heat in the outdoor heat exchanger 23 to the low pressure of the refrigerating cycle. During air-warming operation, the expansion valve 24 decompresses high-pressure refrigerant in the refrigerating cycle which has radiated heat in the indoor heat exchanger 41 to the low pressure of the refrigerating cycle. The expansion valve 24 is provided to a portion of the liquid refrigerant pipe 35 nearer to a liquid-side shutoff valve 25. In this case, an electric expansion valve is used as the expansion valve 24.

[0050] The liquid-side shutoff valve 25 and the gas-side shutoff valve 26 are provided to connection ports of exterior devices and pipes (specifically, the liquid refrigerant communication pipe 5 and the gas refrigerant communication pipe 6). The liquid-side shutoff valve 25 is provided to an end part of the liquid refrigerant pipe 35. The gas-side shutoff valve 26 is provided to an end part of the second gas refrigerant pipe 34.

[0051] The outdoor unit 2 has an outdoor fan 36 for drawing outdoor air into the outdoor unit 2, and then discharging the air outside after the air has undergone heat exchange with refrigerant in the outdoor heat exchanger 23. In other words, the outdoor unit 2 has the outdoor fan 36 as a fan that supplies the outdoor heat exchanger 23 with the outdoor air used as a source for cooling or heating refrigerant flowing through the outdoor heat exchanger 23. In this case, a propeller fan or the like driven by an outdoor fan motor 36a is used as the outdoor fan 36.

<Refrigerant Communication Pipes>

[0052] The refrigerant communication pipes 5, 6 are installed on site when the air conditioning apparatus 1 is set up in a building or other installation location, and pipes having various lengths and/or diameters are used in accordance with the installation location and/or installation conditions such as the combination of the outdoor unit 2 and the indoor unit 4.

(2) Basic action of the air conditioning apparatus

[0053] Next, the basic actions of the air conditioning apparatus 1 are described using FIG. 1. The air conditioning apparatus 1 can perform air-cooling operation, air-warming operation, and defrosting operation as basic actions.

<Air-cooling operation>

[0054] During air-cooling operation, the four-way switching valve 22 is switched to the air-cooling cycle state (the state shown by the solid lines in FIG. 1).

[0055] In the refrigerant circuit 10, gas refrigerant at the low pressure of the refrigerating cycle is drawn into the compressor 21, compressed to the high pressure of the refrigerating cycle, and then discharged.

[0056] The high-pressure gas refrigerant discharged from the compressor 21 is sent through the four-way switching valve 22 to the outdoor heat exchanger 23.

[0057] In the outdoor heat exchanger 23 functioning as a refrigerant radiator, the high-pressure gas refrigerant sent to the outdoor heat exchanger 23 exchanges heat with outdoor air supplied as a cooling source by the outdoor fan 36, and radiates heat to become high-pressure liquid refrigerant.

[0058] The high-pressure liquid refrigerant that has radiated heat in the outdoor heat exchanger 23 is sent to the expansion valve 24.

[0059] The high-pressure liquid refrigerant sent to the expansion valve 24 is decompressed to the low pressure of the refrigerating cycle by the expansion valve 24, becoming low-pressure gas-liquid two-phase refrigerant. The low-pressure gas-liquid two-phase refrigerant decompressed by the expansion valve 24 is sent through the liquid-side shutoff valve 25 and the liquid refrigerant communication pipe 5 to the indoor heat exchanger 41.

[0060] The low-pressure gas-liquid two-phase refrigerant sent to the indoor heat exchanger 41 exchanges heat in the indoor heat exchanger 41 with indoor air supplied as a heating source by the indoor fan 42, and the refrigerant evaporates. The indoor air is thereby cooled and then supplied into the room, whereby air-cooling of the room interior is performed.

[0061] The low-pressure gas refrigerant evaporated in the indoor heat exchanger 41 is drawn back into the compressor 21 through the gas refrigerant communication pipe 6, the gas-side shutoff valve 26, and the four-way switching valve 22.

<Air-warming operation>

[0062] During air-warming operation, the four-way switching valve 22 is switched to the air-warming cycle state (the state shown by the broken lines in FIG. 1).

[0063] In the refrigerant circuit 10, gas refrigerant at the low pressure of the refrigerating cycle is drawn into the compressor 21, compressed to the high pressure of the refrigerating cycle, and then discharged.

[0064] The high-pressure gas refrigerant discharged from the compressor 21 is sent through the four-way switching valve 22, the gas-side shutoff valve 26, and the gas refrigerant communication pipe 6, to the indoor heat exchanger 41.

[0065] The high-pressure gas refrigerant sent to the indoor heat exchanger 41 exchanges heat in the indoor heat exchanger 41 with indoor air supplied as a cooling source by the indoor fan 42, and radiates heat to become high-pressure liquid refrigerant. The indoor air is thereby heated and then supplied into the room, whereby air-warming of the room interior is performed.

[0066] The high-pressure liquid refrigerant that has radiated heat in the indoor heat exchanger 41 is sent through the liquid refrigerant communication pipe 5 and the liquid-side shutoff valve 25 to the expansion valve 24.

[0067] The high-pressure liquid refrigerant sent to the expansion valve 24 is decompressed to the low pressure of the refrigerating cycle by the expansion valve 24, becoming low-pressure gas-liquid two-phase refrigerant. The low-pressure gas-liquid two-phase refrigerant decompressed by the expansion valve 24 is sent to the outdoor heat exchanger 23.

[0068] The low-pressure gas-liquid two-phase refrigerant sent to the outdoor heat exchanger 23 exchanges heat in the outdoor heat exchanger 23 functioning as a refrigerant evaporator with outdoor air supplied as a heating source by the outdoor fan 36, and the refrigerant evaporates to become low-pressure gas refrigerant.

[0069] The low-pressure refrigerant evaporated in the outdoor heat exchanger 23 is drawn back into the compressor 21 through the four-way switching valve 22.

<Defrosting operation>

[0070] During the air-warming operation described above, when frost formation in the outdoor heat exchanger 23 is detected due a factor such as to the refrigerant temperature in the outdoor heat exchanger 23 being lower than a predetermined temperature, i.e., when a condition to start the defrosting operation of the outdoor heat exchanger 23 has been met, the defrosting operation is performed to melt frost adhering to the outdoor heat exchanger 23.

[0071] In this embodiment, the defrosting operation, similar to during the air-cooling operation, entails switching the four-way switching valve 22 to the air-cooling cycle state (the state shown by the solid lines in FIG. 1), whereby a reverse cycle defrosting operation is performed in which the outdoor heat exchanger 23 is caused to function as a radiator for refrigerant. The frost adhering to the outdoor heat exchanger 23 can thereby be melted. This defrosting operation is performed until a condition to end the defrosting operation is met due to a factor such as a predetermined defrosting operation time elapsing, after which the air-warming operation is resumed. The flow of refrigerant through the refrigerant circuit 10 in the defrosting operation is the same as during the air-cooling operation described above, and is therefore not described at this time.

(3) Basic configuration of the outdoor unit

[0072] Next, the basic configuration of the outdoor unit 2 as a heat exchange unit is described using FIGS. 1

through 6. In this case, FIG. 2 is a perspective view showing an external view of the outdoor unit 2. FIG. 3 is a plan view showing the outdoor unit 2 with a top plate 57 removed. FIG. 4 is a perspective view showing the outdoor unit 2 with the top plate 57, front plates 55, 56, and side plates 53, 54 removed. FIG. 5 is a schematic perspective view of the outdoor heat exchanger 23. FIG. 6 is a partial enlarged perspective view of the outdoor heat exchanger 23. In the following description, "up," "down," "left," "right," "vertical," "front surface," "side surface," "back surface," "top surface," "bottom surface," and other terms refer to directions and surfaces in a case of the surface on a fan blow-out grill 55b side being the front surface, unless otherwise specified.

[0073] The outdoor unit 2 has a structure (so-called "trunk structure") in which an interior of a unit casing 51 is partitioned by a vertically extending partition plate 58 into an air blower compartment S1 and a machine compartment S2. The outdoor unit 2 is configured so as to take outdoor air into the interior from a portion of the back surface and a portion of the side surface of the unit casing 51, and then expel the air from the front surface of the unit casing 51. The outdoor unit 2 mainly has the unit casing 51; the devices and pipes configuring the refrigerant circuit 10, including the compressor 21, the four-way switching valve 22, the outdoor heat exchanger 23, the expansion valve 24, the shutoff valves 25, 26, and the refrigerant pipes 31 to 35 connecting these devices; as well as the outdoor fan 36 and the outdoor fan motor 36a. In this case, an example is described in which the air blower compartment S1 is formed near the left-side surface of the unit casing 51 and the machine compartment S2 is formed near the right-side surface of the unit casing 51, but this left-right arrangement may be reversed.

[0074] The unit casing 51 is a steel member having a substantially rectangular parallelepiped shape, mainly accommodating the outdoor fan 36, the outdoor fan motor 36a, and the devices and piping configuring the refrigerant circuit 10, including the compressor 21, the four-way switching valve 22, the outdoor heat exchanger 23, the expansion valve 24, the shutoff valves 25, 26, and the refrigerant pipes 31 to 35 connecting these devices. The unit casing 51 has a bottom plate 52 serving as a support part on which the outdoor fan 36 and the devices and pipes 21-26, 31-35 configuring the refrigerant circuit 10, etc. are placed; an air blower compartment-side side plate 53; a machine compartment-side side plate 54; an air blower compartment-side front plate 55; a machine compartment-side front plate 56; the top plate 57; and two mounting legs 59.

[0075] The bottom plate 52 is a steel plate-shaped member configuring a bottom surface portion of the unit casing 51.

[0076] The air blower compartment-side side plate 53 is a steel plate-shaped member configuring a side surface portion (in this embodiment, the left-side surface portion) of the unit casing 51, that is near the air blower compartment S1. A lower part of the air blower compartment-side side plate 53 is fixed to the bottom plate 52, and in this embodiment, a front-surface-side end part of the air blower compartment-side side plate 53 is a member integrated with a left-side-surface-side end part of the air blower compartment-side front plate 55. Formed in the air blower compartment-side side plate 53 is a side surface fan intake port 53a for outdoor air to be drawn by the outdoor fan 36 into the unit casing 51 from the side-surface side of the unit casing 51. The air blower compartment-side side plate 53 may also be a separate member from the air blower compartment-side front plate 55.

[0077] The machine compartment-side side plate 54 is a steel plate-shaped member configuring a side-surface portion (in this embodiment, the right-side surface portion) of the unit casing 51, that is near the machine compartment S2, and a back-surface portion of the unit casing 51, that is near the machine compartment S2. A lower part of the machine compartment-side side plate 54 is fixed to the bottom plate 52. Between a back-surface-side end part of the air blower compartment-side side plate 53 and an air blower compartment S1-side end part of the machine compartment-side side plate 54 is formed a back surface fan intake port 53b for outdoor air to be drawn by the outdoor fan 36 into the unit casing 51 from the back surface side of the unit casing 51.

[0078] The air blower compartment-side front plate 55 is a steel plate-shaped member configuring a front surface portion of the air blower compartment S1 of the unit casing 51. A lower part of the air blower compartment-side front plate 55 is fixed to the bottom plate 52, and in this embodiment, a left-surface-side end part of the air blower compartment-side front plate 55 is an integrated member with a front-surface-side end part of the air blower compartment-side side plate 53. The air blower compartment-side front plate 55 is provided with a fan blow-out port 55a for blowing to the outside the outdoor air drawn into the unit casing 51 by the outdoor fan 36. The front side of the air blower compartment-side front plate 55 is provided with the fan blow-out grill 55b that covers the fan blow-out port 55a. The air blower compartment-side front plate 55 may also be a separate member from the air blower compartment-side side plate 53.

[0079] The machine compartment-side front plate 56 is a steel plate-shaped member configuring part of the front-surface portion of the machine compartment S2 of the unit casing 51, and part of the side-surface portion of the machine compartment S2 of the unit casing 51. The end part of the machine compartment-side front plate 56 on the air blower compartment S1 side is fixed to the end part of the air blower compartment-side front plate 55 on the machine compartment S2 side, and the end part of the machine compartment-side front plate 56 on the back surface side is fixed to the end part of the machine compartment-side side plate 54 on the front surface side.

[0080] The top plate 57 is a steel plate-shaped member

configuring the top surface portion of the unit casing 51. The top plate 57 is fixed to the air blower compartment-side side plate 53, the machine compartment-side side plate 54, and the air blower compartment-side front plate 55, which form the peripheral surfaces (in this embodiment, the front surface, side surfaces, and back surface) of the unit casing 51, excluding the top surface and bottom surface of the unit casing 51.

[0081] The partition plate 58 is a steel plate-shaped member disposed on the bottom plate 52 and extending vertically. The partition plate 58 in this case divides the interior of the unit casing 51 into left and right spaces, thereby forming the air blower compartment S1, which is near the left side surface, and the machine compartment S2, which is near the right side surface. The lower part of the partition plate 58 is fixed to the bottom plate 52, the end part on the front surface side is fixed to the air blower compartment-side front plate 55, and the end part on the back surface side extends to the side end part of the outdoor heat exchanger 23, that is near the machine compartment S2.

[0082] The mounting legs 59 are longitudinally extending steel plate-shaped members of the unit casing 51. The mounting legs 59 are members fixed to a mounting surface of the outdoor unit 2. In this embodiment, the outdoor unit 2 has two mounting legs 59, one being disposed near the air blower compartment S1, and the other being disposed near the machine compartment S2.

[0083] The outdoor fan 36 is a propeller fan having a plurality of blades, and is disposed at a position on the front surface side of the outdoor heat exchanger 23 within the air blower compartment S1 so as to face the front surface of the unit casing 51. Specifically, the outdoor fan 36 is disposed so as to face the fan blow-out port 55a formed in the front surface of the unit casing 51. The outdoor fan motor 36a is disposed longitudinally between the outdoor fan 36 and the outdoor heat exchanger 23 within the air blower compartment S1. The outdoor fan motor 36a is supported by a motor support stand 36b placed on the bottom plate 52. The outdoor fan 36 is axially supported on the outdoor fan motor 36a.

