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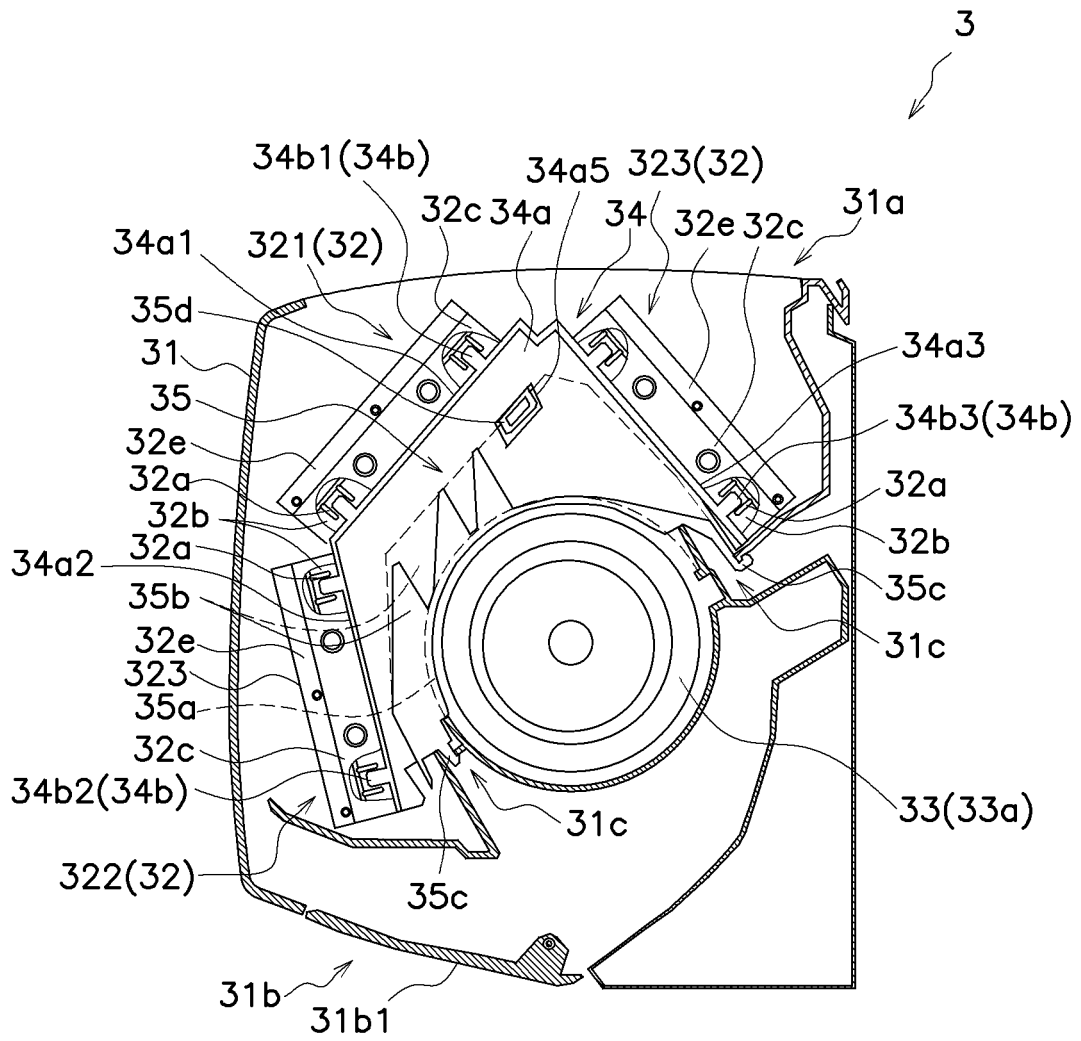
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(54) **HEAT EXCHANGE UNIT**

(57) To provide a heat exchange unit capable of suppressing an increase in manufacturing cost by preventing damage to a flat tube caused by sliding against other members. A utilization unit (3) includes a utilization heat exchanger (32) and a first member (34). In the utilization heat exchanger (32), a plurality of flat tubes (32a) are stacked at predetermined intervals in a thickness direc-

tion by a heat transfer fin (32b). The first member (34) is attached to the utilization heat exchanger (32). The first member (34) includes a body (34a) and a protrusion portion (34b) protruding from the body (34a). The protrusion portion (34b) is inserted between flat tubes (32a) adjacent to each other.

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A - A'

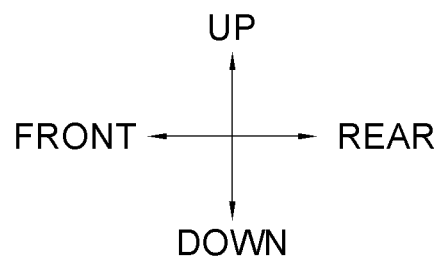


FIG. 4

Description

TECHNICAL FIELD

[0001] The present disclosure relates to a heat exchange unit.

BACKGROUND ART

[0002] There is known a heat exchange unit including a heat exchanger having a plurality of heat transfer tubes arranged substantially in parallel at predetermined intervals in a vertical direction and a plurality of heat transfer fins joined to the heat transfer tubes.

[0003] PTL 1 (International Publication No. 2018/128035) discloses a heat exchange unit (outdoor heat exchanger) including a heat exchanger in which thin and flattened flat tubes are used as heat transfer tubes and brackets that are members that restrict the movement of the heat exchanger while supporting the heat exchanger. In the heat exchange unit according to PTL 1, the bracket is a plate-shaped member in which tube holes into which the heat transfer tubes are inserted are formed. The heat transfer tube inserted into the tube hole is fixed to a housing by being joined to the bracket by brazing.

SUMMARY OF THE INVENTION

<Technical Problem>

[0004] In some cases, corrosion caused by aging may prevent the bracket and the heat transfer tube from being joined to each other in a portion joined using brazing. In such a case, the heat transfer tube slides against the tube hole formed in the bracket due to vibration or the like accompanying the operation of the heat exchange unit. In a case where a flat tube formed to have a relatively thin wall thickness is used as a heat transfer tube, as in the heat exchange unit according to PTL 1, there is a risk of the flat tube being damaged from a portion sliding against the tube hole. Therefore, there is a problem that options for materials that can be used for the flat tube are limited and a manufacturing cost is likely to increase.

[0005] The present disclosure proposes a heat exchange unit capable of suppressing an increase in manufacturing cost by preventing damage to a flat tube caused by sliding against other members.

<Solution to Problem>

[0006] A heat exchange unit according to a first aspect includes a heat exchanger and a first member. In the heat exchanger, a plurality of flat tubes are stacked at predetermined intervals in a thickness direction by a heat transfer fin. The first member is attached to the heat exchanger. The first member includes a body and a protrusion portion protruding from the body, and the protrusion

portion is inserted between flat tubes adjacent to each other.

[0007] According to the heat exchange unit, the contact area between the flat tube and the member (first member) that comes in contact with the flat tube to restrict the movement can be significantly reduced as compared with the case where the heat transfer tube is inserted into the tube hole formed in the bracket to restrict the movement of the heat exchanger. Therefore, even if the first member and the flat tube slide against each other due to vibration or the like caused by the operation of the utilization unit, damage to the flat tube caused by this sliding is prevented. As a result, options for materials that can be used for the flat tube increase, thereby reducing the manufacturing cost of the heat exchange unit.

[0008] A heat exchange unit according to a second aspect is the heat exchange unit according to the first aspect, in which the first member includes a plurality of protrusion portions.

[0009] According to the heat exchange unit, the first member including the plurality of protrusion portions effectively restricts the movement of the heat exchanger.

[0010] A heat exchange unit according to a third aspect is the heat exchange unit according to the first or second aspect, in which the heat exchanger includes a plurality of first heat exchange sections. The first member includes a plurality of protrusion portions for each of the plurality of first heat exchange sections.

[0011] According to the heat exchange unit, the first member including the plurality of protrusion portions effectively restricts the movement of the heat exchanger.

[0012] A heat exchange unit according to a fourth aspect is the heat exchange unit according to any one of the first to third aspects, in which the protrusion portion has a columnar shape.

[0013] According to the heat exchange unit, the protrusion portion can be easily inserted between flat tubes adjacent to each other. Therefore, the manufacturing of the heat exchange unit is facilitated, thereby reducing the manufacturing cost of the heat exchange unit.

[0014] A heat exchange unit according to a fifth aspect is the heat exchange unit according to any one of the first to third aspects, in which the protrusion portion includes a pawl portion that engages with a flat tube.

[0015] According to the heat exchange unit, the first member can effectively restrict the movement of the heat exchanger.

[0016] A heat exchange unit according to a sixth aspect is the heat exchange unit according to any one of the first to fifth aspects, in which the first member is manufactured using resin.

[0017] According to the heat exchange unit, the hardness of the protrusion portion can be reduced as compared with a case where the first member is manufactured using metal. Therefore, even if the first member and the flat tube slide against each other, damage to the flat tube caused by this sliding is prevented. As a result, options for materials that can be used for the flat tube

increase, thereby reducing the manufacturing cost of the heat exchange unit.

[0018] A heat exchange unit according to a seventh aspect is the heat exchange unit according to any one of the first to fifth aspects, in which the first member is manufactured using metal, and a resin coating is applied to a surface of the first member.

[0019] According to the heat exchange unit, the resin coating reduces the hardness of the surface of the first member to a low level. As a result, it is possible to ensure high rigidity of the first member while effectively preventing damage to the flat tube caused by sliding.

[0020] A heat exchange unit according to an eighth aspect is the heat exchange unit according to any one of the first to fifth aspects, in which the first member is manufactured using metal, and an insulating rubber is attached to a surface of the first member.

[0021] According to the heat exchange unit, the insulating rubber reduces the hardness of the surface of the first member to a low level. As a result, it is possible to ensure high rigidity of the first member while effectively preventing damage to the flat tube caused by sliding.

[0022] A heat exchange unit according to a ninth aspect is the heat exchange unit according to any one of the first to eighth aspects, and further includes a casing and a second member fixed to the casing. The first member is fixed to the second member by screw fastening or engagement.

[0023] A heat exchange unit according to a tenth aspect is the heat exchange unit according to any one of the first to ninth aspects, in which the body of the first member is in contact with the heat transfer fin.

[0024] According to the heat exchange unit, the first member can receive the weight of the heat exchanger by the contact between the body and the heat transfer fin. Thus, the weight of the heat exchanger received by the protrusion portion becomes substantially zero or is significantly reduced. Therefore, even if the first member and the flat tube slide against each other, damage to the flat tube caused by this sliding is prevented. As a result, options for the flat tube that can be used increase, thereby reducing the manufacturing cost of the heat exchange unit.

[0025] A heat exchange unit according to an eleventh aspect is the heat exchange unit according to any one of the first to ninth aspects, in which the heat exchanger further includes a header that connects end portions of the plurality of flat tubes to each other. The body of the first member is in contact with the header.

[0026] According to the heat exchange unit, the first member can receive the weight of the heat exchanger through the body as well as the protrusion portion, thereby reducing the weight of the heat exchanger received by the protrusion portion. Therefore, even if the first member and the flat tube slide against each other, damage to the flat tube caused by this sliding is prevented. As a result, options for the flat tube that can be used increase, thereby reducing the manufacturing cost of the heat ex-

change unit.

[0027] A heat exchange unit according to a twelfth aspect is the heat exchange unit according to any one of the first to eleventh aspects, in which the heat exchanger includes a second heat exchange section in which the thickness direction of the flat tubes is inclined with respect to a vertical direction. The first member is attached to the heat exchanger vertically below the second heat exchange section.

[0028] According to the heat exchange unit, the first member can restrict the movement of the second heat exchange section while supporting the second heat exchange section.

BRIEF DESCRIPTION OF THE DRAWINGS

[0029]

Fig. 1 is a diagram illustrating an overall configuration of an air-conditioning apparatus 1.

Fig. 2 is a conceptual diagram of the air-conditioning apparatus 1.

Fig. 3 is a front view of a utilization unit 3.

Fig. 4 is a cross-sectional view of the utilization unit 3 taken along line A-A' in Fig. 3.

Fig. 5 is a perspective view of a first utilization heat exchange section 321.

Fig. 6 is an enlarged cross-sectional view of the first utilization heat exchange section 321 taken along plane B in Fig. 5.

Fig. 7 is a view of the first utilization heat exchange section 321 as viewed in a thickness direction of a flat tube 32a.

Fig. 8 is a perspective view of a first member 34.

Fig. 9 is a perspective view of a second member 35.

Fig. 10 is an exploded perspective view illustrating how the first member 34 and the second member 35 are assembled to a second casing 31.

Fig. 11 is an enlarged cross-sectional view of a periphery of a utilization heat exchanger 32 of the air-conditioning apparatus 1 according to a modification A.

DESCRIPTION OF EMBODIMENTS

(1) Overall configuration

[0030] The application of a heat exchange unit according to the present disclosure is not limited. For example, the heat exchange unit is used in a utilization unit of an air-conditioning apparatus that utilizes a vapor compression refrigeration cycle. In the following description, an air-conditioning apparatus 1 in which a utilization unit 3, which is an example of a heat exchange unit of the present disclosure, is used will be described with reference to the drawings.

[0031] The air-conditioning apparatus 1 performs air conditioning of the inside of a room RM (indoors), which

is a target space, by a vapor compression refrigeration cycle. The air-conditioning apparatus 1 mainly includes a heat source unit 2, the utilization unit 3, a liquid-refrigerant connection pipe 5, a gas-refrigerant connection pipe 6, a remote controller 8, and a control unit 9.

[0032] The liquid-refrigerant connection pipe 5 and the gas-refrigerant connection pipe 6 connect the heat source unit 2 and the utilization unit 3 to each other. The heat source unit 2, the utilization unit 3, the liquid-refrigerant connection pipe 5, and the gas-refrigerant connection pipe 6 are annularly connected by a refrigerant pipe, and form a refrigerant circuit 100. The refrigerant circuit 100 is filled with a refrigerant. Although details will be described later, the control unit 9 controls each device of the air-conditioning apparatus 1 to perform air conditioning operations such as a heating operation and a cooling operation.

[0033] Fig. 1 is a diagram illustrating an overall configuration of the air-conditioning apparatus 1. Fig. 2 is a conceptual diagram of the air-conditioning apparatus 1. Respective directions such as up, down, front, rear, left, and right used in the following description follow the directions indicated by arrows in Figs. 1, 3, and 4.

(2) Detailed configuration

(2-1) Heat source unit

[0034] The heat source unit 2 is installed outside the room RM (outdoors, for example, on a roof of a building, near an outer wall surface of a building, or the like). The heat source unit 2 mainly includes a first casing 21, a compressor 22, a four-way switching valve 23, a heat source heat exchanger 24, a heat source expansion valve 25, a heat source fan 26, and a shutoff valve 27.

(2-1-1) First casing

[0035] The first casing 21 is a housing having a substantially rectangular parallelepiped shape. The first casing 21 accommodates the compressor 22, the four-way switching valve 23, the heat source heat exchanger 24, the heat source expansion valve 25, and the heat source fan 26 therein.

(2-1-2) Compressor

[0036] In the refrigerant circuit 100, the compressor 22 sucks a low-pressure refrigerant from a suction side 22a, compresses the refrigerant to a high pressure, and thereafter, discharges the refrigerant from a discharge side 22b. The compressor 22 includes a compression element (not illustrated) and a compressor motor (not illustrated) that rotationally drives the compression element. The control unit 9 controls the rotation speed of the compressor motor via an inverter or the like. The control unit 9 controls the capacity of the compressor 22 by changing the rotation speed of the compressor motor.

(2-1-3) Four-way switching valve

[0037] The four-way switching valve 23 switches a flow direction of the refrigerant in the refrigerant circuit 100.

5 The four-way switching valve 23 includes a first port P1, a second port P2, a third port P3, and a fourth port P4. The control unit 9 switches the four-way switching valve 23 between a first state (a state indicated by broken lines in Fig. 2) and a second state (a state indicated by solid lines in Fig. 2). In the first state, the first port P1 and the fourth port P4 communicate with each other, and the second port P2 and the third port P3 communicate with each other. In the second state, the first port P1 and the second port P2 communicate with each other and the third port P3 and the fourth port P4 communicate with each other.

10 **[0038]** The first port P1 is connected to the discharge side 22b of the compressor 22. The second port P2 is connected to a gas side of the heat source heat exchanger 24. The third port P3 is connected to the suction side 22a of the compressor 22. The fourth port P4 is connected to the gas-refrigerant connection pipe 6.

(2-1-4) Heat source heat exchanger

25 **[0039]** The heat source heat exchanger 24 is a heat exchanger that exchanges heat between the refrigerant and outdoor air. One end of the heat source heat exchanger 24 is connected to the heat source expansion valve 25. The other end of the heat source heat exchanger 24 is connected to the second port P2 of the four-way switching valve 23.

(2-1-5) Heat source expansion valve

30 **[0040]** The heat source expansion valve 25 is an expansion mechanism that decompresses the refrigerant in the refrigerant circuit 100. The heat source expansion valve 25 is provided between the liquid-refrigerant connection pipe 5 and a liquid side of the heat source heat exchanger 24. The heat source expansion valve 25 is an electric expansion valve whose opening degree is controllable. The control unit 9 controls the opening degree of the heat source expansion valve 25.

(2-1-6) Heat source fan

35 **[0041]** The heat source fan 26 generates an air flow and sends the outdoor air to the heat source heat exchanger 24. The heat source fan 26 facilitates heat exchange between the refrigerant in the heat source heat exchanger 24 and the outdoor air by sending the outdoor air to the heat source heat exchanger 24. The heat source fan 26 is rotationally driven by a heat source fan motor 26a. The control unit 9 controls the air volume of the heat source fan 26 by changing the rotation speed of the heat source fan motor 26a.

(2-1-7) Shutoff valve

[0042] The shutoff valve 27 is a valve that is manually opened or closed. For example, the shutoff valve 27 is opened or closed by an installation worker at the time of installation or the like of the air-conditioning apparatus 1. The shutoff valve 27 includes a liquid-side shutoff valve 27a and a gas-side shutoff valve 27b. The liquid-side shutoff valve 27a is provided in the refrigerant circuit 100 between the heat source expansion valve 25 and the liquid-refrigerant connection pipe 5. The gas-side shutoff valve 27b is provided in the refrigerant circuit 100 between the fourth port P4 of the four-way switching valve 23 and the gas-refrigerant connection pipe 6.

(2-2) Utilization unit

[0043] The utilization unit 3 is a wall-hung type indoor air conditioner that is hung and mounted on a wall WL in the room RM. The utilization unit 3 mainly includes a second casing 31, three utilization heat exchangers 32, a utilization fan 33, two first members 34, and two second members 35.

[0044] Fig. 3 is a front view of the utilization unit 3. Fig. 4 is a cross-sectional view of the utilization unit 3 taken along line A-A' in Fig. 3. Fig. 3 illustrates the inside of the second casing 31 through a portion of the second casing 31 for convenience. Fig. 4 illustrates protrusion portions 34b (described later) of the first member 34 in a transparent manner for convenience.