[0084] The outdoor heat exchanger 23, which is a heat exchanger panel substantially describing an L shape as seen in a plan view, is disposed inside the air blower compartment S1, so as to face the peripheral surfaces (in this embodiment, the left side surface and the back surface) of the unit casing 51, on the bottom plate 52 serving as a support part. In this embodiment, the portion of the outdoor heat exchanger 23 that is bent so as to run along a corner (in this embodiment, the corner formed by the left side surface and the back surface) of the peripheral surfaces of the unit casing 51 is designated as a heat exchange rounded part 23a. Specifically, the outdoor heat exchanger 23 is an inserted-fin type all-aluminum heat exchanger, configured from numerous heat transfer tubes 61 composed of flat tubes, and numerous heat transfer fins 64 composed of inserted fins. The heat transfer tubes 61, which are made of aluminum or an aluminum alloy, are flat perforated tubes having a flat surface 62 that serves as a heat transfer surface, and numerous small internal flow channels 63 through which the refrigerant flows. The numerous heat transfer tubes 61 are disposed in a plurality of rows at intervals along the vertical direction, with the flat surfaces 62 facing each other. In this embodiment, the numerous heat transfer tubes 61 are arranged in two columns along a direction in which outdoor air is ventilated, one end (the right end in this embodiment) of each tube in the longitudinal direction being connected to a refrigerant diverter 66, an exit/entry header 67, or an intermediate header 68, and the other end (the left front end in this embodiment) of each tube in the longitudinal direction being connected to a linking header 69. In this embodiment, the refrigerant diverter 66, the exit/entry header 67, the intermediate header 68, and the linking header 69 are vertically long members made of aluminum or an aluminum alloy, having refrigerant flow channels formed inside. The heat transfer fins 64 are made of aluminum or an aluminum alloy, and a plurality of the heat transfer fins are disposed at intervals along the longitudinal direction of the heat transfer tubes 61. In this embodiment, to conform to the two-column disposition of the heat transfer tubes 61 along the direction in which outdoor air is ventilated, the heat transfer fins 64 are also disposed in two columns along the direction in which outdoor air is ventilated. Numerous recesses 65 for inserting the heat transfer tubes 61 are formed in the heat transfer fins 64. The recesses 65 extend thinly in the horizontal direction from the edges of the heat transfer fins 64 on one side in the horizontal direction (in this embodiment, the edges on the upstream side relative to the direction in which outdoor air is ventilated). The outdoor heat exchanger 23, composed of such an all-aluminum heat exchanger, is placed on the bottom plate 52 forming the bottom surface of the unit casing 51, as described above. At this time, a large part of the outdoor heat exchanger 23 is lifted off the bottom plate 52 by placing the outdoor heat exchanger 23 on the bottom plate 52, as the support part, with spacer members 71, 72, 73 therebetween for purposes such as improving water drainage from the outdoor heat exchanger 23 and suppressing the growth of ice (ice-up) in the lower end of the outdoor heat exchanger 23. The spacer members 71, 72, 73 are composed of rubber or another electrically insulating material so that electric corrosion can be prevented between the steel bottom plate 52 and the outdoor heat exchanger 23 made of aluminum or an aluminum alloy. In this embodiment, the spacer member 71 is a plate-shaped member disposed vertically between lower ends of the refrigerant diverter 66, the exit/entry header 67, and the intermediate header 68, and a portion of the bottom plate 52 near the right of the back surface side. The spacer member 72 is a plate-shaped member disposed vertically between a lower end of the linking header 69 and a portion of the bottom plate 52 near the left of the front surface side. The spacer member 73 is a plate-shaped member disposed vertically be-

tween a lower end of the heat exchange rounded part 23a of the outdoor heat exchanger 23 and a corner of the bottom plate 52 near the left of the back surface side. Thus, the outdoor heat exchanger 23 is supported from below on the bottom surface of the unit casing 51 via the spacer members 71, 72, 73. In this embodiment, the portion of the outdoor heat exchanger 23 near the left of the front surface side and the portion near the right of the back surface side are supported on the peripheral surfaces (e.g., the front surface, the left side surface, and the back surface) of the unit casing 51 via brackets composed of resin or another electrically insulating material. In this embodiment, the heat transfer tubes 61 and the heat transfer fins 64 are disposed in two columns along the direction in which outdoor air is ventilated, but this arrangement is not provided by way of limitation, and the heat transfer tubes 61 and heat transfer fins 64 may be disposed in a single column, or disposed in three or more columns. At this time, the refrigerant diverter and/or the header, if appropriate and if necessary, are preferably connected to the longitudinal end parts of the heat transfer tubes 61 in accordance with the alignment of and/or the paths taken by the heat transfer tubes 61. The locations where the spacer members are disposed are not limited to the three aforementioned locations, and the spacer members may be disposed in other locations such as, e.g., near the longitudinal center of the portion of the outdoor heat exchanger 23 that runs along the left side surface and/or back surface of the unit casing 51.

[0085] The compressor 21 in this case is a hermetic compressor in the shape of a vertical cylinder, and is placed on the bottom plate 52 within the machine compartment S2.

(4) Configuration for suppressing crushing of heat transfer fins in lower end of outdoor heat exchanger

[0086] In the outdoor unit 2 (heat exchange unit) having the basic configuration described above, because the outdoor heat exchanger 23 is placed on the bottom plate 52 (support part) of the outdoor unit 2, there is a risk that the heat transfer fins 64 would be crushed in the lower end of the outdoor heat exchanger 23 by vibration and/or falling during transportation of the outdoor unit 2 or vibration during operation. Particularly, when the structure is employed in which the outdoor heat exchanger 23 is placed on the bottom plate 52 with the spacer members 71, 72, 73 therebetween as described above, the weight (load) of the outdoor heat exchanger 23 concentrates in one part thereof due to the effect of, e.g., the center of gravity of the outdoor heat exchanger 23 being displaced, and there is a risk that the heat transfer fins 64 would be readily crushed in the lower end of the part where this load concentrates. In this embodiment, because the outdoor heat exchanger 23 has a substantial L shape in a plan view, the center of gravity of the outdoor heat exchanger 23 is positioned near the heat exchange rounded part 23a, and the effect of this positioning is that the heat transfer fins 64 are readily crushed in the lower end of the heat exchange rounded part 23a.

[0087] Thus, in the outdoor unit 2 having the basic configuration described above, it is preferable to suppress crushing of the heat transfer fins 64 in the lower end of the outdoor heat exchanger 23.

[0088] In view of this, in this embodiment, a fin crushing prevention member 80, which has higher rigidity than the heat transfer fins 64, is disposed between the spacer member 73 and a lowest-row heat transfer tube 61a, which is the lowest positioned heat transfer tube of the plurality of heat transfer tubes 61, whereby the weight (load) of the outdoor heat exchanger 23 exerted on the heat transfer fins 64 is dispersed to the fin crushing prevention member 80, the heat transfer fins 64 are protected, and crushing of the heat transfer fins 64 in the lower end of the outdoor heat exchanger 23 is suppressed. The configuration for suppressing the crushing of the heat transfer fins 64 in the lower end of such an outdoor heat exchanger 23 is described below using FIGS. 2 to 10. In this embodiment, FIG. 7 is an enlarged view of part A in FIG. 3. FIG. 8 is a perspective view of the fin crushing prevention member 80. FIG. 9 is a cross-sectional view (only the lower end of the outdoor heat exchanger 23) along line I-I of FIG. 7. FIG. 10 is a cross-sectional view (only the lower end of the outdoor heat exchanger 23) along line II-II of FIG. 7. In the following description, "up," "down," "left," "right," "vertical," "front surface," "side surface," "back surface," "top surface," "bottom surface," and other terms refer to directions and surfaces in a case of the surface on the fan blow-out grill 55b side being the front surface, unless otherwise specified.

[0089] The fin crushing prevention member 80, as described above, is disposed between the spacer member 73 and the lowest-row heat transfer tube 61a, which is the lowest positioned heat transfer tube of the plurality of heat transfer tubes 61, and the fin crushing prevention member 80 has higher rigidity than the heat transfer fins 64. In this embodiment, the thickness of the fin crushing prevention member 80 is made to be greater than the plate thickness of the heat transfer fins 64 in order for the rigidity to be higher than that of the heat transfer fins 64. The weight (load) of the outdoor heat exchanger 23 exerted on the heat transfer fins 64 can thereby be dispersed to the fin crushing prevention member 80, the heat transfer fins 64 can be protected, and crushing of the heat transfer fins 64 in the lower end of the outdoor heat exchanger 23 can be suppressed. In this embodiment, because the outdoor heat exchanger 23 is made of aluminum or an aluminum alloy, the bottom plate 52 is made of steel, and both are formed from different types of metals, there would be a risk of electric corrosion should the entire outdoor heat exchanger 23 be placed directly on the bottom plate 52 without the spacer members 71, 72, 73. However, in this embodiment, as described above, the structure is employed in which the large part of the outdoor heat exchanger 23 is lifted off the bottom plate 52 by placing the outdoor heat exchang-

er 23 on the bottom plate 52 with spacer members 71, 72, 73 therebetween, and the fin crushing prevention member 80 is disposed between the lowest-row heat transfer tube 61a and the spacer member 73; therefore, both electric corrosion and crushing of the heat transfer fins 64 can be suppressed.

[0090] The fin crushing prevention member 80 is separate from the spacer member 73. For the sake of rigidity, corrosion resistance, and light resistance, the fin crushing prevention member 80 is configured from polypropylene (PP), polyethylene terephthalate (PET), or another resin material in this embodiment. The fin crushing prevention member 80 may be the same material (aluminum or an aluminum alloy in this embodiment) as the heat transfer tubes 61 or the heat transfer fins 64. The horizontal position of the outdoor heat exchanger 23 on the bottom plate 52 can thereby be finely adjusted with the fin crushing prevention member 80 disposed between the lowest-row heat transfer tube 61a and the spacer member 73, and the ease of assembling the outdoor unit 2 can therefore be improved from the standpoint of positional adjustment.

[0091] The fin crushing prevention member 80, which has horizontally extending first fin insertion parts 81, is disposed between the lowest-row heat transfer tube 61a and the spacer member 73 by horizontally inserting the first fin insertions parts 81 between the heat transfer fins 64. In this embodiment, the fin crushing prevention member 80 is disposed between the lowest-row heat transfer tube 61a and the spacer member 73 by horizontally inserting the first fin insertion parts 81 between the heat transfer fins 64 from a side near the left side surface or back surface of the unit casing 51 (i.e., a side near a peripheral surface of the outdoor heat exchanger 23). Specifically, the fin crushing prevention member 80 is disposed between the spacer member 73 and the lowest-row heat transfer tube 61a configuring the heat exchange rounded part 23a by inserting the first fin insertion parts 81 between the heat transfer fins 64 configuring the heat exchange rounded part 23a. Additionally, the fin crushing prevention member 80 is disposed between the lowest-row heat transfer tube 61a and the spacer member 73 after the heat exchange rounded part 23a has been formed by bending the outdoor heat exchanger 23. The fin crushing prevention member 80 can thereby easily be disposed between the lowest-row heat transfer tube 61a and the spacer member 73 by inserting the first fin insertion parts 81 between the heat transfer fins 64. Additionally, the heat transfer fins 64 configuring the heat exchange rounded part 23a where the weight (load) of the outdoor heat exchanger 23 readily concentrates can be protected, and crushing of the heat transfer fins 64 in the lower end of the heat exchange rounded part 23a can be suppressed. Furthermore, the heat exchange rounded part 23a can be more easily formed by bending the outdoor heat exchanger 23 than in cases in which the fin crushing prevention member 80 is disposed in advance so as to correspond to the lowest-row heat transfer tube 61a configuring the heat exchange rounded part 23a before the heat exchanger 23 is bent.

[0092] The first fin insertion parts 81 are plate-shaped members extending from a side near the peripheral surface of the outdoor heat exchanger 23 toward a side far from the peripheral surface. In this embodiment, a vertical height dimension H of the first fin insertion parts 81 is equal to or greater than a height hf from a lower end of the lowest-row heat transfer tube 61a to a lower end of the heat transfer fins 64. The weight (load) of the outdoor heat exchanger 23 exerted on the heat transfer fins 64 can thereby be reliably dispersed to the fin crushing prevention member 80. In this embodiment, the first fin insertion parts 81 are inserted only in the column that, of the heat transfer fins 64 aligned in the plurality of columns (two columns in this embodiment), is on the side nearest to the peripheral surface. The first fin insertion parts 81 are thereby inserted in only one column in the outdoor heat exchanger 23 which is structured with the heat transfer fins 64 aligned in the plurality of columns, and the work of inserting the first fin insertion parts 81 between the heat transfer fins 64 can thereby be performed more easily than in cases in which the first fin insertion parts 81 are inserted in all of the columns (two columns in this embodiment). Additionally, in this embodiment, insertion deep end parts 81b, which are the end parts of the first fin insertion parts 81 on a deep side in a direction of insertion, have tapers formed therein which narrow in the direction in which the first fin insertion parts 81 are inserted. The work of inserting the first fin insertion parts 81 between the heat transfer fins 64 can thereby be performed smoothly.

[0093] The fin crushing prevention member 80 further has a fin insertion base part 83 extending from insertion frontal end parts 81a, which are end parts of the first fin insertion parts 81 on a frontal side in the direction of insertion, the fin insertion base part 83 extending in a horizontal direction that intersects the direction in which the first fin insertion parts 81 are inserted. In this embodiment, the fin insertion base part 83 is a substantially rectangular plate-shaped member. The first fin insertion parts 81 can thereby easily be inserted between the heat transfer fins 64 by pressing the fin insertion base part 83 in the direction in which the first fin insertion parts 81 are inserted. Additionally, in this embodiment, the fin crushing prevention member 80 has a plurality (two in this embodiment) of the first fin insertion parts 81, and the insertion frontal end parts 81a of the first fin insertion parts 81 are joined to each other via the fin insertion base part 83. Specifically, the insertion frontal end parts 81a of the two first fin insertion parts 81 extend from both end parts of the fin insertion base part 83 on the sides that intersect with the direction in which the first fin insertion parts 81 are inserted. The plurality (two in this embodiment) of first fin insertion parts 81 can thereby be inserted all together between the heat transfer fins 64 by pressing the fin insertion base part 83 in the direction in which the first fin insertion parts 81 are inserted, and the degree to which

the weight (load) of the outdoor heat exchanger 23 exerted on the heat transfer fins 64 is dispersed can be increased.

[0094] The fin crushing prevention member 80 furthermore has, above the lowest-row heat transfer tube 61a, second fin insertion parts 82 which are horizontally inserted between the heat transfer fins 64. In this embodiment, the second fin insertion parts 82 are plate-shaped members which, above the first fin insertion parts 81, extend from the side near the peripheral surface of the outdoor heat exchanger 23 toward the side far from the peripheral surface. The second fin insertion parts 82 are a plurality (two) in number, as are the first fin insertion parts 81. Insertion frontal end parts 82a of the two second fin insertion parts 82 extend from both end parts of the fin insertion base part 83 on the sides intersecting the direction in which the first fin insertion parts 81 are inserted. Formed vertically between the first fin insertion parts 81 and the second fin insertion parts 82 are slit parts 84 into which the heat transfer tubes 61 (in this embodiment, the lowest-row heat transfer tube 61a) can be inserted when the first fin insertion parts 81 are inserted between the heat transfer fins 64. The first fin insertion parts 81 can thereby be made less likely to fall out from the heat transfer fins 64 by inserting both the first fin insertion parts 81 and the second fin insertion parts 82 together between the heat transfer fins 64.

[0095] Additionally, when the first fin insertion parts 81 have been inserted between the heat transfer fins 64, a gap S is ensured between the fin insertion base 83 and the end parts of the heat transfer fins 64 on the side near the insertion frontal end parts 81a, the purpose of the gap S being to prevent the fin insertion base 83 from coming into contact with the end parts of the heat transfer fins 64 on the side near the insertion frontal end parts 81a. In this embodiment, insertion-limiting parts 85, which close the portions of the slit parts 84 near the fin insertion base part 83, are formed vertically between the first fin insertion parts 81 and the second fin insertion parts 82 so that the gap S can easily be ensured when the first fin insertion parts 81 are inserted between the heat transfer fins 64. The insertion-limiting parts 85 are plate-shaped members formed so that the first fin insertion parts 81 and the second fin insertion parts 82 are joined. When the first fin insertion parts 81 are inserted between the heat transfer fins 64, the degree to which the first fin insertion parts 81 are inserted is limited by the heat transfer tubes 61 (the lowest-row heat transfer tube 61a in this embodiment) coming into contact with the insertion-limiting parts 85, whereby the gap S is ensured. Water can thereby be prevented from remaining adhered to the fin insertion base 83, the end parts of the heat transfer fins 64 on the side near the insertion frontal end parts 81a, and the vicinities thereof by the gap S between the fin insertion base 83 and the end parts of the heat transfer fins 64 on the side near the insertion frontal end parts 81a; therefore, water drainage from the outdoor heat exchanger 23 can be ensured, and ice growth (ice-up) in the lower end of the outdoor heat exchanger 23 can be suppressed. The size of the gap S is at least 5 mm, taking into consideration an amount of drain water produced in the outdoor heat exchanger 23 during air-warming operation and/or during defrosting operation, the degree of expected ice growth, etc.

(5) Modifications

<A>

[0096] In the outdoor unit 2 (heat exchange unit) described above, the fin crushing prevention member 80 is disposed between the lowest-row heat transfer tube 61a and the spacer member 73 by horizontally inserting the first fin insertion parts 81 between the heat transfer fins 64 from the side near the left side surface or the back surface of the unit casing 51 (i.e., the side near the peripheral surface of the outdoor heat exchanger 23), as shown in FIG. 10. Additionally, the first fin insertion parts 81 are inserted only in the column that, of the heat transfer fins 64 aligned in the plurality of columns (two columns in this modification), is on the side nearest to the left side surface or the back surface of the unit casing 51 (i.e., the side nearest to the peripheral surface of the outdoor heat exchanger 23).

[0097] However, this arrangement is not provided by way of limitation, and the fin crushing prevention member 80 may be disposed between the lowest-row heat transfer tube 61a and the spacer member 73 by horizontally inserting the first fin insertion parts 81 between the heat transfer fins 64 from the side far from the left side surface or the back surface of the unit casing 51 (the side far from the peripheral surface of the outdoor heat exchanger 23), as shown in FIG. 11. Additionally, the first fin insertion parts 81 may be inserted only in the column that, of the heat transfer fins 64 aligned in the plurality of columns (two columns in this modification), is on the side farthest from the left side surface or the back surface of the unit casing 51 (i.e., the side farthest from the peripheral surface of the outdoor heat exchanger 23), as shown in FIG. 11.

[0098] In the outdoor unit 2 (heat exchange unit) according to the above embodiment, the first fin insertion parts 81 are inserted only in the column that, of the heat transfer fins 64 aligned in the plurality of columns (two columns in this modification), is on the side nearest to the peripheral surface, as shown in FIG. 10.

[0099] However, this arrangement is not provided by way of limitation, and the first fin insertion parts 81 may be inserted in all of the columns of the heat transfer fins 64 aligned in the plurality of columns (two columns in this modification), as shown in FIGS. 12 and 13. In this modification, the configuration shown in FIG. 12 entails two fin crushing prevention members 80 disposed between the lowest-row heat transfer tubes 61a and the spacer member 73 by inserting the first fin insertion parts 81 from both the side near the left side surface or the back surface

of the unit casing 51 (the side near the peripheral surface of the outdoor heat exchanger 23) and the side far from the left side surface or the back surface of the unit casing 51 (the side far from the peripheral surface of the outdoor heat exchanger 23). Additionally, the configuration shown in FIG. 13 entails one fin crushing prevention member 80 disposed between the lowest-row heat transfer tubes 61a and the spacer member 73 by inserting the first fin insertion parts 81, which span two columns of the heat transfer fins 64, from the side near the left side surface or the back surface of the unit casing 51 (the side near the peripheral surface of the outdoor heat exchanger 23).

[0100] In these cases, the work of inserting the first fin insertion parts 81 between the heat transfer fins 64 requires slightly more labor than inserting the first fin insertion parts 81 in only one column, but crushing of the heat transfer fins 64 can be suppressed throughout the entire space from the side near the peripheral surface of the unit casing 51 to the side far from the peripheral surface.

<B>

[0101] In the outdoor unit 2 (heat exchange unit) described above, the fin crushing prevention member 80 has a plurality (two in the above embodiment) of first fin insertion parts 81, and the insertion frontal end parts 81a of the first fin insertion parts 81 are joined to each other via the fin insertion base part 83, forming a U shape in a plan view, as shown in FIG. 8.

[0102] However, this arrangement is not provided by way of limitation, and one first fin insertion part 81 may extend from the fin insertion base part 83 so as to have a T shape in a plan view, as shown in FIG. 14.

<C>

[0103] In the outdoor unit 2 (heat exchange unit) described above, the fin crushing prevention member 80 has the second fin insertion parts 82 only between the lowest-row heat transfer tube 61a and the heat transfer tube 61 one row above, as shown in FIGS. 8 and 10. Specifically, the fin crushing prevention member 80 has the second fin insertion parts 82 only in the one row above the first fin insertion parts 81.

[0104] However, this arrangement is not provided by way of limitation, and the fin crushing prevention member 80 may also have the second fin insertion parts 82 in the next row above as shown in FIG. 15, or no second fin insertion parts 82 as shown in FIG. 16.

<D>

[0105] In the outdoor unit 2 (heat exchange unit) described above, the fin crushing prevention member 80 is disposed between the lowest-row heat transfer tube 61a and the spacer member 73 by horizontally inserting the first fin insertion parts 81 between the heat transfer fins 64, as shown in FIGS. 8 and 9.

[0106] However, this arrangement is not provided by way of limitation, and the fin crushing prevention member 80 may be disposed between the lowest-row heat transfer tube 61a and the spacer member 73 by vertically inserting the first fin insertion parts 81 between the heat transfer fins 64, as shown in FIGS. 17 and 18. In this modification, the fin crushing prevention member 80 is disposed between the lowest-row heat transfer tube 61a and the spacer member 73 by vertically inserting the first fin insertion parts 81 between the heat transfer fins 64 from a side near the bottom surface of the unit casing 51 (i.e., the side near the bottom surface of the outdoor heat exchanger 23). Additionally, the first fin insertion parts 81 are plate-shaped members extending from the side near the bottom surface of the outdoor heat exchanger 23 toward the side far from the bottom surface. In this modification, the first fin insertion parts 81 are tapered so as to narrow in the direction of insertion. The fin crushing prevention member 80 furthermore has the fin insertion base part 83 extending from the end parts of the first fin insertion parts 81 on the frontal side in the direction of insertion, the fin insertion base part 83 extending in a horizontal direction intersecting the direction in which the first fin insertion parts 81 are inserted. In this modification, the fin insertion base part 83 is a substantially arcuate plate-shaped member. Additionally, in this modification, the fin crushing prevention member 80 has a plurality (six in this modification) of first fin insertion parts 81, and the lower ends of the first fin insertion parts 81 are joined via the fin insertion base part 83.

<E>

[0107] In the outdoor unit 2 (heat exchange unit) described above, the fin crushing prevention member 80 and the spacer member 73 are separate members, as shown in FIGS. 8 and 14 to 17.

[0108] However, this arrangement is not provided by way of limitation, and though not illustrated for this modification, the fin crushing prevention member 80 may be integrated with the spacer member 73.

[0109] In this case, the work of placing the outdoor heat exchanger 23 on the bottom plate 52 (support part) with the spacer member 73 therebetween and the work of disposing the fin crushing prevention member 80 between the lowest-row heat transfer tube 61a and the spacer member 73 can be performed simultaneously, and the ease of assembling the outdoor unit 2 can therefore be improved from the standpoint of the number of man-hours.

[0110] Also, instead of the spacer member 73, the fin crushing prevention member 80 and an intake grill (not shown) provided to the back surface fan intake port 53b may also be integrated.

<F>

[0111] In the outdoor unit 2 (heat exchange unit) described above, the fin crushing prevention member 80 is disposed to correspond to the spacer member 73 disposed at the lower end of the heat exchange rounded part 23a, as shown in FIG. 7.

[0112] However, this arrangement is not provided by way of limitation, and the fin crushing prevention member may be disposed to correspond to the other spacer members 71, 72.

<G>

[0113] In the outdoor unit 2 (heat exchange unit) described above, the outdoor heat exchanger 23 is employed in which flat tubes are used as the heat transfer tubes 61, as shown in FIGS. 6 and 10 to 13.

[0114] However, this arrangement is not provided by way of limitation, and the fin crushing prevention member 80 described above can also be applied when an outdoor heat exchanger 23 is employed in which round tubes are used as the heat transfer tubes 61.

<H>

[0115] The outdoor unit 2 is used in the above descriptions as an example of the heat exchange unit, and the specifics of applying the above-described fin crushing prevention member 80 are described.

[0116] However, this arrangement is not provided by way of limitation, and the above-described fin crushing prevention member 80 can also be applied to heat exchange units other than outdoor units.

INDUSTRIAL APPLICABILITY

[0117] The present invention is widely applicable to heat exchange units of air conditioning apparatuses which are provided with a heat exchanger having a plurality of heat transfer tubes and heat transfer fins, and a casing having a support part on which the heat exchanger is placed.

REFERENCE SIGNS LIST

[0118]

2	Outdoor unit (heat exchange unit)
23	Outdoor heat exchanger (heat exchanger)
23a	Heat exchange rounded part
51	Unit casing
52	Bottom plate (support part)
61	Heat transfer tube
61a	Lowest-row heat transfer tube
64	Heat transfer fin
71, 72, 73	Spacer member
80	Fin crushing prevention member
81	First fin insertion part
81a	Insertion frontal end part
82	Second fin insertion part
83	Fin insertion base

CITATION LIST

PATENT LITERATURE

[Patent Literature 1]

[0119] Japanese Laid-open Patent Application No. H9-276940

Claims

1. A heat exchange unit (2) of an air conditioning apparatus, comprising:

a heat exchanger (23) having a plurality of heat transfer tubes (61) that are disposed along a vertical direction and that extend horizontally, and a plurality of heat transfer fins (64) that are disposed horizontally at intervals and that extend vertically; and
a casing (51) having a support part (52) on which the heat exchanger is placed;
the heat exchange unit of the air conditioning apparatus further comprising:

a spacer member (71, 72, 73) disposed between the heat exchanger and the support part; and
a fin crushing prevention member (80) disposed between the spacer member and a lowest-row heat transfer tube (61a), which is the lowest heat transfer tube of the plurality of heat transfer tubes, the fin crushing prevention member having higher rigidity than the heat transfer fins.

2. The heat exchange unit (2) of the air conditioning apparatus according to claim 1, wherein

the fin crushing prevention member (80) is separate from the spacer member (71, 72, 73).

3. The heat exchange unit (2) of the air conditioning apparatus according to claim 1, wherein

the fin crushing prevention member (80) is integrated with the spacer member (71, 72, 73).

4. The heat exchange unit (2) of the air conditioning apparatus according to any of claims 1 to 3, wherein

the fin crushing prevention member (80) has a

first fin insertion part (81) extending vertically and horizontally, and the fin crushing prevention member is disposed between the lowest-row heat transfer tube (61a) and the spacer member (71, 72, 73) by inserting the first fin insertion part between the heat transfer fins (64).

5. The heat exchange unit (2) of the air conditioning apparatus according to claim 4, wherein

a vertical height dimension of the first fin insertion part (81) is equal to or greater than a height from a lower end of the lowest-row heat transfer tube (61a) to a lower end of the heat transfer fins (64).

6. The heat exchange unit (2) of the air conditioning apparatus according to claim 4 or 5, wherein

the fin crushing prevention member (80) is disposed between the lowest-row heat transfer tube (61a) and the spacer member (71, 72, 73) by horizontally inserting the first fin insertion part (81) between the heat transfer fins (64).

7. The heat exchange unit (2) of the air conditioning apparatus according to claim 6, wherein

the fin crushing prevention member (80) further has a fin insertion base (83) extending in a horizontal direction intersecting an insertion direction of the first fin insertion part from an insertion frontal end part (81a), which is an end part of the first fin insertion part (81) on a front side in the insertion direction.

8. The heat exchange unit (2) of the air conditioning apparatus according to claim 7, wherein

the fin crushing prevention member (80) has a plurality of first fin insertion parts (81), and
the insertion frontal end parts (81a) of the first fin insertion parts are joined to each other via the fin insertion base (83).

9. The heat exchange unit (2) of the air conditioning apparatus according to claim 7 or 8, wherein

when the first fin insertion part (81) has been inserted between the heat transfer fins (64), a gap for preventing the fin insertion base (83) from coming into contact with end parts of the heat transfer fins on a side near the insertion frontal end part (81a) is ensured between the fin insertion base and the end parts of the heat transfer fins on the side near the insertion frontal end part.

10. The heat exchange unit (2) of the air conditioning apparatus according to any of claims 6 to 9, wherein

the fin crushing prevention member (80) further has, higher than the lowest-row heat transfer tube (61a), a second fin insertion part (82) horizontally inserted between the heat transfer fins (64).