(2-2-1) Second casing

[0045] The second casing 31 is a housing having a substantially rectangular parallelepiped shape elongated in a left-right direction. The second casing 31 accommodates the utilization heat exchangers 32, the utilization fan 33, the first members 34, and the second members 35 therein. The second casing 31 has an inlet 31a, an outlet 31b, and openings 31c.

[0046] The second casing 31 is an example of a casing.

[0047] The inlet 31a is an opening through which indoor air flows into the second casing 31. The inlet 31a is formed in an upper portion of a front surface of the second casing 31.

[0048] The outlet 31b is an opening through which the air heat-exchanged with the refrigerant in the utilization heat exchangers 32 is blown out. The outlet 31b is formed in a lower portion of the front surface of the second casing 31. The outlet 31b is closed by a flap 31b1. The control unit 9 controls the posture (rotational angle) of the flap 31b1. The control unit 9 adjusts the opening degree of the outlet 31b by controlling the posture of the flap 31b1.

[0049] The opening 31c is an opening for engaging a first fixing portion 35c (described later) of the second member 35. Although details will be described later, in the present embodiment, the second member 35 is provided in the vicinity of each end of the utilization heat

exchangers 32 in the left-right direction. Furthermore, each second member 35 includes two first fixing portions 35c. Therefore, two openings 31c are also formed in the vicinity of each end of the utilization heat exchangers 32 in the left-right direction.

(2-2-2) Utilization fan

[0050] The utilization fan 33 generates an air flow. The utilization fan 33 makes the indoor air pass through the utilization heat exchangers 32 by generating the air flow. The indoor air passing through the utilization heat exchangers 32 facilitates the heat exchange between the refrigerant in the utilization heat exchangers 32 and the outdoor air. The utilization fan 33 is a cross-flow fan in which a rotation shaft is disposed in the left-right direction.

[0051] The utilization fan 33 is rotationally driven by a utilization fan motor 33a. The control unit 9 controls the air volume of the utilization fan 33 by changing the rotation speed of the utilization fan motor 33a.

(2-2-3) Utilization heat exchanger

[0052] The utilization heat exchanger 32 exchanges heat between the refrigerant and the indoor air in the refrigerant circuit 100. One end of the utilization heat exchanger 32 is connected to the liquid-refrigerant connection pipe 5. The other end of the utilization heat exchanger 32 is connected to the gas-refrigerant connection pipe 6.

[0053] The utilization heat exchanger 32 is an example of a heat exchanger.

[0054] In the present embodiment, the utilization heat exchanger 32 is constituted of three utilization heat exchange sections including a first utilization heat exchange section 321, a second utilization heat exchange section 322, and a third utilization heat exchange section 323. The difference between the first utilization heat exchange section 321, the second utilization heat exchange section 322, and the third utilization heat exchange section 323 is the arrangement inside the second casing 31. The first utilization heat exchange section 321, the second utilization heat exchange section 322, and the third utilization heat exchange section 323 have an identical structure. Therefore, in the following description, the structure of the first utilization heat exchange section 321 will be described as an example, and descriptions of the structures of the second utilization heat exchange section 322 and the third utilization heat exchange section 323 will be omitted. Note that the arrangement of the first utilization heat exchange section 321, the second utilization heat exchange section 322, and the third utilization heat exchange section 323 inside the second casing 31 will be described later.

[0055] Note that, in a case where the first utilization heat exchange section 321, the second utilization heat exchange section 322, and the third utilization heat exchange section 323 are collectively referred to, the first utilization heat exchange section 321, the second utili-

zation heat exchange section 322, and the third utilization heat exchange section 323 are referred to as utilization heat exchange sections 321, 322, and 323.

[0056] The utilization heat exchange sections 321, 322, and 323 are examples of a first heat exchange section. The first utilization heat exchange section 321 and the third utilization heat exchange section 323 are examples of a second heat exchange section.

[0057] Fig. 5 is a perspective view of the first utilization heat exchange section 321. Fig. 6 is an enlarged cross-sectional view of the first utilization heat exchange section 321 taken along plane B in Fig. 5. Fig. 7 is a view of the first utilization heat exchange section 321 as viewed in a thickness direction of a flat tube 32a. Fig. 7 also illustrates portions of the first members 34 for convenience. Respective directions such as the thickness direction, a width direction, and a longitudinal direction of the flat tube 32a used in the following description follow the directions indicated by arrows in Figs. 5, 6, and 7.

[0058] The first utilization heat exchange section 321 includes a plurality of flat tubes 32a, a plurality of heat transfer fins 32b, a first header 32c, a second header 32d, and a third header 32e. The first utilization heat exchange section 321 is a stacked heat exchanger in which the plurality of flat tubes 32a are stacked at predetermined intervals in the thickness direction of the flat tube 32a by the plurality of heat transfer fins 32b. In the present embodiment, the utilization heat exchanger 32 includes an inner utilization heat exchange section 32i and an outer utilization heat exchange section 32o.

[0059] The flat tube 32a is a heat transfer tube in which a refrigerant flows. The flat tube 32a is formed in a flat oval shape in cross section. The flat tube 32a is a multi-hole tube having a plurality of refrigerant flow paths 32a1 formed so as to be orthogonal to the cross section. The plurality of refrigerant flow paths 32a1 are formed so as to be arranged in the width direction of the flat tube 32a. The flat tube 32a is formed by extrusion molding using, for example, aluminum or an aluminum alloy. In the present embodiment, the flat tube 32a is arranged such that the longitudinal direction of the flat tube 32a is in the left-right direction.

[0060] The heat transfer fin 32b is a band-shaped plate member that supports the plurality of flat tubes 32a at predetermined intervals. The heat transfer fin 32b has a plurality of slit-shaped cutouts 32b1 for inserting the flat tubes 32a. The cutout 32b1 is formed so as to extend, as viewed in a thickness direction of the heat transfer fin 32b, from one end edge extending in a longitudinal direction of the heat transfer fin 32b toward the other end edge while being orthogonal to the one end edge. The plurality of cutouts 32b1 are formed at predetermined intervals in the longitudinal direction of the heat transfer fin 32b. The heat transfer fin 32b is formed by using, for example, aluminum or an aluminum alloy.

[0061] The flat tube 32a is inserted into the cutout 32b1 with the width direction of the flat tube 32a being in an extending direction of the cutout 32b1 of the heat transfer

fin 32b. The plurality of heat transfer fins 32b are arranged at predetermined intervals in the longitudinal direction of the flat tube 32a. The heat transfer fins 32b and the flat tubes 32a are joined by brazing at the cutouts 32b1. The plurality of flat tubes 32a are joined to the heat transfer fins 32b such that the end portions of the flat tubes 32a are arranged in the thickness direction of the flat tube 32a. Figs. 5 and 7 illustrate an outer edge formed by the plurality of heat transfer fins 32b arranged in the longitudinal direction of the flat tube 32a and portions of the plurality of heat transfer fins 32b for convenience.

[0062] The inner utilization heat exchange section 32i and the outer utilization heat exchange section 32o are each formed by joining a predetermined number of flat tubes 32a to a predetermined number of heat transfer fins 32b and formed in a substantially identical shape. The inner utilization heat exchange section 32i and the outer utilization heat exchange section 32o are each arranged so as to overlap in the thickness direction of the flat tube 32a. With such an arrangement, as indicated by arrows in Fig. 6, a gap formed between each adjacent flat tubes 32a of the inner utilization heat exchange section 32i and the outer utilization heat exchange section 32o and a gap formed between each adjacent heat transfer fins 32b of the inner utilization heat exchange section 32i and the outer utilization heat exchange section 32o form flow paths through which an air flow generated by the utilization fan 33 flows. The inner utilization heat exchange section 32i is disposed at a position closer to the utilization fan 33 than the outer utilization heat exchange section 32o.

[0063] The first header 32c, the second header 32d, and the third header 32e are tubular members that allow the refrigerant flow paths 32a1 of the plurality of flat tubes 32a to communicate with each other at end portions of the plurality of flat tubes 32a.

[0064] The first header 32c is provided at one end of each flat tubes 32a included in the inner utilization heat exchange section 32i in the longitudinal direction so as to allow the refrigerant flow paths 32a1 of the plurality of flat tubes 32a to communicate with each other. Specifically, each one end of the plurality of flat tubes 32a included in the inner utilization heat exchange section 32i in the longitudinal direction is inserted into the first header 32c through openings formed in a side surface of the first header 32c, and is fixed to the first header 32c using brazing or the like.

[0065] The first header 32c is fixed to the flat tubes 32a so as to form, between the first header 32c and the heat transfer fin 32b of the inner utilization heat exchange section 32i adjacent to the first header 32c, a gap G1 of a predetermined width into which the protrusion portion 34b (described later) of the first member 34 can be inserted. The first header 32c is connected to the liquid-refrigerant connection pipe 5 via branch pipes 32c1.

[0066] The second header 32d is provided at the other ends of the flat tubes 32a included in the inner utilization heat exchange section 32i in the longitudinal direction

and the other ends of the flat tubes 32a included in the outer utilization heat exchange section 32o in the longitudinal direction so as to allow the refrigerant flow paths 32a1 of the plurality of flat tubes 32a of the inner utilization heat exchange section 32i and the refrigerant flow paths 32a1 of the plurality of flat tubes 32a of the outer utilization heat exchange section 32o to communicate with each other. Specifically, the other ends of the flat tubes 32a included in the inner utilization heat exchange section 32i in the longitudinal direction and the other ends of the flat tubes 32a included in the outer utilization heat exchange section 32o in the longitudinal direction are inserted into the second header 32d through openings formed in a side surface of the second header 32d, and are fixed to the second header 32d using brazing or the like.