11. The heat exchange unit (2) of the air conditioning apparatus according to any of claims 6 to 10, wherein

the casing (51) has a rectangular parallelepiped shape;
the support part (52) forms a bottom surface of the casing;
the heat exchanger (23) is disposed inside the casing so as to run along a peripheral surface of the casing, excluding a top surface and the bottom surface of the casing; and
the fin crushing prevention member (80) is disposed between the lowest-row heat transfer tube (61a) and the spacer member (71, 72, 73) by horizontally inserting the first fin insertion part (81) between the heat transfer fins (64) from a side near the peripheral surface of the heat exchanger.

12. The heat exchange unit (2) of the air conditioning apparatus according to any of claims 6 to 10, wherein

the casing (51) has a rectangular parallelepiped shape;
the support part (52) forms a bottom surface of the casing;
the heat exchanger (23) is disposed inside the casing so as to run along a peripheral surface of the casing, excluding a top surface and the bottom surface of the casing; and
the fin crushing prevention member (80) is disposed between the lowest-row heat transfer tube (61a) and the spacer member (71, 72, 73) by horizontally inserting the first fin insertion part (81) between the heat transfer fins (64) from a side far from the peripheral surface of the heat exchanger.

13. The heat exchange unit of the air conditioning apparatus according to claim 4 or 5, wherein

the fin crushing prevention member (80) is disposed between the lowest-row heat transfer tube (61a) and the spacer member by vertically inserting the first fin insertion part (81) between the heat transfer fins (64).

14. The heat exchange unit (2) of the air conditioning apparatus according to claim 13, wherein

the casing (51) has a rectangular parallelepiped shape;
the support part (52) forms a bottom surface of the casing;
the heat exchanger (23) is disposed inside the casing so as to run along a peripheral surface of the casing, excluding a top surface and the bottom surface of the casing; and
the fin crushing prevention member (80) is disposed between the lowest-row heat transfer tube (61a) and the spacer member (71, 72, 73) by vertically inserting the first fin insertion part (81) between the heat transfer fins (64) from a side near the bottom surface of the heat exchanger.

15. The heat exchange unit (2) of the air conditioning apparatus according to any of claims 11, 12, and 14, wherein

the heat exchanger (23) has a heat exchange rounded part (23a) bent so as to run along a corner of the peripheral surface of the casing (51);
the spacer member (73) is disposed between the heat exchange rounded part and the support part (52); and
the fin crushing prevention member (80) is disposed between the spacer member and the lowest-row heat transfer tube (61a) configuring the heat exchange rounded part by inserting the first fin insertion part (81) between the heat transfer fins (64) configuring the heat exchange rounded part.

16. The heat exchange unit (2) of the air conditioning apparatus according to claim 15, wherein

after the heat exchange rounded part (23a) has been formed by bending the heat exchanger (23), the fin crushing prevention member (80) is disposed between the lowest-row heat transfer tube (61a) and the spacer member (73).

17. The heat exchange unit (2) of the air conditioning apparatus according to any of claims 11, 12, and 14 to 16, wherein

the heat exchanger (23) has a structure in which the heat transfer fins (64) are aligned in a plurality of columns from a side near the peripheral surface of the casing (51) to a side far from the peripheral surface; and
the first fin insertion part (81) is inserted in all of the columns of the heat transfer fins aligned in the plurality of columns.

18. The heat exchange unit (2) of the air conditioning apparatus according to any of claims 11, 12, and 14 to 16, wherein

the heat exchanger (23) has a structure in which the heat transfer fins (64) are aligned in a plurality of columns from a side near the peripheral surface of the casing (51) to a side far from the peripheral surface; and
the first fin insertion part (81) is inserted either only in the column that, of the heat transfer fins aligned in the plurality of columns, is on the side nearest to the peripheral surface, or only in the column that is on the side farthest from the peripheral surface.

19. The heat exchange unit (2) of the air conditioning apparatus according to any of claims 1 to 18, wherein

the heat exchanger (23) is formed from a different type of metal than the support part (52).

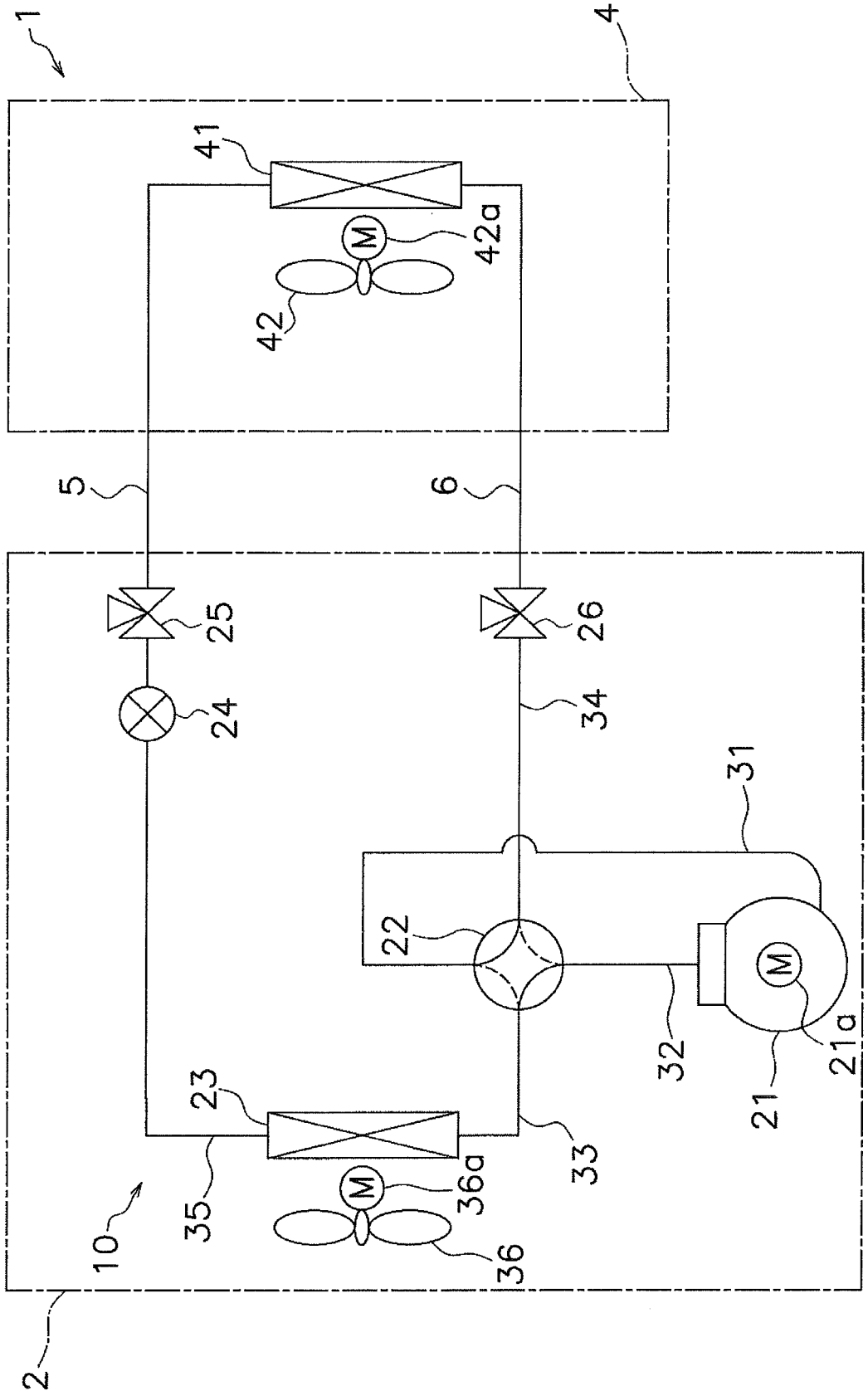


FIG. 1

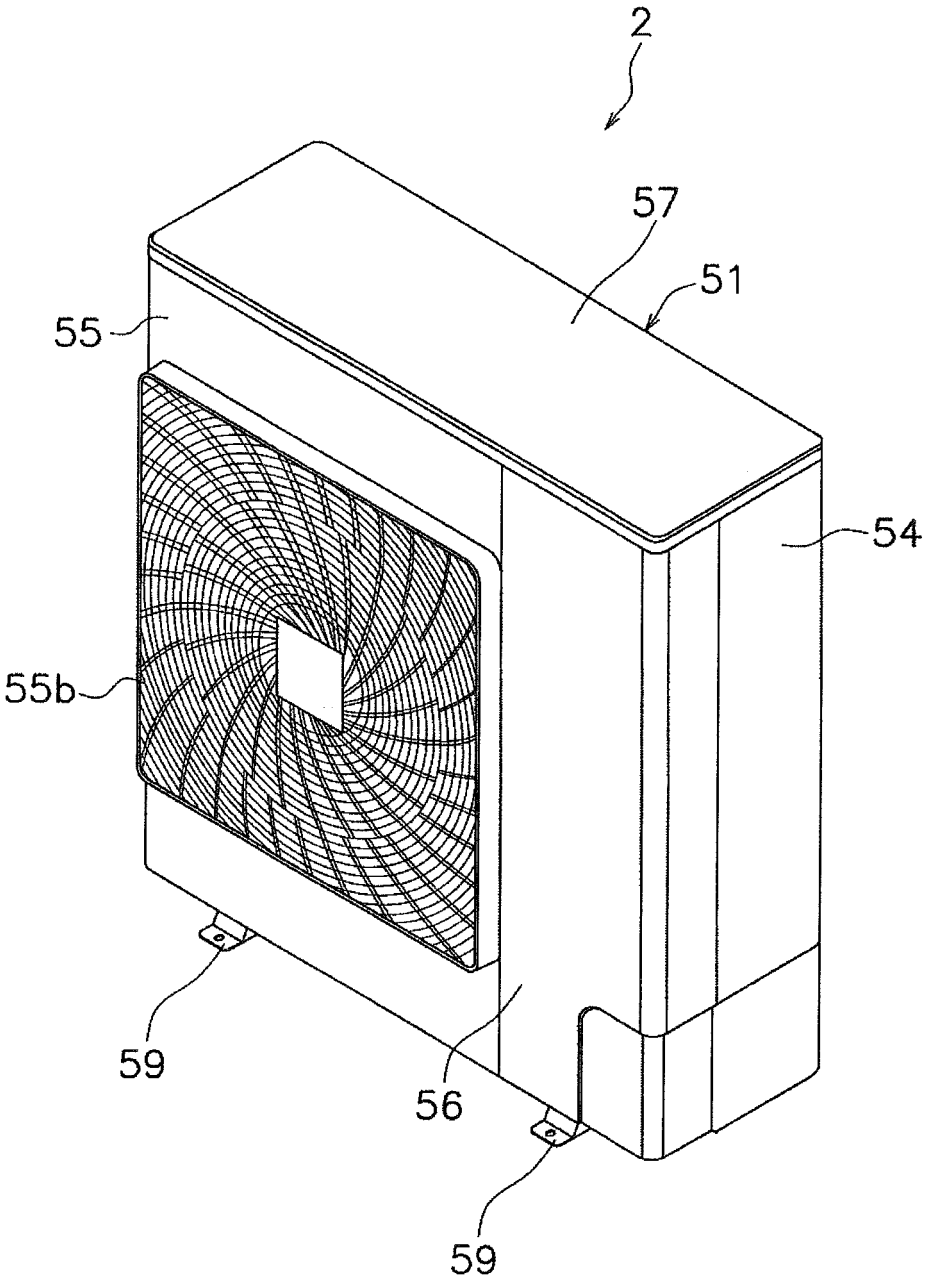
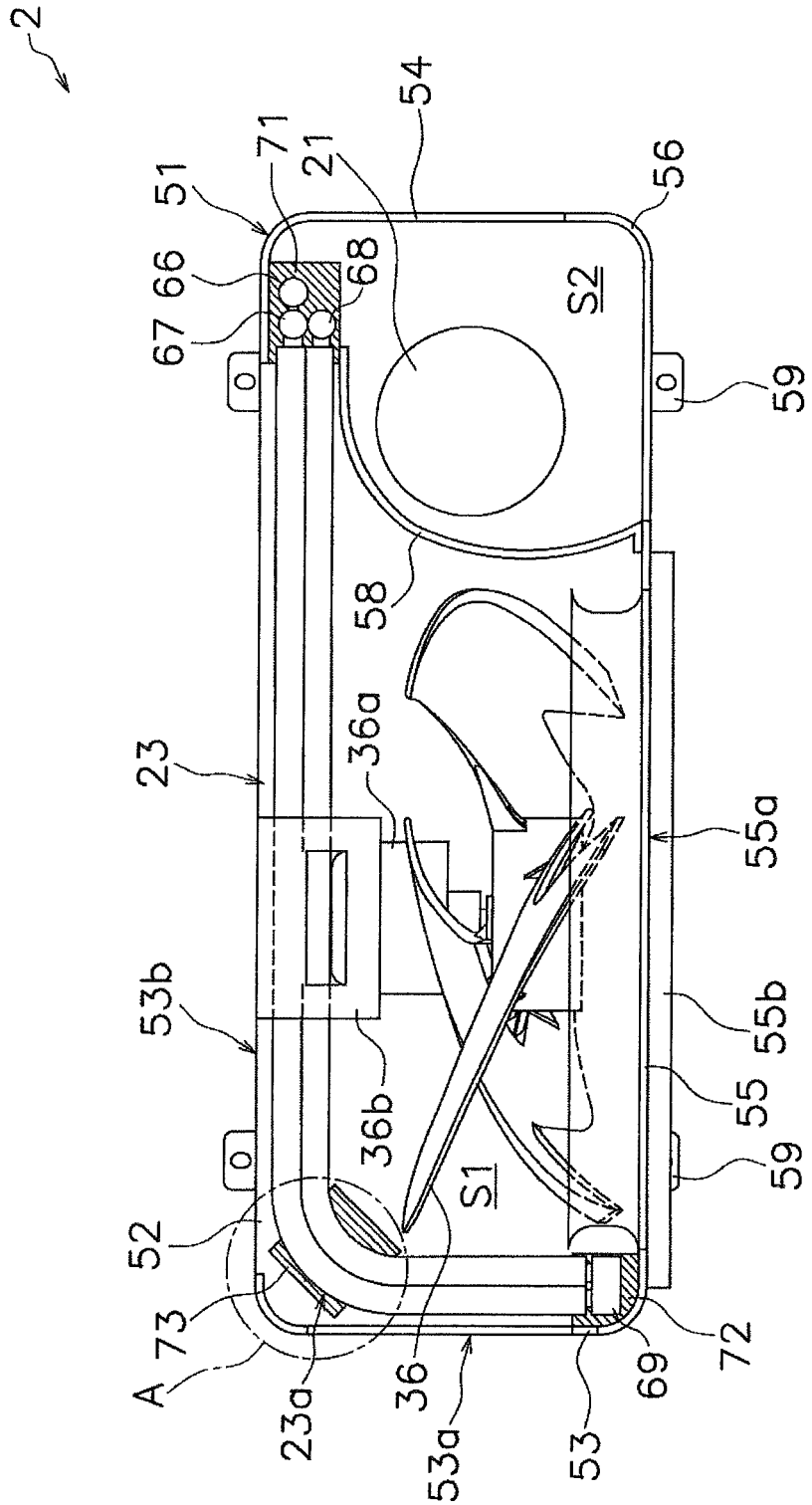