[0067] The second header 32d is fixed to the flat tubes 32a so as to form, between the second header 32d and the heat transfer fin 32b of the inner utilization heat exchange section 32i adjacent to the second header 32d, a gap G2 of a predetermined width into which the protrusion portion 34b (described later) of the first member 34 can be inserted.

[0068] The third header 32e is provided at one end of each flat tubes 32a included in the outer utilization heat exchange section 32o in the longitudinal direction so as to allow the refrigerant flow paths 32a1 of the plurality of flat tubes 32a to communicate with each other. Specifically, each one end of the plurality of flat tubes 32a included in the outer utilization heat exchange section 32o in the longitudinal direction is inserted into the third header 32e through openings formed in a side surface of the third header 32e, and is fixed to the third header 32e using brazing or the like. The third header 32e is connected to the gas-refrigerant connection pipe 6 via branch pipes 32e1.

[0069] With such a configuration, the refrigerant that has passed through the liquid-refrigerant connection pipe 5 and flowed into the first header 32c passes through the plurality of refrigerant flow paths 32a1 formed in the flat tubes 32a of the inner utilization heat exchange section 32i and flows into the second header 32d. The refrigerant that has flowed into the second header 32d passes through the plurality of refrigerant flow paths 32a1 formed in the outer utilization heat exchange section 32o, passes through the third header 32e, and flows into the gas-refrigerant connection pipe 6. Furthermore, the refrigerant that has passed through the gas-refrigerant connection pipe 6 and flowed into the third header 32e passes through the plurality of refrigerant flow paths 32a1 formed in the flat tubes 32a of the outer utilization heat exchange section 32o and flows into the second header 32d. The refrigerant that has flowed into the second header 32d passes through the plurality of refrigerant flow paths 32a1 formed in the inner utilization heat exchange section 32i, passes through the first header 32c, and flows into the liquid-refrigerant connection pipe 5.

[0070] Note that, in a case where the first header 32c,

the second header 32d, and the third header 32e are collectively referred to, the first header 32c, the second header 32d, and the third header 32e are referred to as headers 32c, 32d, and 32e.

[0071] The first utilization heat exchange section 321 is, when the utilization unit 3 is viewed in the left-right direction, provided such that the thickness direction of the flat tube 32a is inclined rearward with respect to the up-down direction (vertical direction) in front of the utilization fan 33.

[0072] The second utilization heat exchange section 322 is, when the utilization unit 3 is viewed in the left-right direction, provided such that the thickness direction of the flat tube 32a is inclined frontward with respect to the up-down direction below the first utilization heat exchange section 321.

[0073] The third utilization heat exchange section 323 is, when the utilization unit 3 is viewed in the left-right direction, provided such that the thickness direction of the flat tube 32a is inclined frontward with respect to the up-down direction behind and above the utilization fan 33.

(2-2-4) First member

[0074] The first member 34 is attached to the utilization heat exchanger 32 and restricts the movement of the utilization heat exchanger 32 caused by vibration or the like accompanying the operation of the utilization unit 3 while supporting the utilization heat exchanger 32. The first member 34 is a plate-shaped member, and is disposed so as to be orthogonal to the left-right direction at each of left and right ends of the flat tubes 32a of the utilization heat exchanger 32 in a region surrounded by an outer periphery of the utilization fan 33 and the utilization heat exchanger 32. The first member 34 includes a body 34a and the protrusion portions 34b. The first member 34 is manufactured using a hard resin.

[0075] In the present disclosure, a state where the first member 34 is attached to the utilization heat exchanger 32 means a state where the protrusion portions 34b are inserted between flat tubes 32a adjacent to each other in the thickness direction.

[0076] In the present embodiment, the utilization unit 3 includes two first members 34. Each of the two first members 34 is disposed such that the body 34a faces the gap G1 or the gap G2 of the utilization heat exchanger 32. Furthermore, in the present embodiment, the first member 34 is attached to the utilization heat exchanger 32 vertically below the first utilization heat exchange section 321 and the third utilization heat exchange section 323 of the utilization heat exchanger 32 and behind the second utilization heat exchange section 322 of the utilization heat exchanger 32.

[0077] Fig. 8 is a perspective view of the first member 34.

[0078] The body 34a is a member having a polygonal shape in a plan view, mainly has a first cross-sectional

surface 34a1, a second cross-sectional surface 34a2, a third cross-sectional surface 34a3, and a fourth cross-sectional surface 34a4, and has an opening 34a5 formed in a main surface.

[0079] The first cross-sectional surface 34a1 is a surface that is formed so as to come in contact with at least an end portion of the heat transfer fin 32b included in the inner utilization heat exchange section 32i of the first utilization heat exchange section 321 and face the gap G1 or the gap G2 of the flat tubes 32a in a state where the first member 34 is attached to the utilization heat exchanger 32.

[0080] The second cross-sectional surface 34a2 is a surface that is formed so as to come in contact with at least an end portion of the heat transfer fin 32b included in the inner utilization heat exchange section 32i of the second utilization heat exchange section 322 and face the gap G1 or the gap G2 of the flat tubes 32a in a state where the first member 34 is attached to the utilization heat exchanger 32.

[0081] The third cross-sectional surface 34a3 is a surface that is formed so as to come in contact with at least an end portion of the heat transfer fin 32b included in the inner utilization heat exchange section 32i of the third utilization heat exchange section 323 and face the gap G1 or the gap G2 of the flat tubes 32a in a state where the first member 34 is attached to the utilization heat exchanger 32.

[0082] The fourth cross-sectional surface 34a4 is a surface that is formed so as to position outside each end of the utilization fan 33 in the left-right direction. In the present embodiment, the fourth cross-sectional surface 34a4 is formed so as to come in contact with a body 35a (described later) of the second member 35.

[0083] The opening 34a5 is an opening for engaging a second fixing portion 35d (described later) of the second member 35.

[0084] The protrusion portions 34b are, in a state where each of the first cross-sectional surface 34a1, the second cross-sectional surface 34a2, and the third cross-sectional surface 34a3 is in contact with the flat tubes 32a of the inner utilization heat exchange section 32i, inserted between adjacent flat tubes 32a in the gap G1 or the gap G2. The protrusion portion 34b is a columnar protrusion. The protrusion portions 34b include first protrusion portions 34b1, second protrusion portions 34b2, and third protrusion portions 34b3.

[0085] The first protrusion portion 34b1 is inserted between adjacent flat tubes 32a in the gap G1 or the gap G2 of the inner utilization heat exchange section 32i that comes in contact with the first cross-sectional surface 34a1. The first protrusion portion 34b1 is formed so as to protrude from the first cross-sectional surface 34a1.

[0086] The second protrusion portion 34b2 is inserted between adjacent flat tubes 32a in the gap G1 or the gap G2 of the inner utilization heat exchange section 32i that comes in contact with the second cross-sectional surface 34a2. The second protrusion portion 34b2 is formed so

as to protrude from the second cross-sectional surface 34a2.

[0087] The third protrusion portion 34b3 is inserted between adjacent flat tubes 32a in the gap G1 or the gap G2 of the inner utilization heat exchange section 32i that comes in contact with the third cross-sectional surface 34a3. The third protrusion portion 34b3 is formed so as to protrude from the third cross-sectional surface 34a3.

[0088] In the present embodiment, the first member 34 provided on the left side of the utilization heat exchanger 32 includes three first protrusion portions 34b1, three second protrusion portions 34b2, and three third protrusion portions 34b3. Furthermore, the first member 34 provided on the right side of the utilization heat exchanger 32 includes two first protrusion portions 34b1, two second protrusion portions 34b2, and two third protrusion portions 34b3. The number of first protrusion portions 34b1, second protrusion portions 34b2, and third protrusion portions 34b3 is not limited to two or three, and may be one, four, or more. For example, the number of first protrusion portions 34b1, second protrusion portions 34b2, and third protrusion portions 34b3 included in the first member 34 provided on the left side of the utilization heat exchanger 32 may or may not be equal to the number of first protrusion portions 34b1, second protrusion portions 34b2, and third protrusion portions 34b3 included in the first member 34 provided on the right side of the utilization heat exchanger 32.

[0089] As described above, by inserting the protrusion portions 34b between adjacent flat tubes 32a in the gaps G1 or the gaps G2 of the inner utilization heat exchange section 32i, the first member 34 restricts the movement of the utilization heat exchanger 32 in the thickness direction or the longitudinal direction of the flat tube 32a. At the same time, the body 34a (specifically, the first cross-sectional surface 34a1, the second cross-sectional surface 34a2, and the third cross-sectional surface 34a3) comes in contact with the end portions of the heat transfer fins 32b included in the inner utilization heat exchange section 32i in a state where the first member 34 is attached to the utilization heat exchanger 32. In this manner, the first member 34 supports the utilization heat exchanger 32.

(2-2-5) Second member

[0090] The second member 35 is fixed to both the second casing 31 and the first member 34, and supports the utilization heat exchanger 32 via the first member 34. The second member 35 includes the body 35a, an insertion portion 35b, two first fixing portions 35c, and the second fixing portion 35d.

[0091] In the present embodiment, the utilization unit 3 includes two second members 35. Each of the two second members 35 is disposed so as to support the first member 34 disposed on the right side of the utilization heat exchanger 32 or the first member 34 disposed on the left side of the utilization heat exchanger 32.

[0092] Fig. 9 is a perspective view of the second member 35. Fig. 10 is an exploded perspective view illustrating how the first member 34 and the second member 35 are assembled to the second casing 31.

[0093] The body 35a is an arc-shaped plate-shaped member that partially covers the upper side of the utilization fan 33 as viewed in the left-right direction. In the present embodiment, the body 35a is formed so as to come in contact with the fourth cross-sectional surface 34a4 of the first member 34.