FIG. 2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54
71
21
56
51
66
68
67
S2
59
58
23
36a
55a
53b
55b
55
36b
59
S1
52
73
A
23a
36
53a
53
69
72

FIG. 3

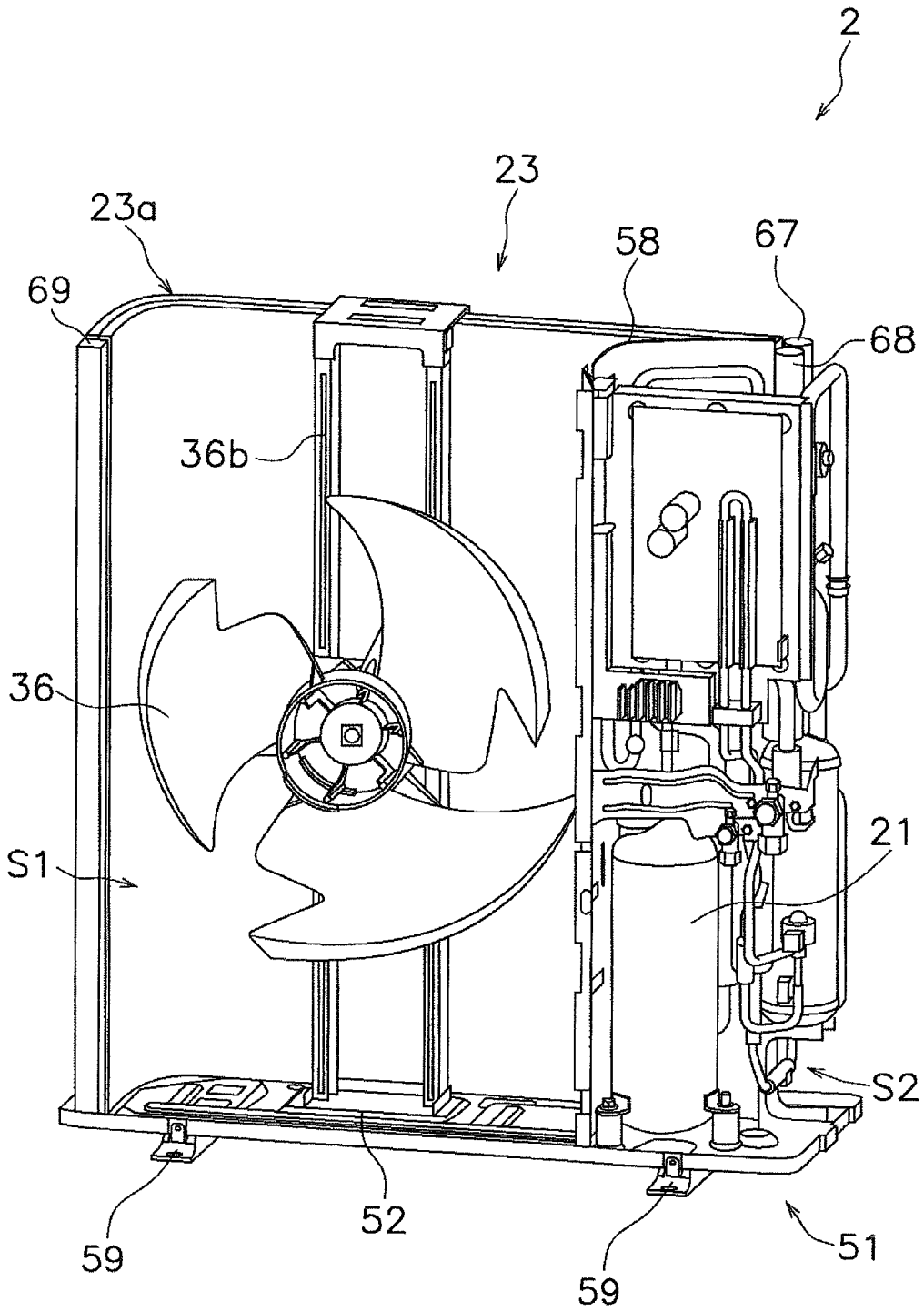


FIG. 4

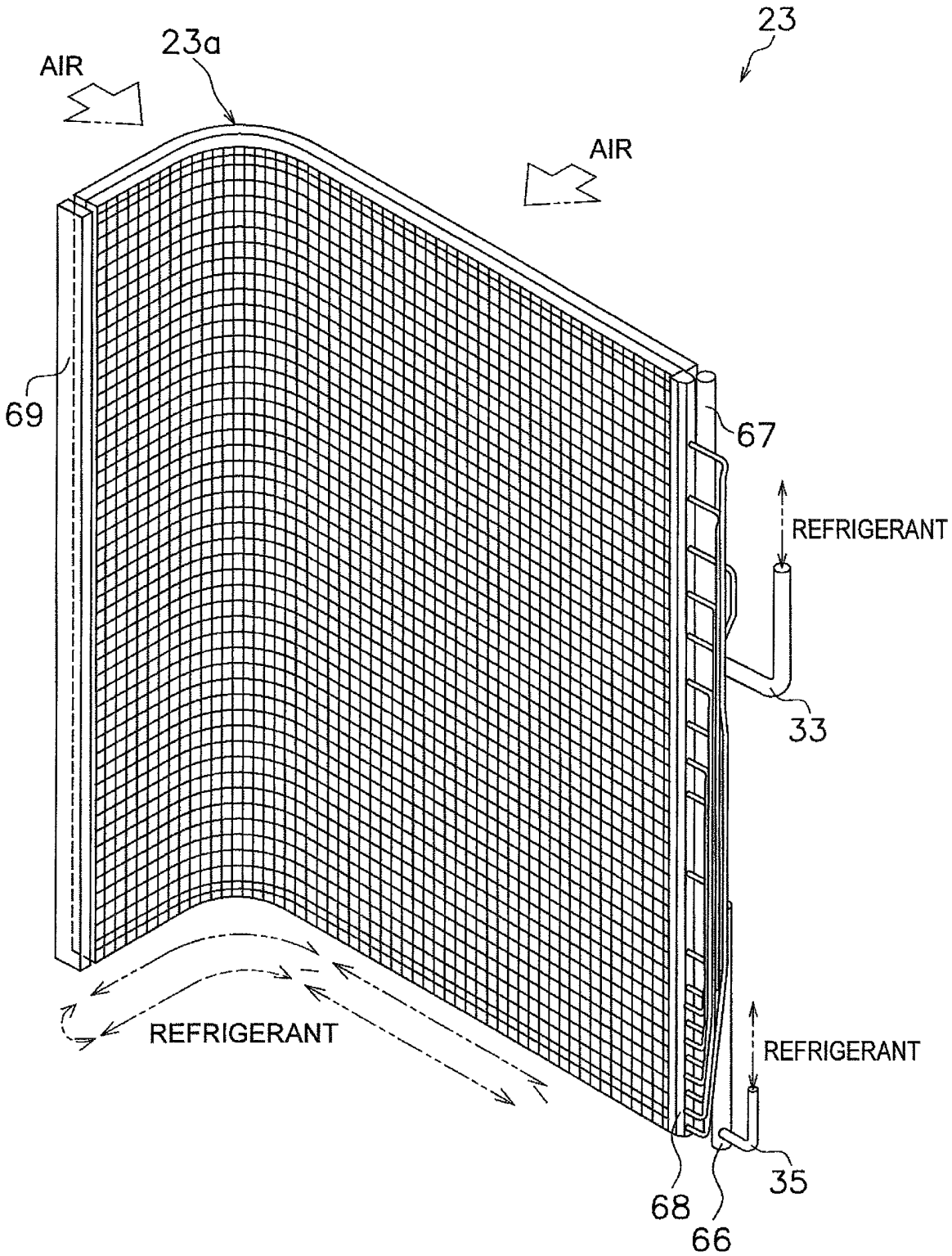

23
23a
AIR
AIR
69
67
REFRIGERANT
33
REFRIGERANT
REFRIGERANT
35
68
66

FIG. 5

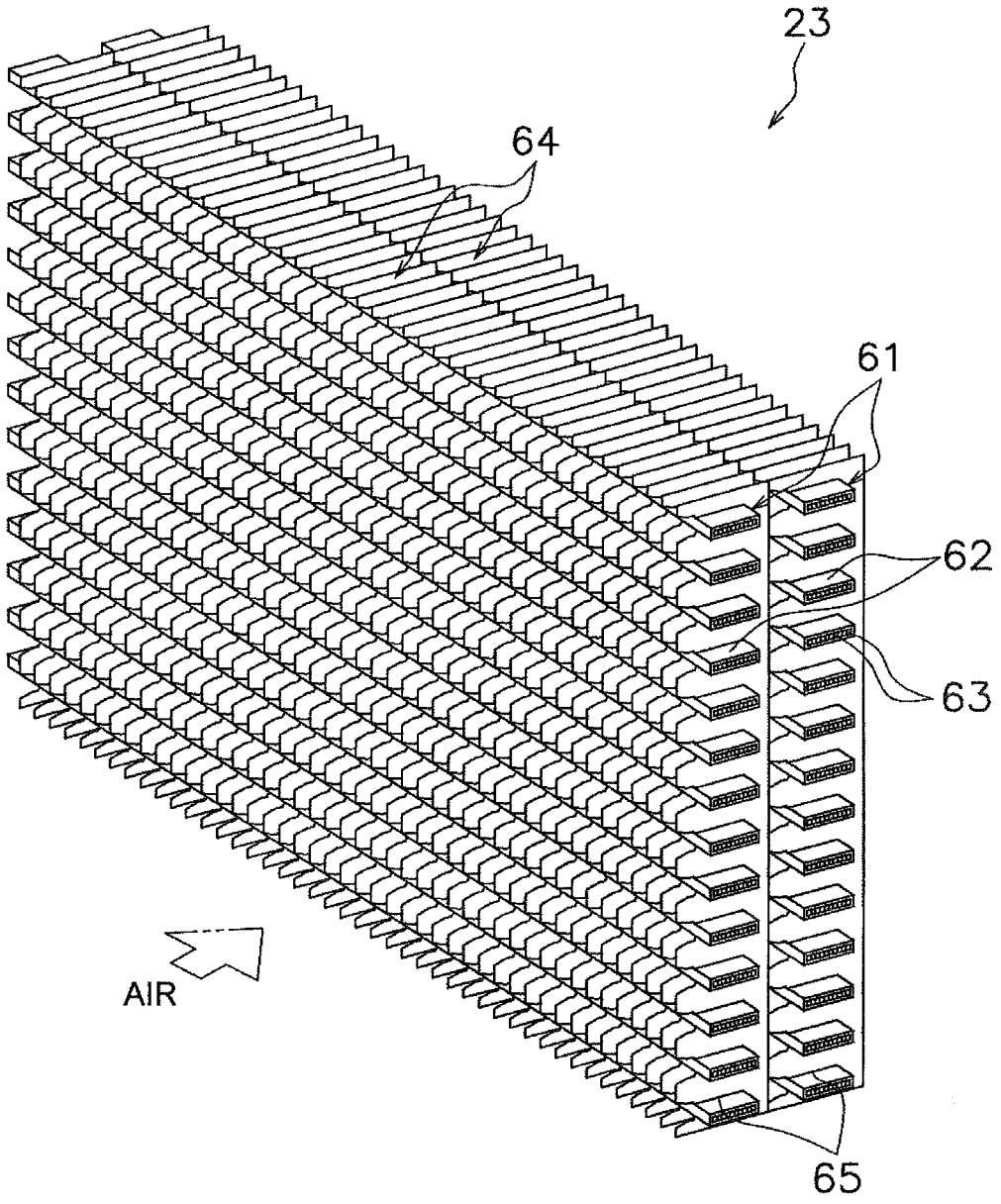