[0094] The insertion portion 35b restricts the movement of the first member 34 in the left-right direction. The insertion portion 35b is constituted of plate-shaped members that protrude from the body 35a so as to be orthogonal to the left-right direction. The plate-shaped members constituting the insertion portion 35b are provided with a gap of a predetermined width in the left-right direction so as to sandwich the body 34a of the first member 34 from the left-right direction. As illustrated in Fig. 10, the body 34a of the first member 34 is inserted into the gap formed by the insertion portion 35b.

[0095] The first fixing portions 35c fix the second member 35 to the second casing 31. In the present embodiment, the first fixing portions 35c are pawls that engage with the openings 31c of the second casing 31. The first fixing portions 35c are formed so as to protrude downward from end portions of the body 35a in the circumferential direction as viewed in the left-right direction. As illustrated in Figs. 10 and 4, by covering the upper side of the utilization fan 33 with the body 35a, the first fixing portions 35c engage with the openings 31c. The movement of the second member 35 in the up-down direction is restricted by the engagement of the first fixing portions 35c with the openings 31c, and the second member 35 is fixed to the second casing 31.

[0096] The second fixing portion 35d fixes the first member 34 to the second member 35. In the present embodiment, the second fixing portion 35d is a pawl that engages with the opening 34a5 of the first member 34. As illustrated in Fig. 10, by inserting the first member 34 into the insertion portion 35b, the second fixing portion 35d engages with the opening 34a5. The first member 34 is fixed to the second member 35 by the engagement of the second fixing portion 35d with the opening 34a5, thereby restricting the movement of the first member 34 in the up-down direction.

[0097] As described above, the first member 34 is fixed to the second member 35, and the second member 35 is fixed to the second casing 31. Therefore, the second member 35 can support the utilization heat exchanger 32 via the first member 34.

[0098] The second member 35 according to the present embodiment also has a function of allowing the condensed water generated in the utilization heat exchanger 32 to flow to a drain pan (not illustrated) provided below the second member 35 at each of the front and rear of the utilization fan 33. Specifically, when the condensed water generated in the utilization heat exchanger

32 falls from an end portion of the utilization heat exchanger 32 to the body 35a, the condensed water moves along an upper surface of the body 35a to a front end portion or a rear end portion and falls to the drain pan.

(2-3) Remote controller

[0099] The remote controller 8 receives, from a user, an instruction to execute a heating operation, a cooling operation, a humidifying operation, or the like, an instruction to stop the air-conditioning apparatus 1, and a set value such as a set temperature T_s , and transmits the received result to the control unit 9 as a control signal.

(2-4) Control unit

[0100] The control unit 9 is mainly connected to the compressor 22, the four-way switching valve 23, the heat source expansion valve 25, the heat source fan 26, the utilization fan 33, and the remote controller 8 so as to be capable of transmitting and receiving a control signal. Although details will be described later, the control unit 9 controls the refrigerant circuit 100 by controlling an operation of each of the compressor 22, the four-way switching valve 23, the heat source expansion valve 25, the heat source fan 26, and the utilization fan 33.

[0101] The control unit 9 is typically realized by a computer including a control arithmetic device and a storage device (both not illustrated). The control arithmetic device is a processor such as a CPU or a GPU. The control arithmetic device reads a control program stored in the storage device and controls an operation in accordance with the control program. Moreover, the control arithmetic device can write a calculation result in the storage device and read information stored in the storage device in accordance with the control program.

[0102] Note that Fig. 2 is a schematic view. The control unit 9 is constituted of an outdoor control unit provided inside the heat source unit 2 and an indoor control unit provided inside the utilization unit 3. The outdoor control unit and the indoor control unit may be connected by a communication line capable of transmitting and receiving a control signal to and from each other.

(3) Air conditioning operations

[0103] Next, a heating operation and a cooling operation, which are air conditioning operations executed by the control unit 9, will be described.

(3-1) Heating operation

[0104] The control unit 9 starts a heating operation when receiving a control signal regarding an instruction to execute the heating operation from the remote controller 8. In the heating operation, the control unit 9 switches the four-way switching valve 23 to the first state (see the broken lines in Fig. 2). Moreover, the control unit 9

sets the opening degree of the heat source expansion valve 25 to the degree corresponding to the set temperature T_s received from the remote controller 8, operates the compressor 22, and rotationally drives the utilization fan 33. With such an operation, the heat source heat exchanger 24 functions as an evaporator of the refrigerant, and the utilization heat exchanger 32 functions as a condenser of the refrigerant.

[0105] During the heating operation, the refrigerant circuit 100 functions as follows. A highpressure refrigerant discharged from the compressor 22 exchanges heat with indoor air sent by the utilization fan 33 and is condensed in the utilization heat exchanger 32. As a result, the indoor air is heated and discharged into the room as conditioned air. The condensed refrigerant passes through the heat source expansion valve 25 and is decompressed, and thereafter, exchanges heat with outdoor air sent by the heat source fan 26 and is evaporated in the heat source heat exchanger 24. The refrigerant that has passed through the heat source heat exchanger 24 is sucked into the compressor 22 and is compressed.

(3-2) Cooling operation

[0106] The control unit 9 starts a cooling operation when receiving a control signal regarding an instruction to execute the cooling operation from the remote controller 8. In the cooling operation, the control unit 9 switches the four-way switching valve 23 to the second state (see the solid lines in Fig. 2). Moreover, the control unit 9 sets the opening degree of the heat source expansion valve 25 to the degree corresponding to the set temperature T_s received from the remote controller 8, operates the compressor 22, and rotationally drives the utilization fan 33. With such an operation, the heat source heat exchanger 24 functions as a condenser of the refrigerant, and the utilization heat exchanger 32 functions as an evaporator of the refrigerant.

[0107] During the cooling operation, the refrigerant circuit 100 functions as follows. A highpressure refrigerant discharged from the compressor 22 exchanges heat with outdoor air sent by the heat source fan 26 and is condensed in the heat source heat exchanger 24. The condensed refrigerant passes through the heat source expansion valve 25 and is decompressed, and thereafter, exchanges heat with indoor air sent by the utilization fan 33 and is evaporated in the utilization heat exchanger 32. As a result, the indoor air is cooled and discharged into the room as conditioned air. The refrigerant that has passed through the utilization heat exchanger 32 is sucked into the compressor 22 and is compressed.

(4) Features

(4-1)

[0108] The utilization unit 3 includes the utilization heat exchanger 32, the first member 34, and the second mem-

ber 35. In the utilization heat exchanger 32, a plurality of flat tubes 32a are stacked at predetermined intervals in the thickness direction by the heat transfer fins 32b. The first member 34 is attached to the utilization heat exchanger 32. The second member 35 supports the utilization heat exchanger 32 via the first member 34. The first member 34 includes the body 34a and the protrusion portion 34b protruding from the body 34a. The protrusion portion 34b is inserted between adjacent flat tubes 32a.

[0109] In the utilization unit 3, the protrusion portion 34b included in the first member 34 is inserted between adjacent flat tubes 32a, thereby restricting the movement of the utilization heat exchanger 32 in the thickness direction or the longitudinal direction of the flat tube 32a. With such a configuration, the contact area between the flat tube 32a and the member (first member 34) that comes in contact with the flat tube 32a to restrict the movement can be significantly reduced as compared with the case where the heat transfer tube is inserted into the tube hole formed in the bracket to restrict the movement of the heat exchanger. Therefore, even if the first member 34 and the flat tube 32a slide against each other due to vibration or the like caused by the operation of the utilization unit 3, damage to the flat tube 32a caused by this sliding is prevented. As a result, options for materials that can be used for the flat tube 32a increase, thereby reducing the manufacturing cost of the utilization unit 3.

(4-2)

[0110] The first member 34 includes the plurality of protrusion portions 34b. In the utilization unit 3 including the utilization heat exchanger 32 having a plurality of heat exchange sections (the first utilization heat exchange section 321, the second utilization heat exchange section 322, and the third utilization heat exchange section 323), the first member 34 includes the plurality of protrusion portions 34b for each of the utilization heat exchange sections 321, 322, and 323.

[0111] According to the utilization unit 3, the first member 34 including the plurality of protrusion portions 34b effectively restricts the movement of the utilization heat exchanger 32 in the thickness direction or the longitudinal direction of the flat tube 32a.

(4-3)

[0112] The protrusion portion 34b has a columnar shape.

[0113] The protrusion portion 34b formed in a columnar shape enables easy insertion of the protrusion portion 34b between adjacent flat tubes 32a. Therefore, the manufacturing of the utilization unit 3 is facilitated, thereby reducing the manufacturing cost of the utilization unit 3.

(4-4)

[0114] The first member 34 is manufactured using res-

in.

[0115] By manufacturing the first member 34 using resin, the hardness of the protrusion portion 34b can be reduced as compared with a case where the first member 34 is manufactured using metal. Therefore, even if the first member 34 and the flat tube 32a slide against each other, damage to the flat tube 32a caused by this sliding is prevented. As a result, options for materials that can be used for the flat tube 32a increase, thereby reducing the manufacturing cost of the utilization unit 3.

(4-5)

[0116] The utilization unit 3 further includes the second casing 31 and the second member 35 fixed to the second casing 31. The first member 34 is fixed to the second member 35 by engagement.

(4-6)

[0117] The body 34a of the first member 34 is in contact with the heat transfer fin 32b.