FIG. 6

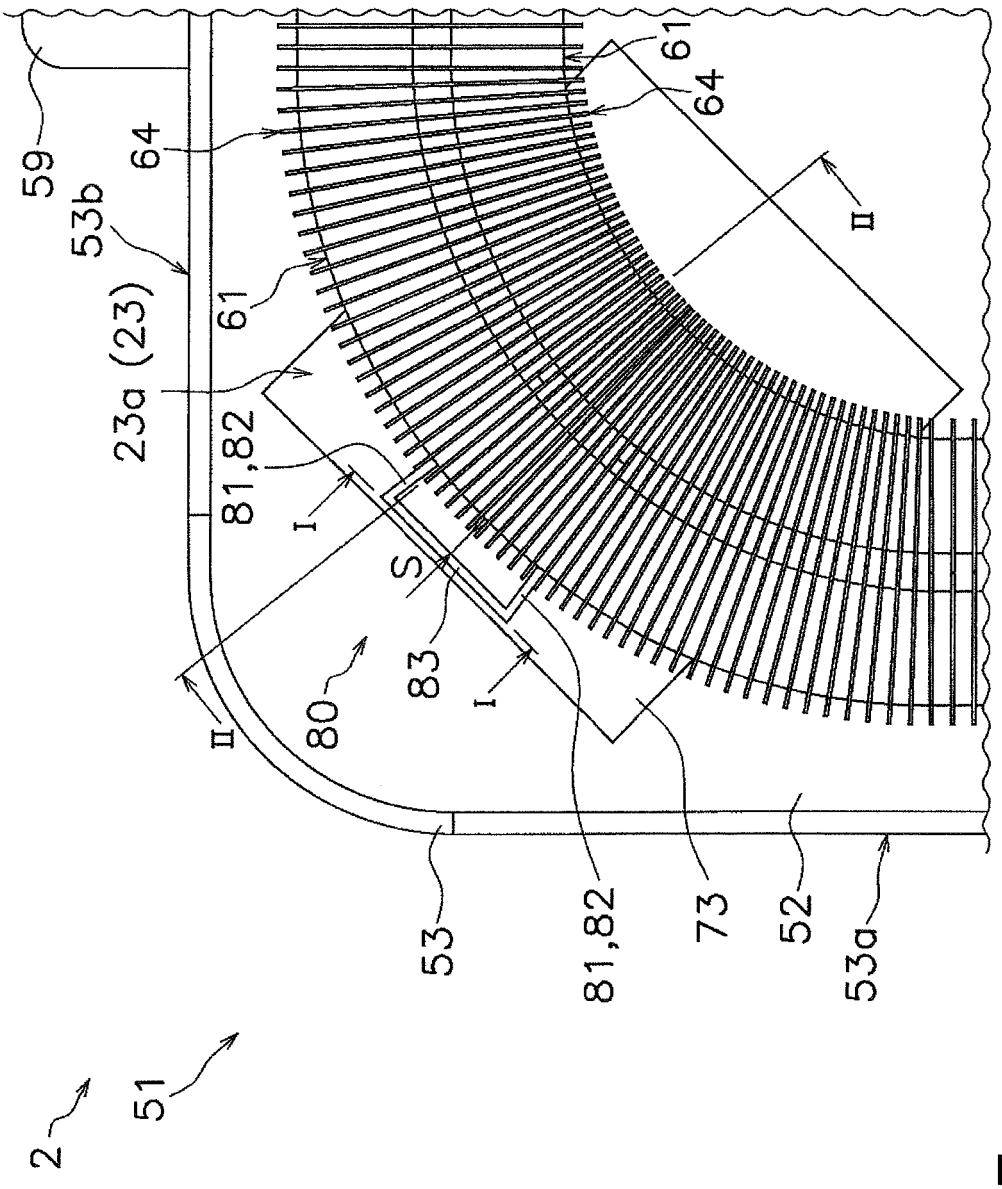
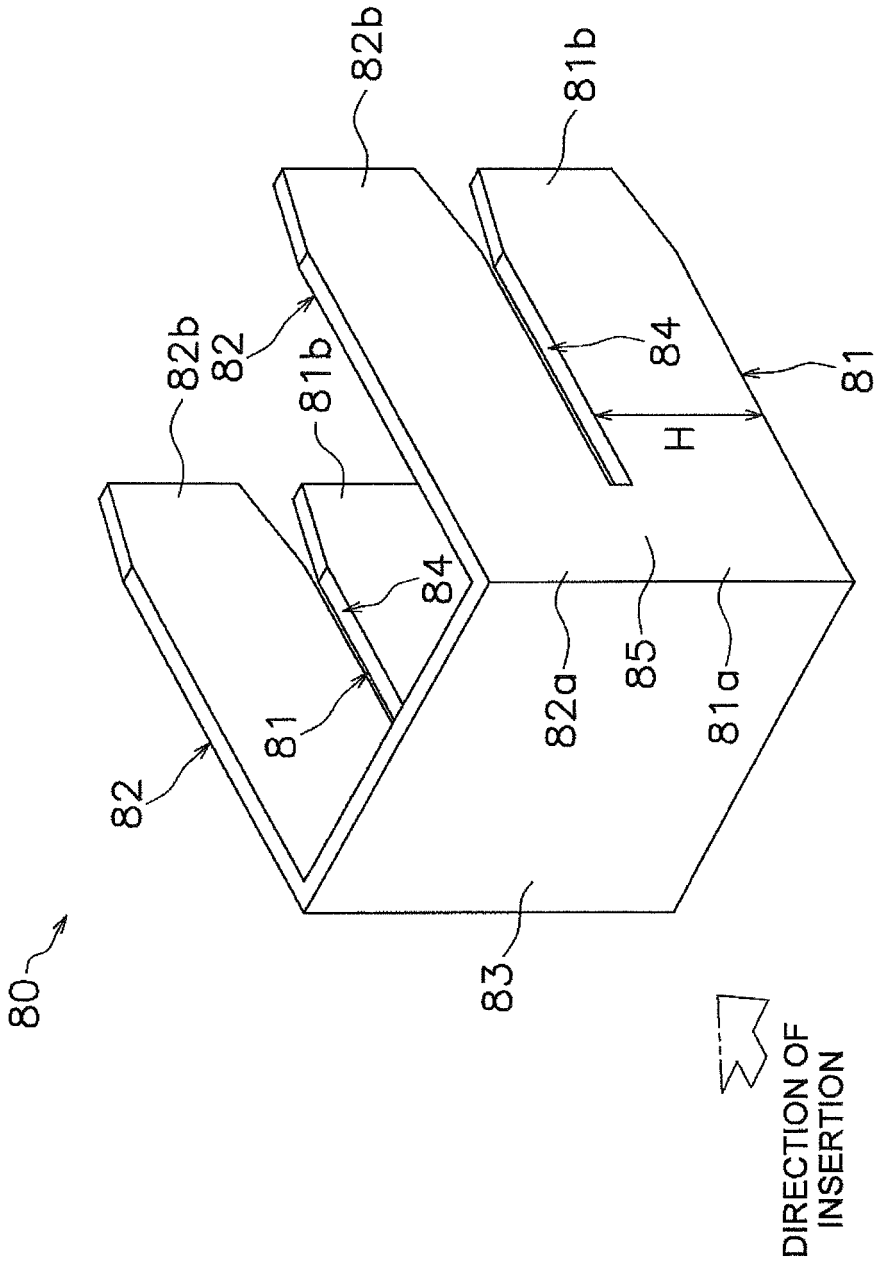


FIG. 7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82b
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81b
84
H
81
82b
81b
82a
85
81a
83
DIRECTION OF INSERTION

FIG. 8

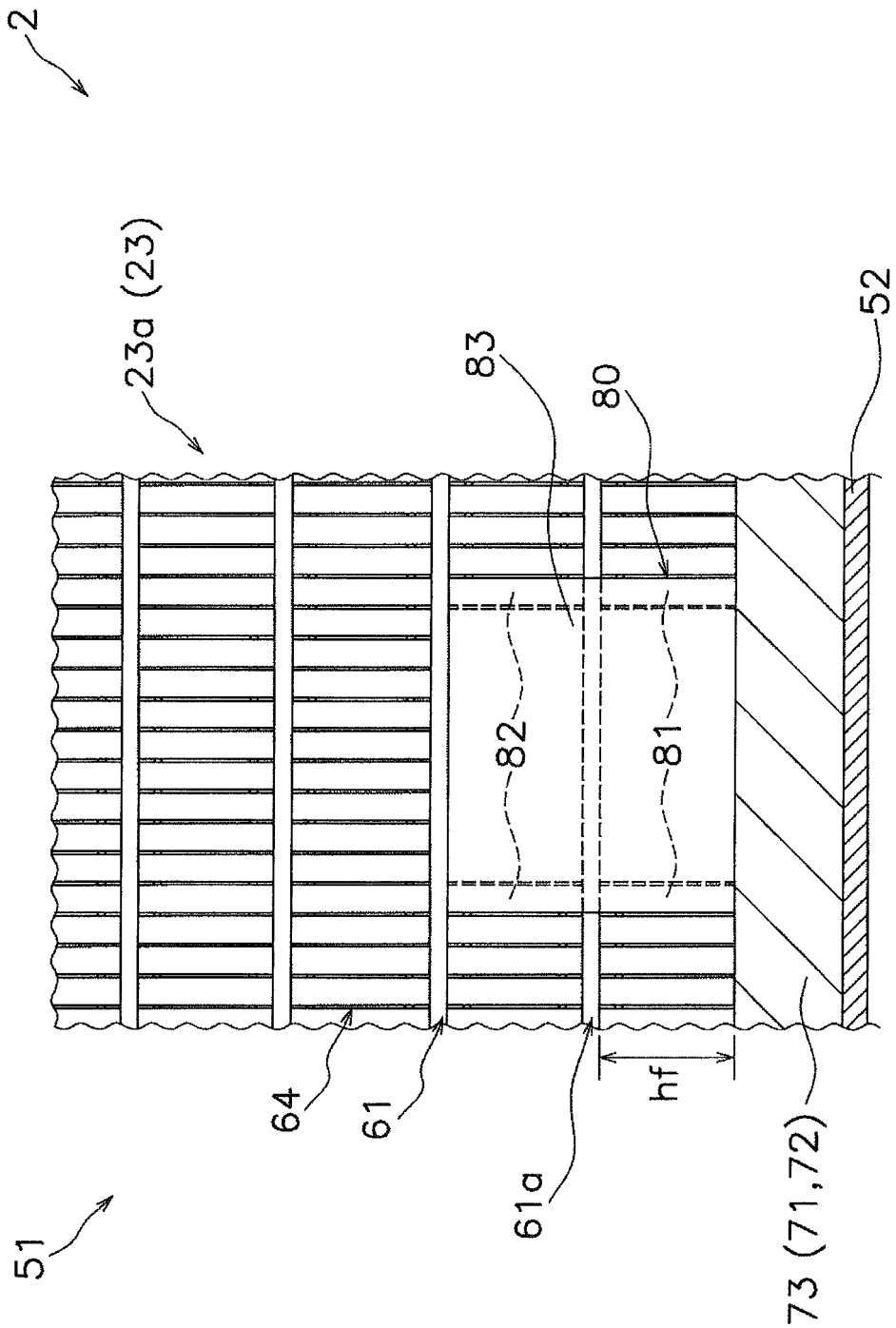
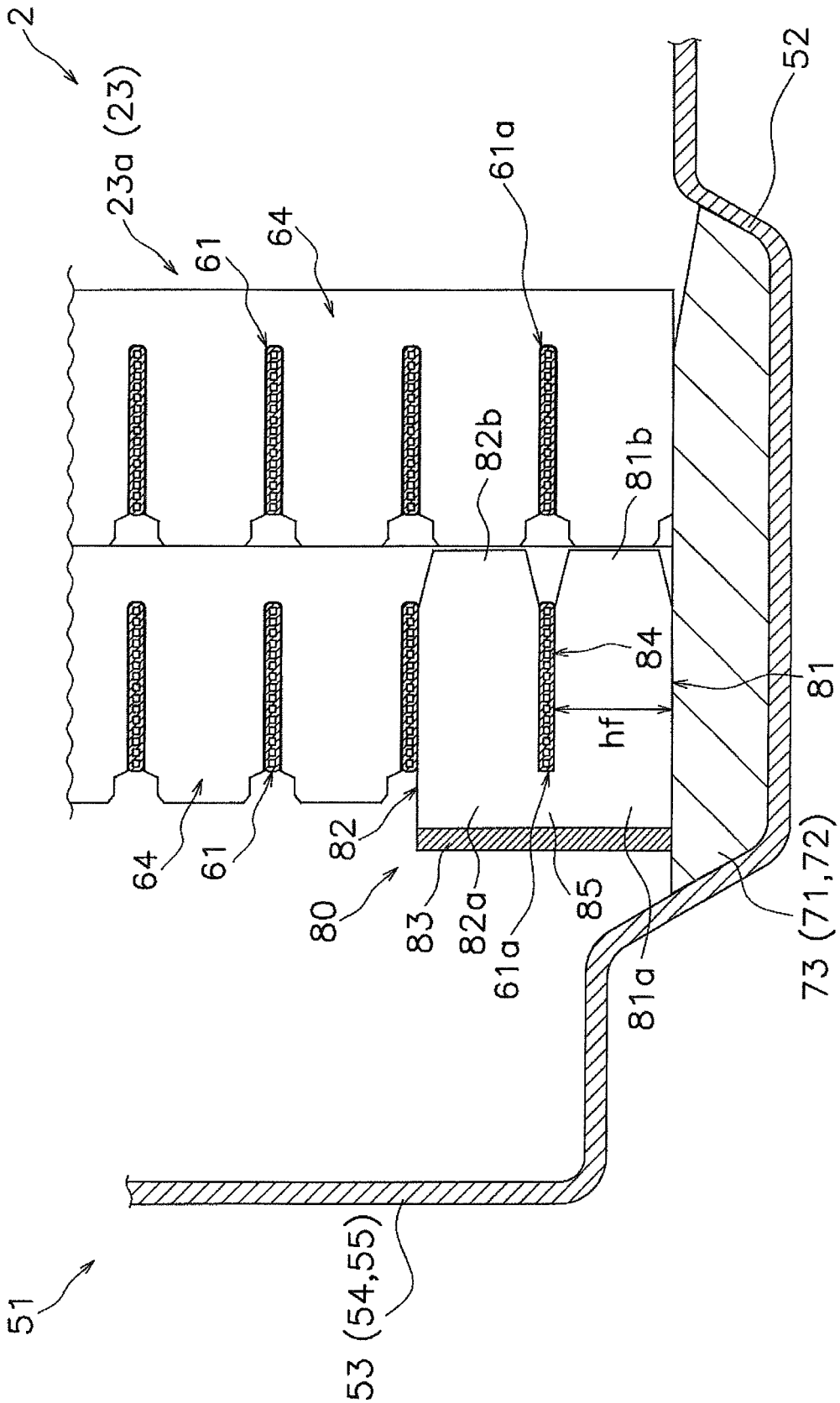


FIG. 9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23a (23)
61
64
61a
52
82b
81b
84
81
hf
64
61
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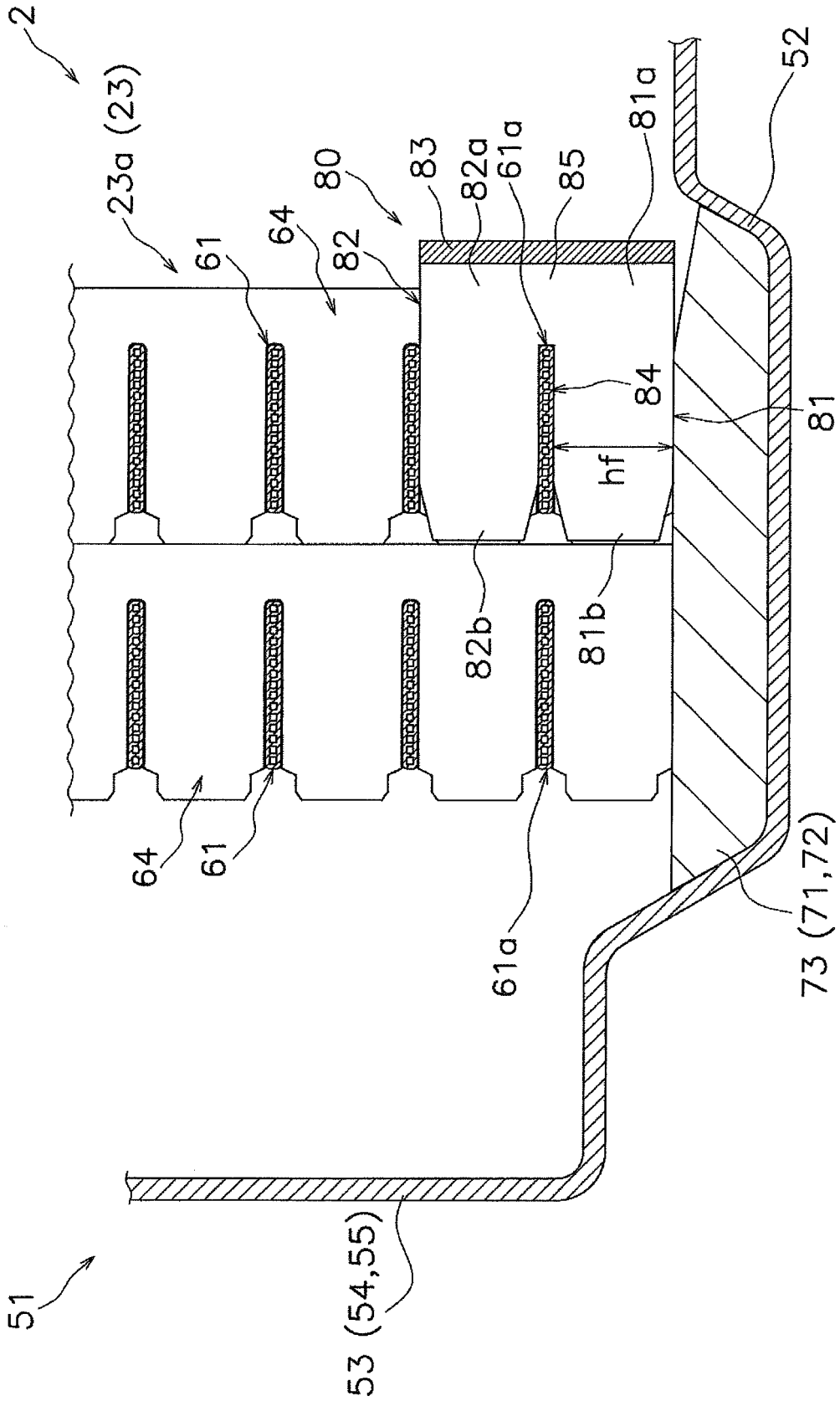
80
83
82a
61a
85
81a
73 (71,72)
51
53 (54,55)

FIG. 10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61a
73 (71,72)
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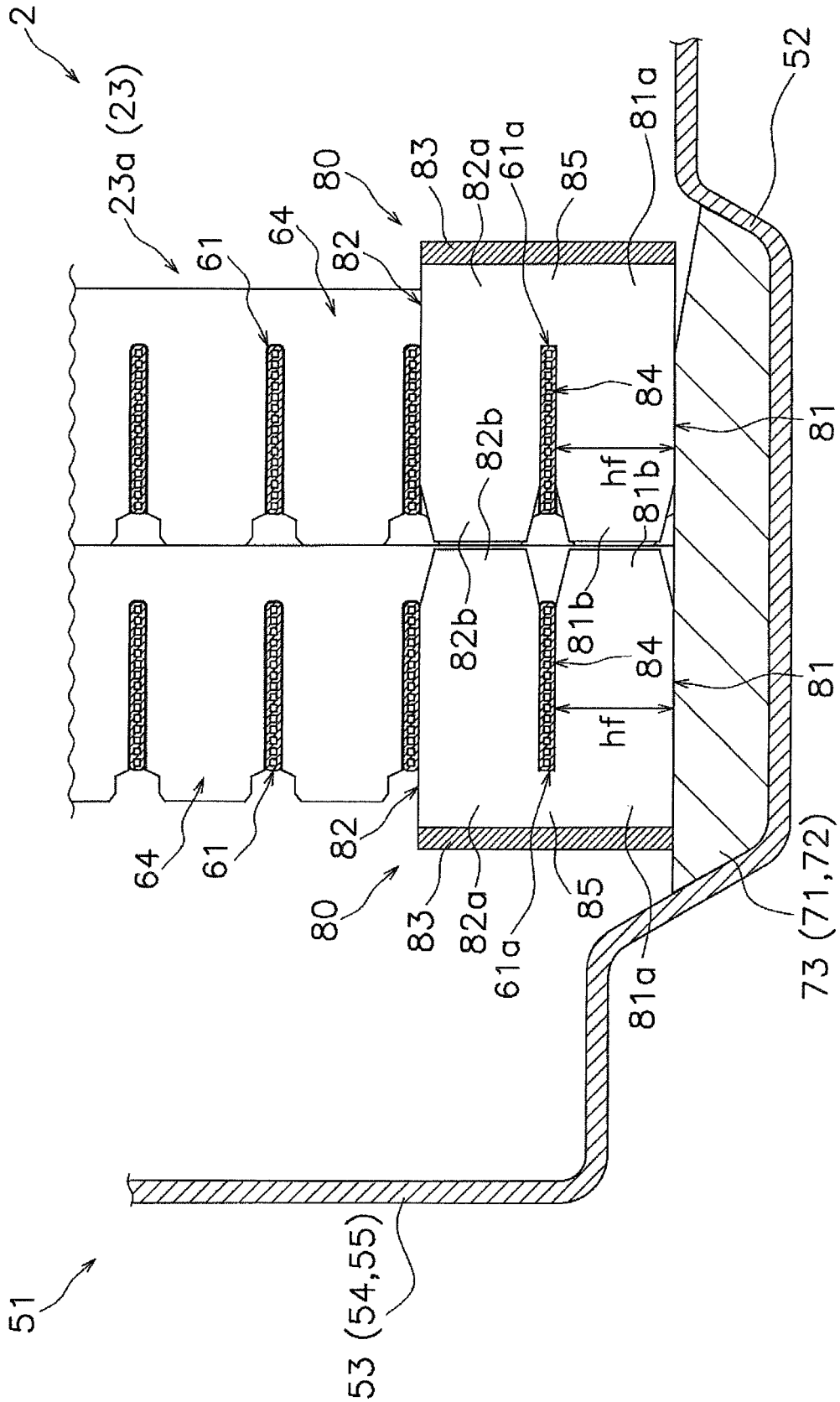
FIG. 11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61a
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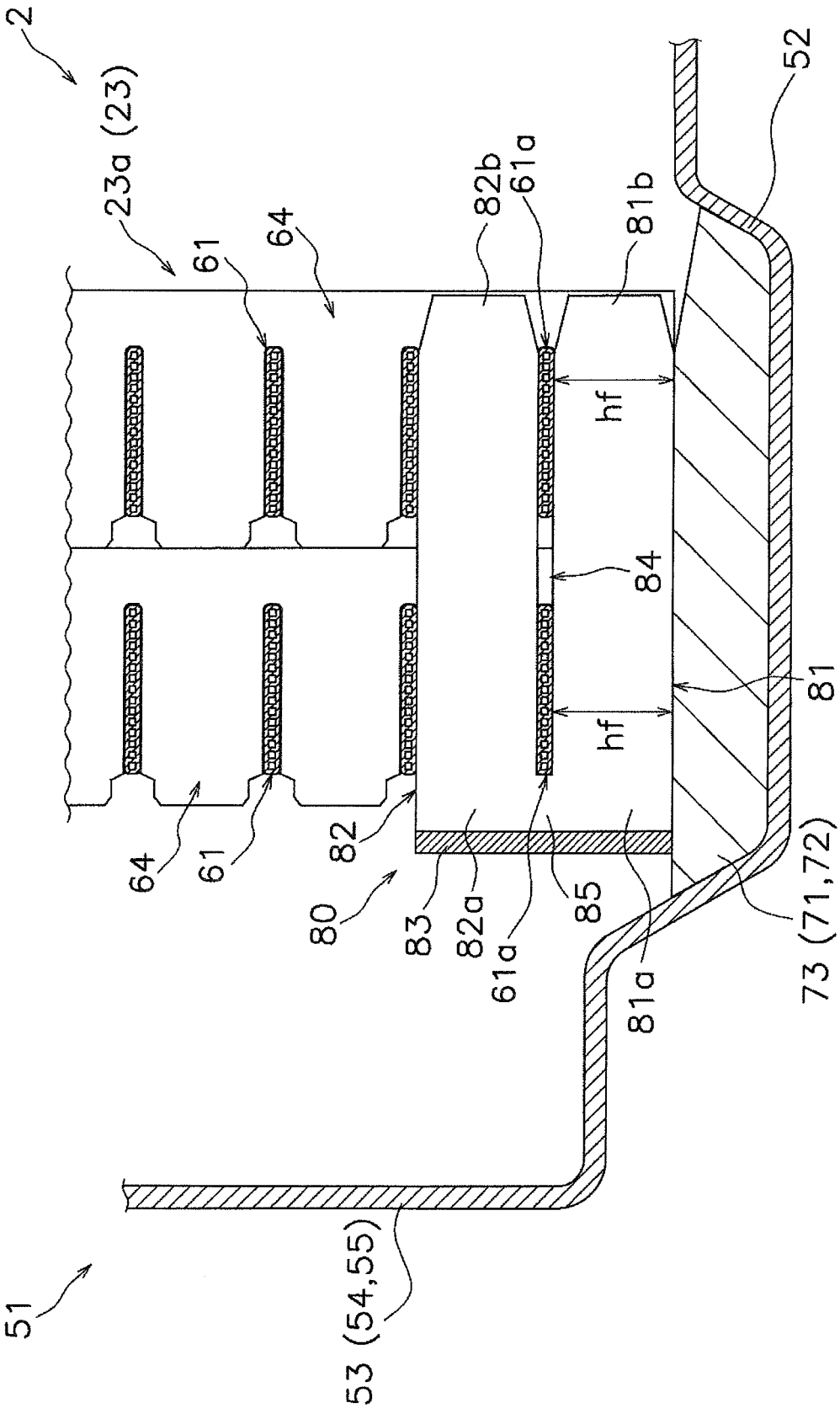
73 (71,72)
51
53 (54,55)

FIG. 12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81b
52
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61a
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73 (71,72)
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53 (54,55)

FIG. 13

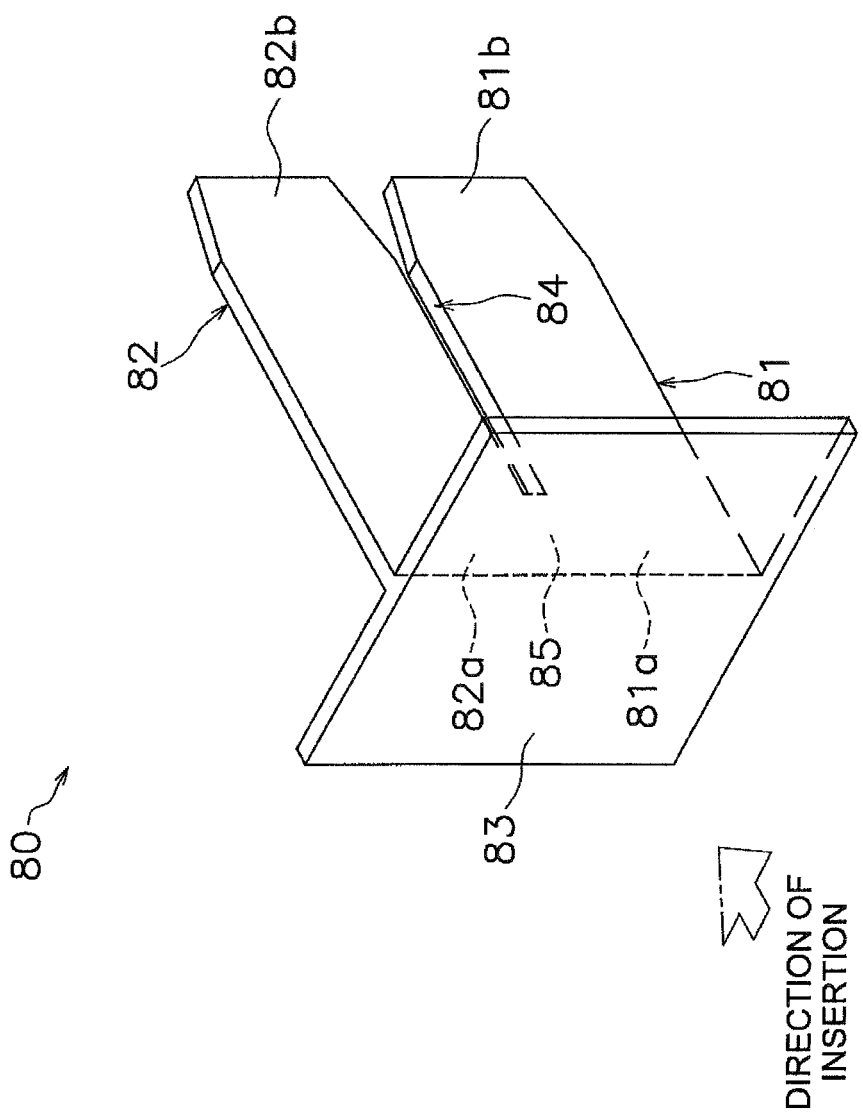
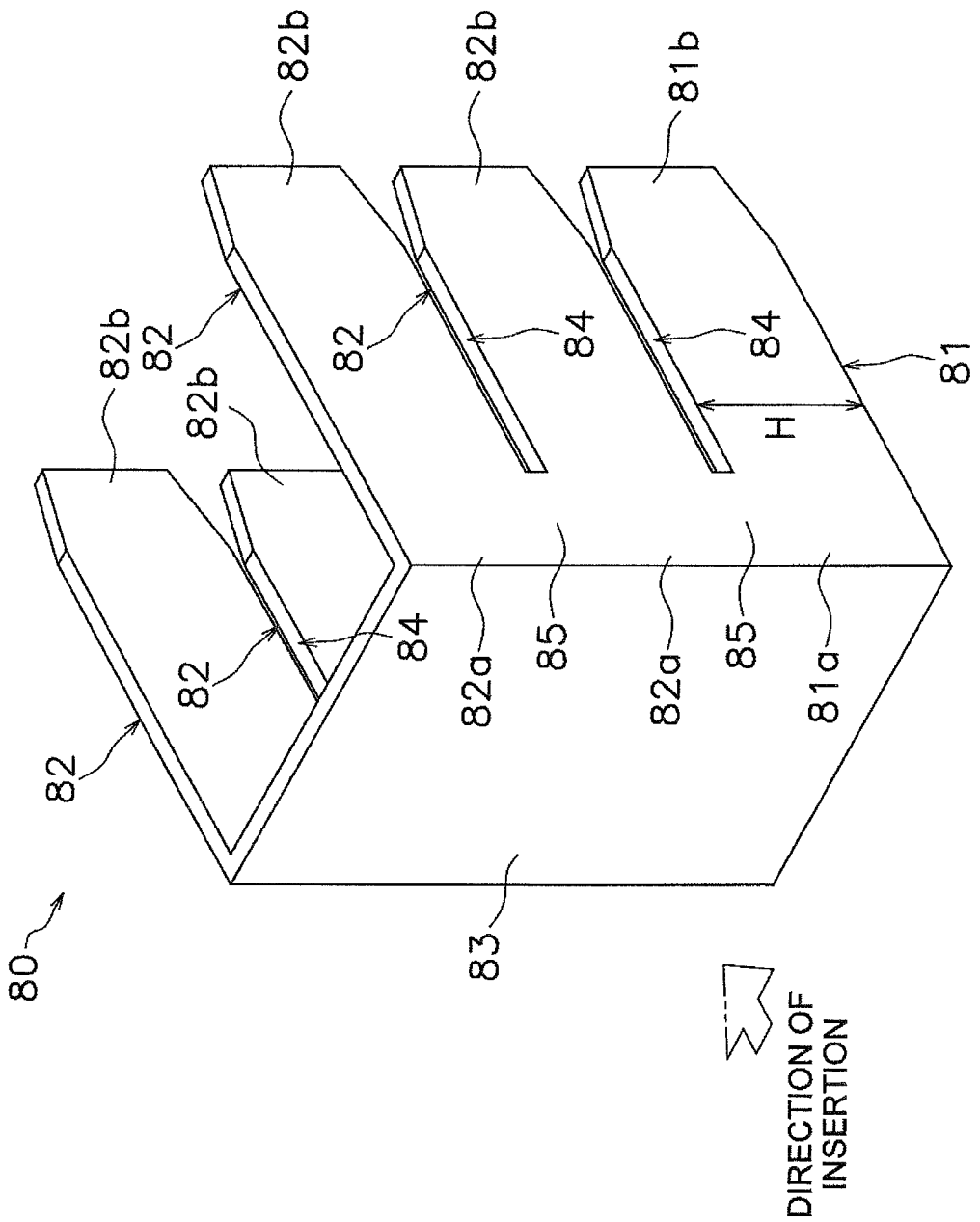