[0118] More specifically, the first member 34 is formed such that the first cross-sectional surface 34a1, the second cross-sectional surface 34a2, and the third cross-sectional surface 34a3 of the body 34a are in contact with the end portions of the heat transfer fins 32b included in the inner utilization heat exchange section 32i in a state where the first member 34 is attached to the utilization heat exchanger 32. Therefore, the first member 34 can receive the weight of the utilization heat exchanger 32 by the contact between the first cross-sectional surface 34a1, the second cross-sectional surface 34a2, and the third cross-sectional surface 34a3 of the body 34a and the heat transfer fins 32b included in the inner utilization heat exchange section 32i. Thus, the weight of the utilization heat exchanger 32 received by the protrusion portions 34b becomes substantially zero or is significantly reduced. Therefore, even if the first member 34 and the flat tube 32a slide against each other, damage to the flat tube 32a caused by this sliding is prevented. As a result, options for the flat tube 32a that can be used increase, thereby reducing the manufacturing cost of the utilization unit 3.

(4-7)

[0119] The utilization heat exchanger 32 includes, as viewed in the left-right direction, the first utilization heat exchange section 321 and the third utilization heat exchange section 323 in which the thickness direction of the flat tube 32a is inclined with respect to the vertical direction. The first member 34 is attached to the utilization heat exchanger 32 vertically below the first utilization heat exchange section 321 and the third utilization heat exchange section 323.

[0120] With such a configuration, in the utilization unit 3, the first member 34 can restrict the movement of the

first utilization heat exchange section 321 and the third utilization heat exchange section 323 while supporting the first utilization heat exchange section 321 and the third utilization heat exchange section 323.

(5) Modifications

(5-1) Modification A

[0121] The protrusion portion 34b may include a pawl portion 34c that engages with the flat tubes 32a. The pawl portion 34c is formed so as to engage with the end portions, on the outer utilization heat exchange section 32o side, of the flat tubes 32a of the inner utilization heat exchange section 32i by inserting the protrusion portion 34b between adjacent flat tubes 32a.

[0122] Fig. 11 is an enlarged cross-sectional view of a periphery of the utilization heat exchanger 32 of the air-conditioning apparatus 1 according to a modification A.

[0123] The first member 34 can effectively restrict the movement of the utilization heat exchanger 32 by the engagement of the pawl portion 34c with the end portions of the flat tubes 32a.

(5-2) Modification B

[0124] The first member 34 may be manufactured using a material other than resin. The first member 34 may be manufactured using metal, and a resin coating may be applied to a surface of the first member 34. Alternatively, the first member 34 may be manufactured using metal, and an insulating rubber may be attached to the surface of the first member 34.

[0125] With such a configuration, the resin coating or the insulating rubber reduces the hardness of the surface of the first member 34 to a low level. As a result, it is possible to ensure high rigidity of the first member 34 while effectively preventing damage to the flat tube 32a caused by sliding.

(5-3) Modification C

[0126] In the above-described embodiment, the first member 34 is fixed to the second member 35 by the engagement of the second fixing portion 35d with the opening 34a5 of the first member 34. However, the fixing method is not limited thereto. For example, the first member 34 may be fixed to the second member 35 by screw fastening.

(5-4) Modification D

[0127] The body 34a of the first member 34 may be in contact with any one of the headers 32c, 32d, and 32e.

[0128] The body 34a of the first member 34 is in contact with any one of the headers 32c, 32d, and 32e, so that the first member 34 can receive the weight of the utilization heat exchanger 32 by the contact between the body

34a and any one of the headers 32c, 32d, and 32e. This reduces the weight of the utilization heat exchanger 32 received by the protrusion portions 34b. Thus, the weight of the utilization heat exchanger 32 received by the protrusion portions 34b becomes substantially zero or is significantly reduced. Therefore, even if the first member 34 and the flat tube 32a slide against each other, damage to the flat tube 32a caused by this sliding is prevented. As a result, options for the flat tube 32a that can be used increase, thereby reducing the manufacturing cost of the utilization unit 3.

(5-5) Modification E

[0129] In the above-described embodiment, the utilization heat exchanger 32 includes a plurality of utilization heat exchange sections 321, 322, and 323, but the utilization heat exchanger 32 may be constituted of only one heat exchange section.

(5-6) Modification F

[0130] An example in which the second member 35 different from the second casing 31 supports the utilization heat exchanger 32 via the first member 34 has been described above as an embodiment, but alternatively, the second casing 31 may be the second member. In other words, the second casing 31 may function as the second member to support the first member 34.

(5-7) Modification G

[0131] The utilization unit 3 including the first member 34 has been described above as an embodiment, but the heat source unit 2 may include the first member attached to the heat source heat exchanger 24.

[0132] The embodiment of the present disclosure has been described heretofore, and it will be understood that a variety of modifications in mode and detail may be made without departing from the gist and scope of the present disclosure as set forth in claims.

REFERENCE SIGNS LIST

[0133]

1 air-conditioning apparatus
100 refrigerant circuit
2 heat source unit
3 utilization unit
31 second casing (casing)
32 utilization heat exchanger
321 first utilization heat exchange section
322 second utilization heat exchange section
323 third utilization heat exchange section
32a flat tube
32b heat transfer fin
32c first header

32d second header
32e third header
33 utilization fan
34 first member
34a body
34b protrusion portion
34c pawl portion
35 second member

10 CITATION LIST

PATENT LITERATURE

[0134] PTL 1: International Publication No. 2018/128035

Claims

- 20 1. A heat exchange unit comprising:
- 25 a heat exchanger (32) in which a plurality of flat tubes (32a) are stacked at predetermined intervals in a thickness direction by a heat transfer fin (32b); and
- 30 a first member (34) that is attached to the heat exchanger and restricts a movement of the heat exchanger, wherein the first member includes
- 35 a body (34a) and a protrusion portion (34b) protruding from the body, and the protrusion portion is inserted between flat tubes adjacent to each other.
- 40 2. The heat exchange unit according to claim 1, wherein
- the first member includes a plurality of protrusion portions.
- 45 3. The heat exchange unit according to claim 1 or 2, wherein
- the heat exchanger includes a plurality of first heat exchange sections (321, 322, and 323), and the first member includes a plurality of protrusion portions for each of the plurality of first heat exchange sections.
- 50 4. The heat exchange unit according to any one of claims 1 to 3, wherein
- the protrusion portion has a columnar shape.
- 55 5. The heat exchange unit according to any one of claims 1 to 3, wherein

the protrusion portion includes
a pawl portion (34c) that engages with a flat tube.

6. The heat exchange unit according to any one of
claims 1 to 5, wherein 5

the first member is
manufactured using resin.

7. The heat exchange unit according to any one of 10
claims 1 to 5, wherein

the first member is
manufactured using metal, and a resin coating
is applied to a surface of the first member. 15

8. The heat exchange unit according to any one of
claims 1 to 5, wherein

the first member is 20
manufactured using metal, and an insulating
rubber is attached to a surface of the first mem-
ber.

9. The heat exchange unit according to any one of 25
claims 1 to 8, further comprising a casing (31) and
a second member (35) fixed to the casing, wherein

the first member is
fixed to the second member by screw fastening 30
or engagement.

10. The heat exchange unit according to any one of
claims 1 to 9, wherein 35

the body of the first member is
in contact with the heat transfer fin.

11. The heat exchange unit according to any one of
claims 1 to 9, wherein 40

the heat exchanger further includes
a header (32c, 32d, 32e) that connects end por-
tions of the plurality of flat tubes to each other,
and 45
the body of the first member is
in contact with the header.

12. The heat exchange unit according to any one of
claims 1 to 11, wherein 50

the heat exchanger includes
a second heat exchange section (321, 323) in
which the thickness direction of the flat tubes is
inclined with respect to a vertical direction, and 55
the first member is
attached to the heat exchanger vertically below
the second heat exchange section.