FIG. 14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DIRECTION OF INSERTION

FIG. 15

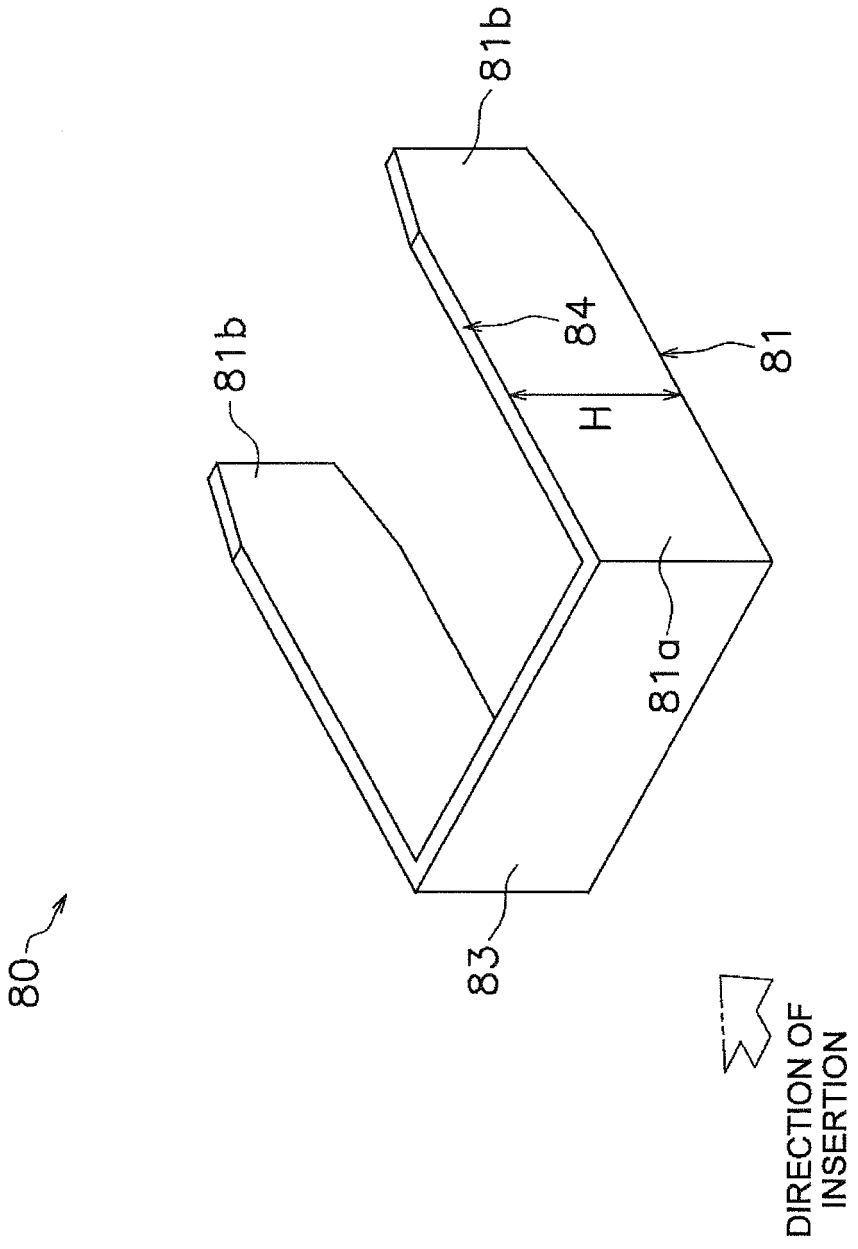

FIG. 16

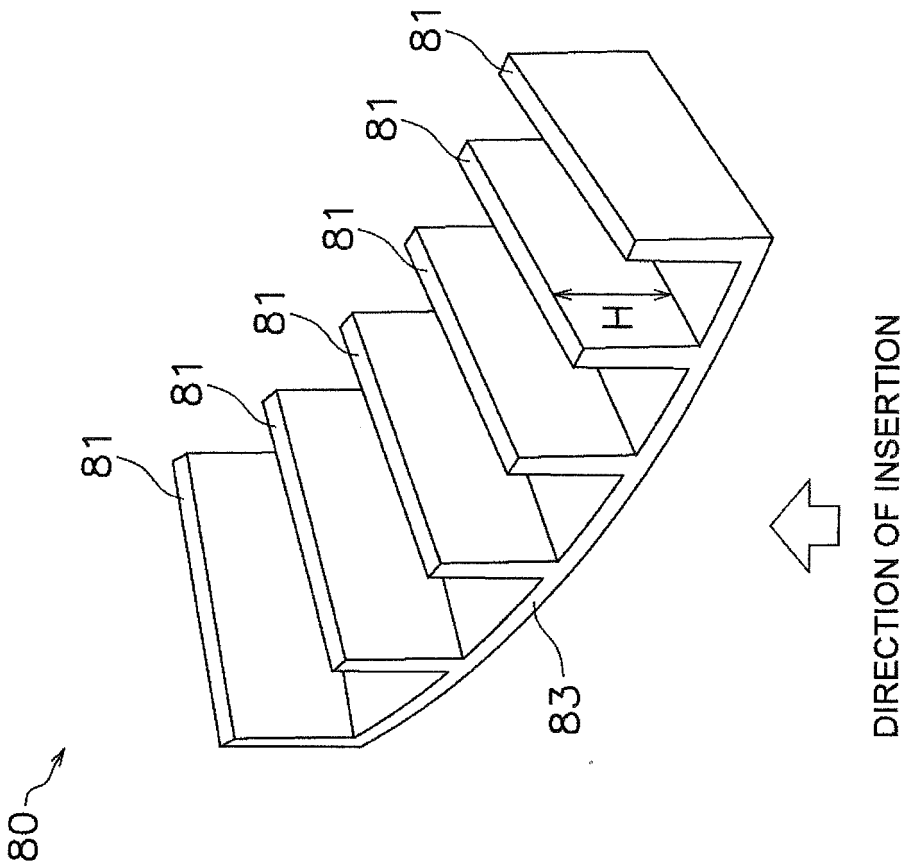

FIG. 17

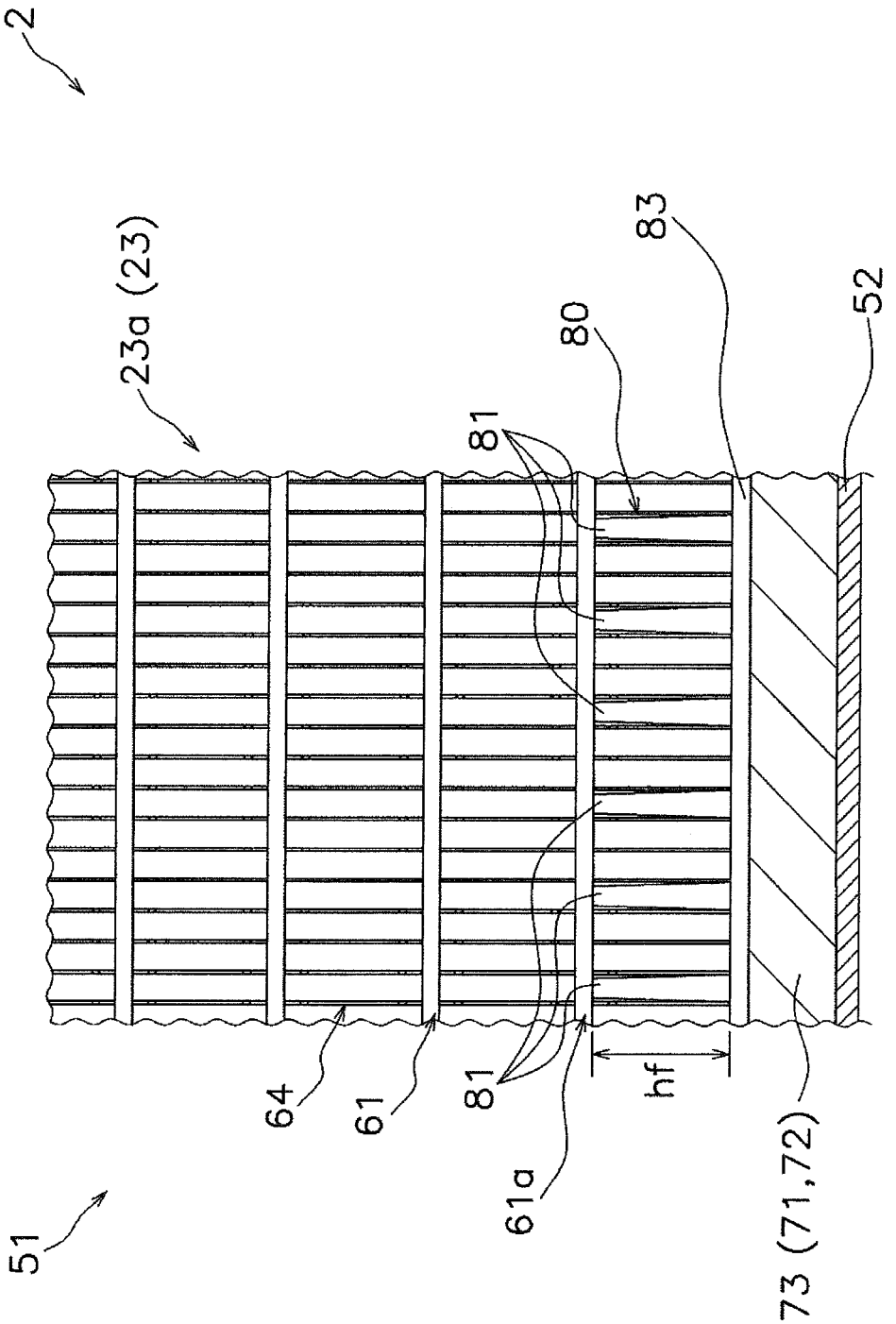

FIG. 18

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2016/050959

A. CLASSIFICATION OF SUBJECT MATTER
F24F1/14(2011.01)i, *F28D1/047*(2006.01)i, *F28F9/00*(2006.01)i

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

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
F24F1/14, F28D1/047, F28F9/00

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
Jitsuyo Shinan Koho 1922-1996 Jitsuyo Shinan Toroku Koho 1996-2016
Kokai Jitsuyo Shinan Koho 1971-2016 Toroku Jitsuyo Shinan Koho 1994-2016

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

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y A	JP 2013-139918 A (Daikin Industries, Ltd.), 18 July 2013 (18.07.2013), paragraphs [0001] to [0058]; fig. 1 to 9 & US 2014/0374078 A1 paragraphs [0001] to [0067]; fig. 1 to 9 & WO 2013/099897 A1 & EP 2806220 A1 & CN 103998869 A & KR 10-2014-0116432 A	1-4,6,10-19 5,7-9
Y A	JP 7-198165 A (Mitsubishi Heavy Industries, Ltd.), 01 August 1995 (01.08.1995), paragraphs [0011] to [0013]; fig. 1 (Family: none)	1-4,6,10-19 5,7-9

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

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"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
30 March 2016 (30.03.16)	12 April 2016 (12.04.16)
Name and mailing address of the ISA/ Japan Patent Office 3-4-3,Kasumigaseki,Chiyoda-ku, Tokyo 100-8915,Japan	Authorized officer Telephone No.

Form PCT/ISA/210 (second sheet) (January 2015)

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2016/050959

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y A	JP 2013-127341 A (Daikin Industries, Ltd.), 27 June 2013 (27.06.2013), paragraphs [0014] to [0044]; fig. 1 to 9 (Family: none)	1-4,6,10-19 5,7-9
Y A	JP 2013-113468 A (Mitsubishi Electric Corp.), 10 June 2013 (10.06.2013), paragraphs [0015] to [0020]; fig. 1 to 7 (Family: none)	1-4,6,10-19 5,7-9
A	JP 58-55662 A (Matsushita Electric Industrial Co., Ltd.), 02 April 1983 (02.04.1983), entire text; fig. 3 (Family: none)	1-19

Form PCT/ISA/210 (continuation of second sheet) (January 2015)

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- JP H9276940 B **[0002] [0119]**