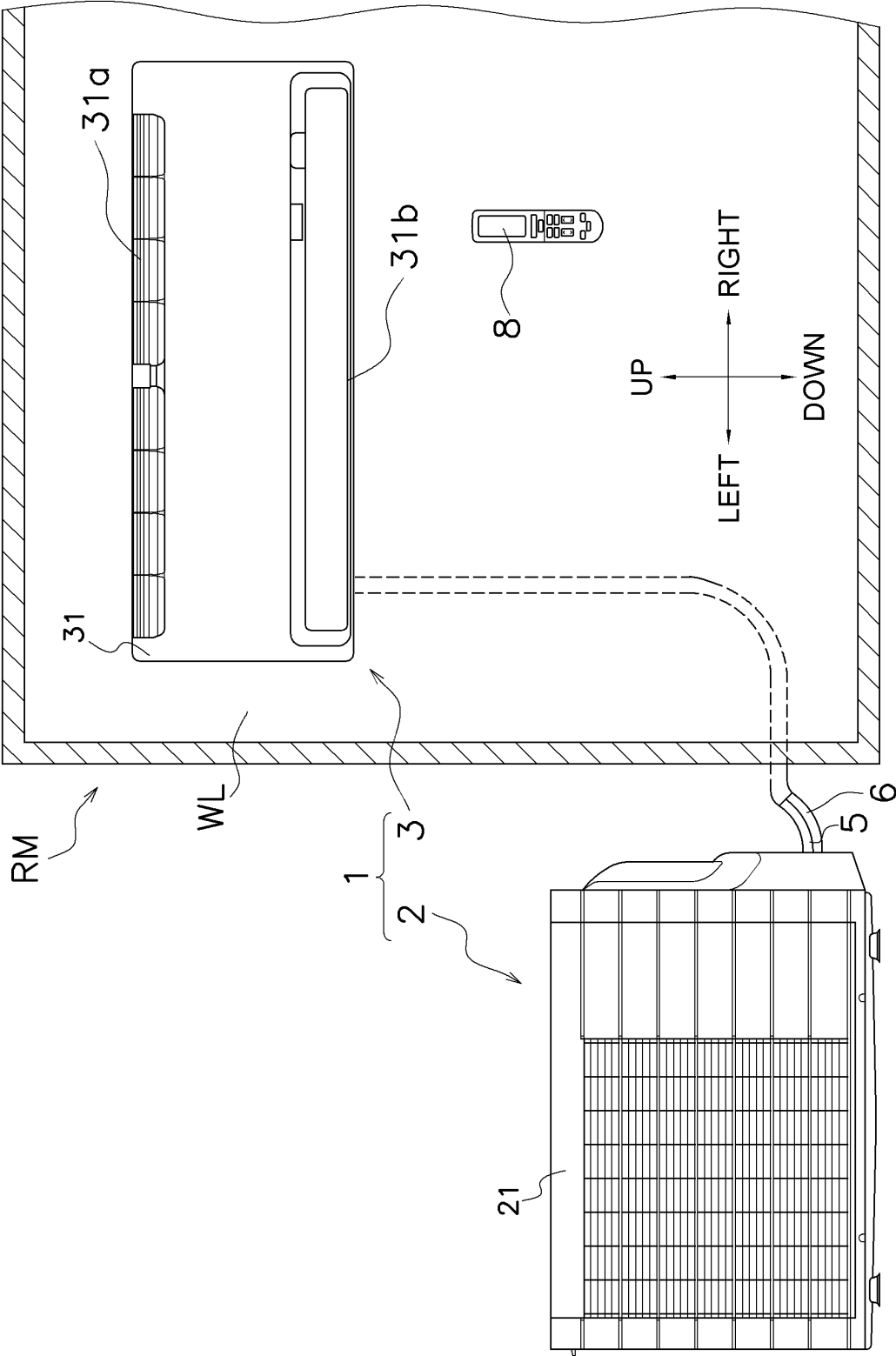


FIG. 1

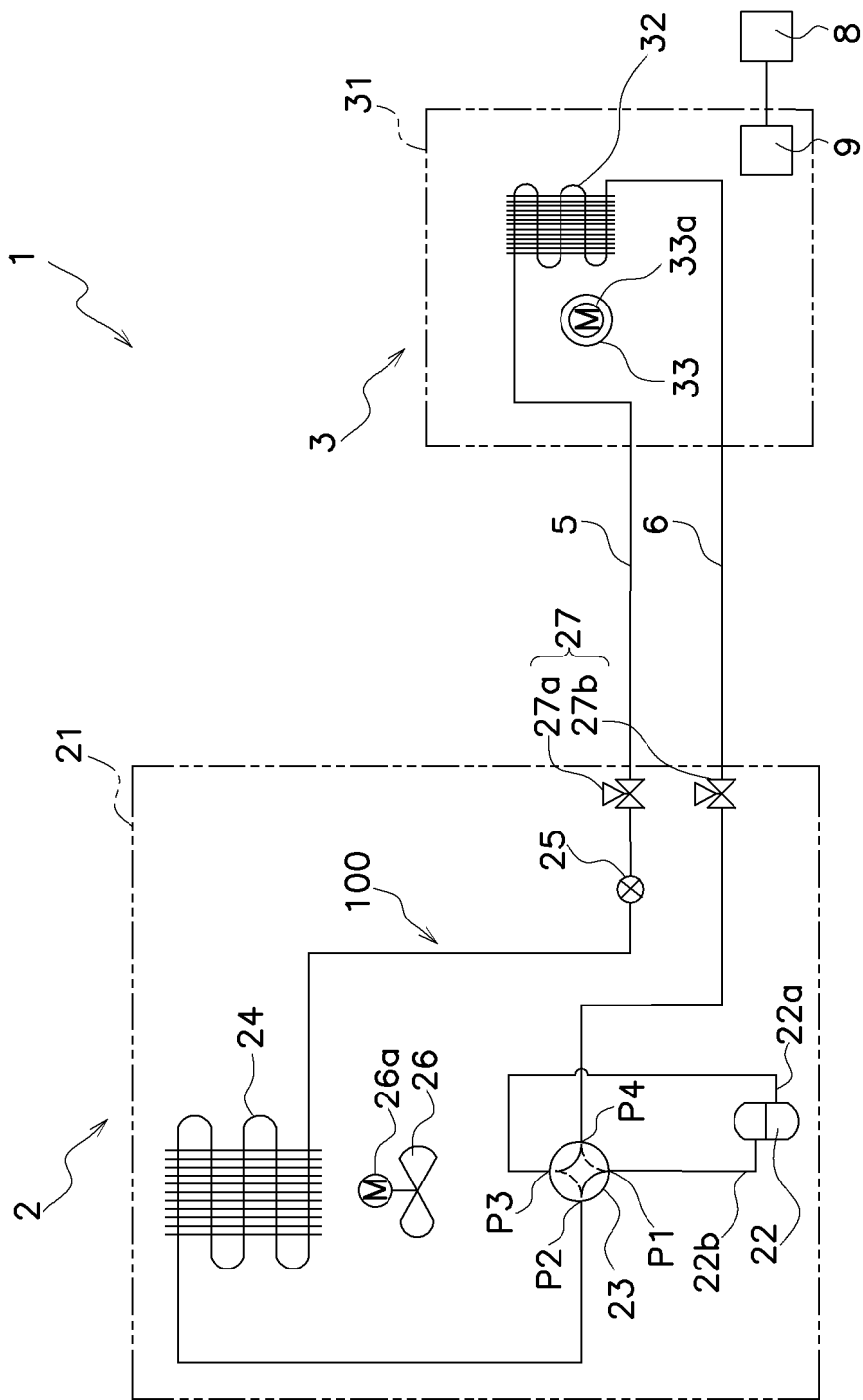


FIG. 2

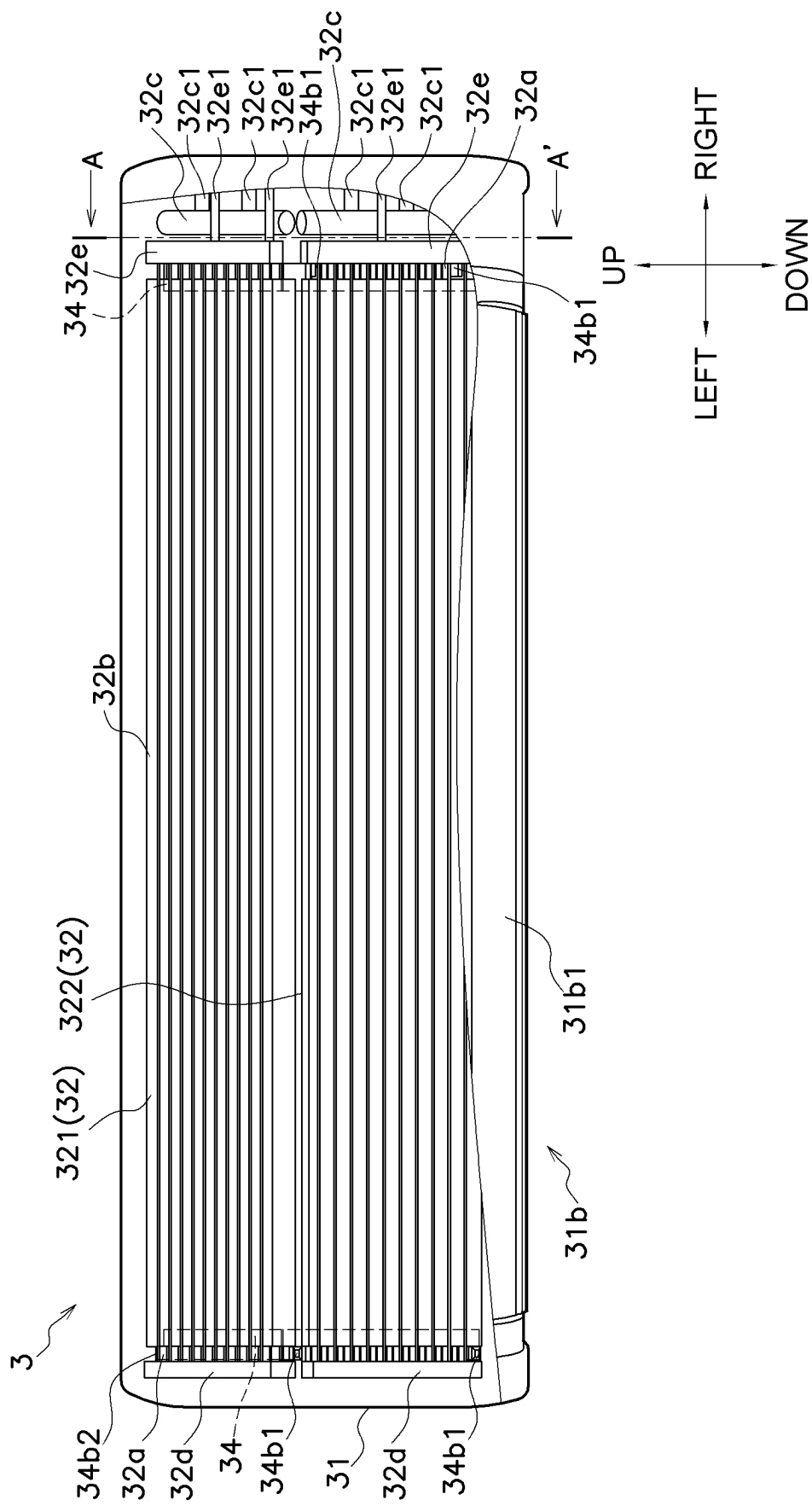
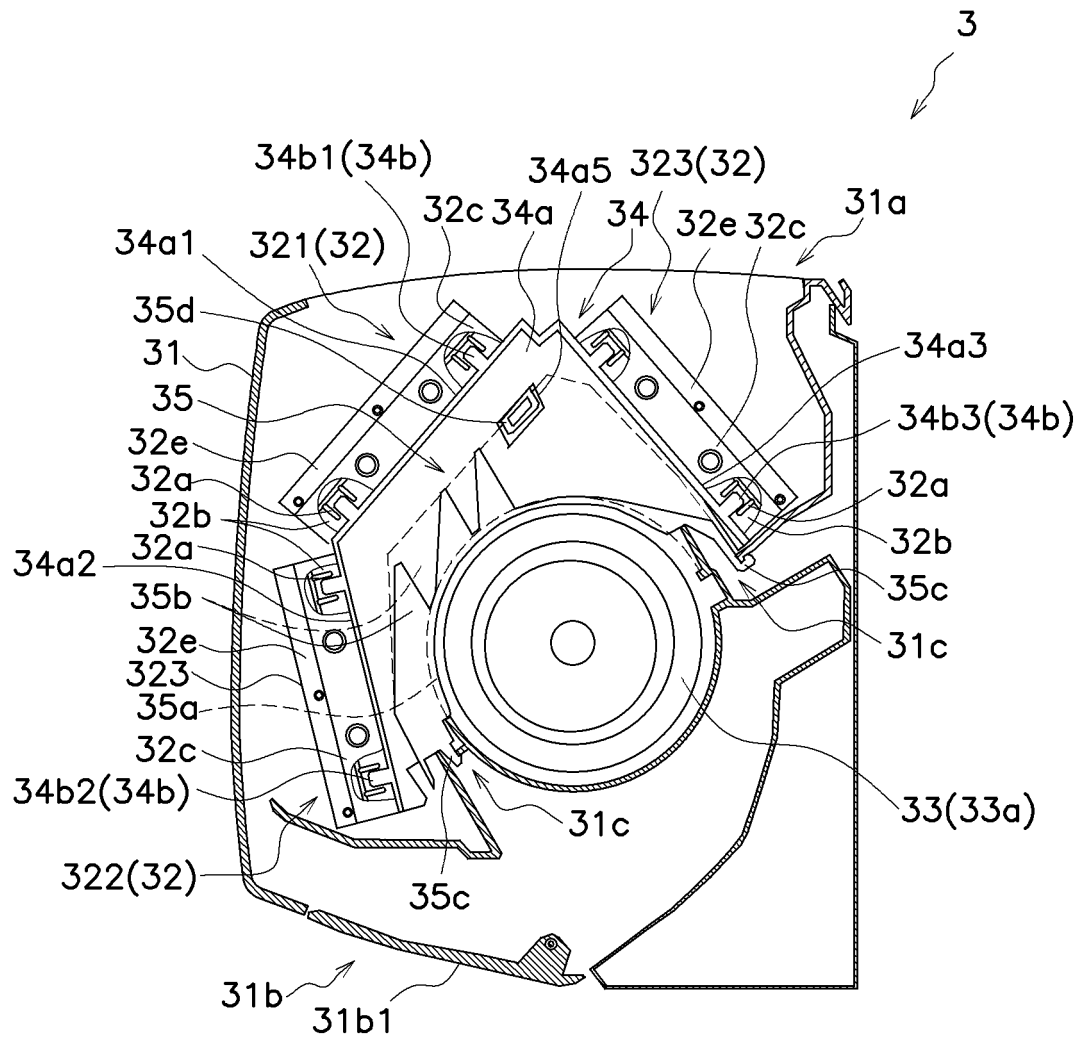


FIG. 3



A - A'

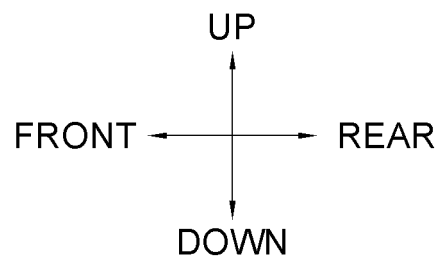


FIG. 4

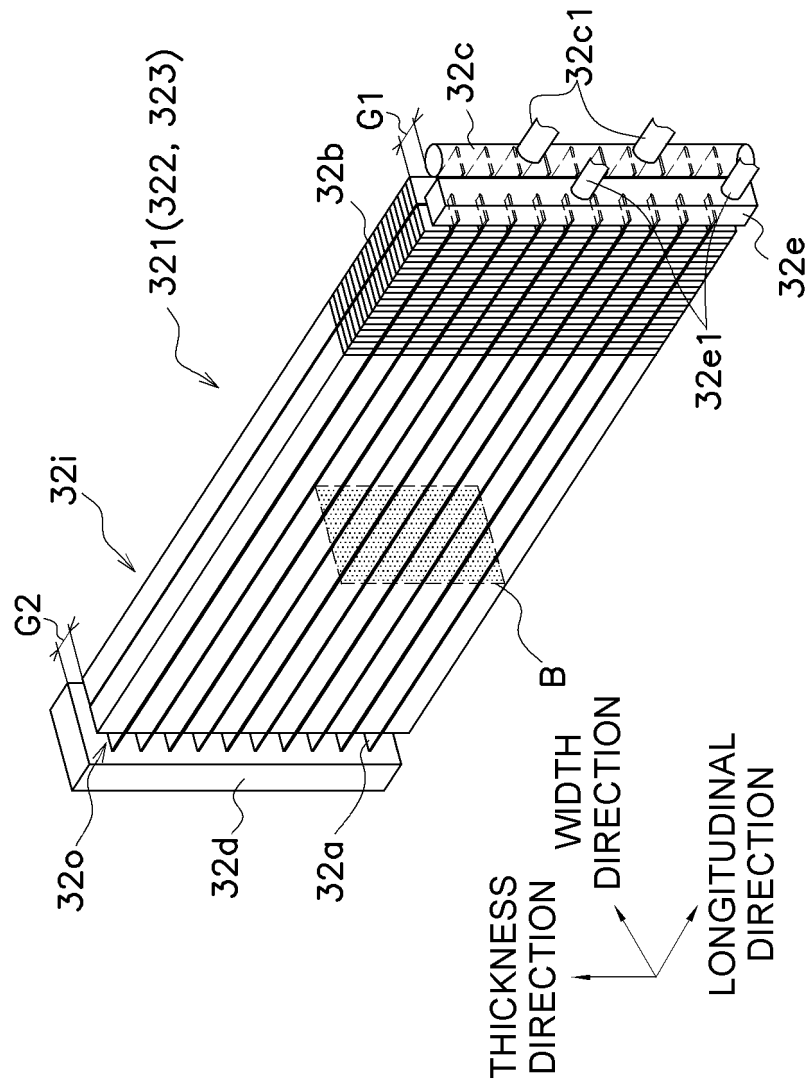


FIG. 5

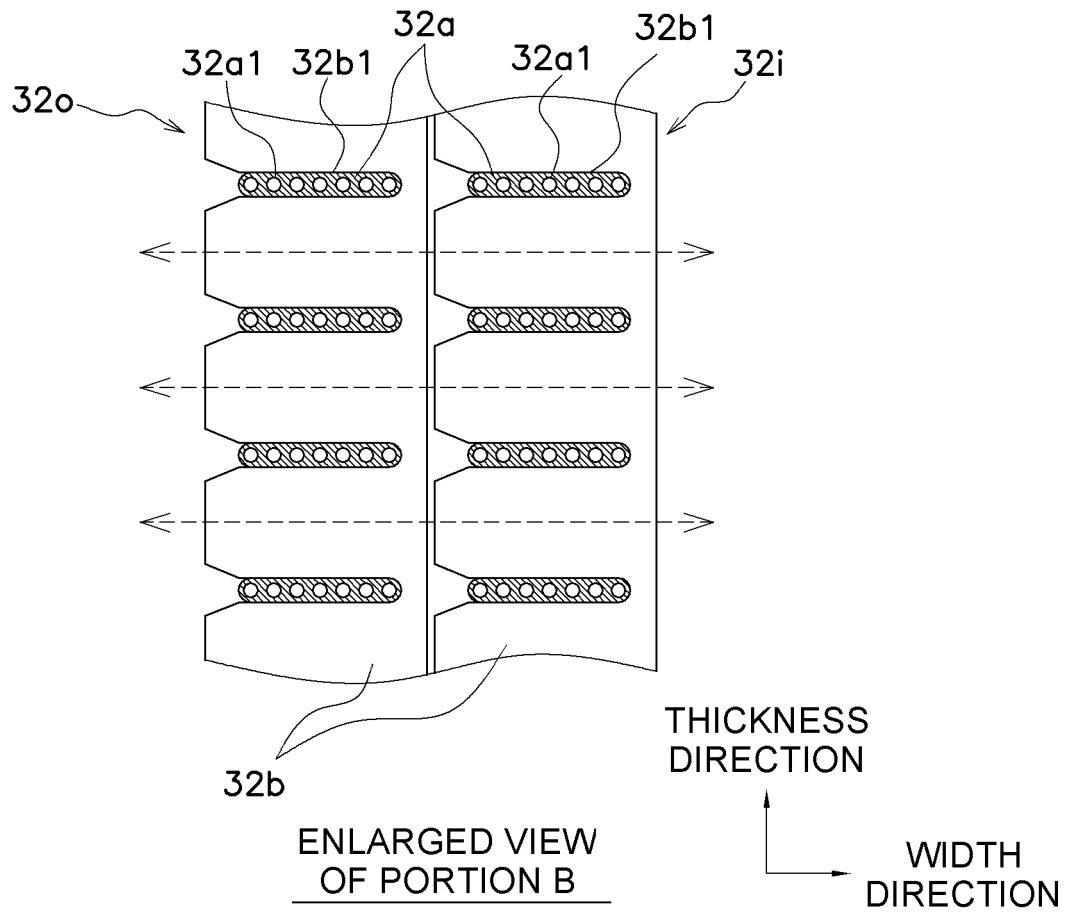


FIG. 6

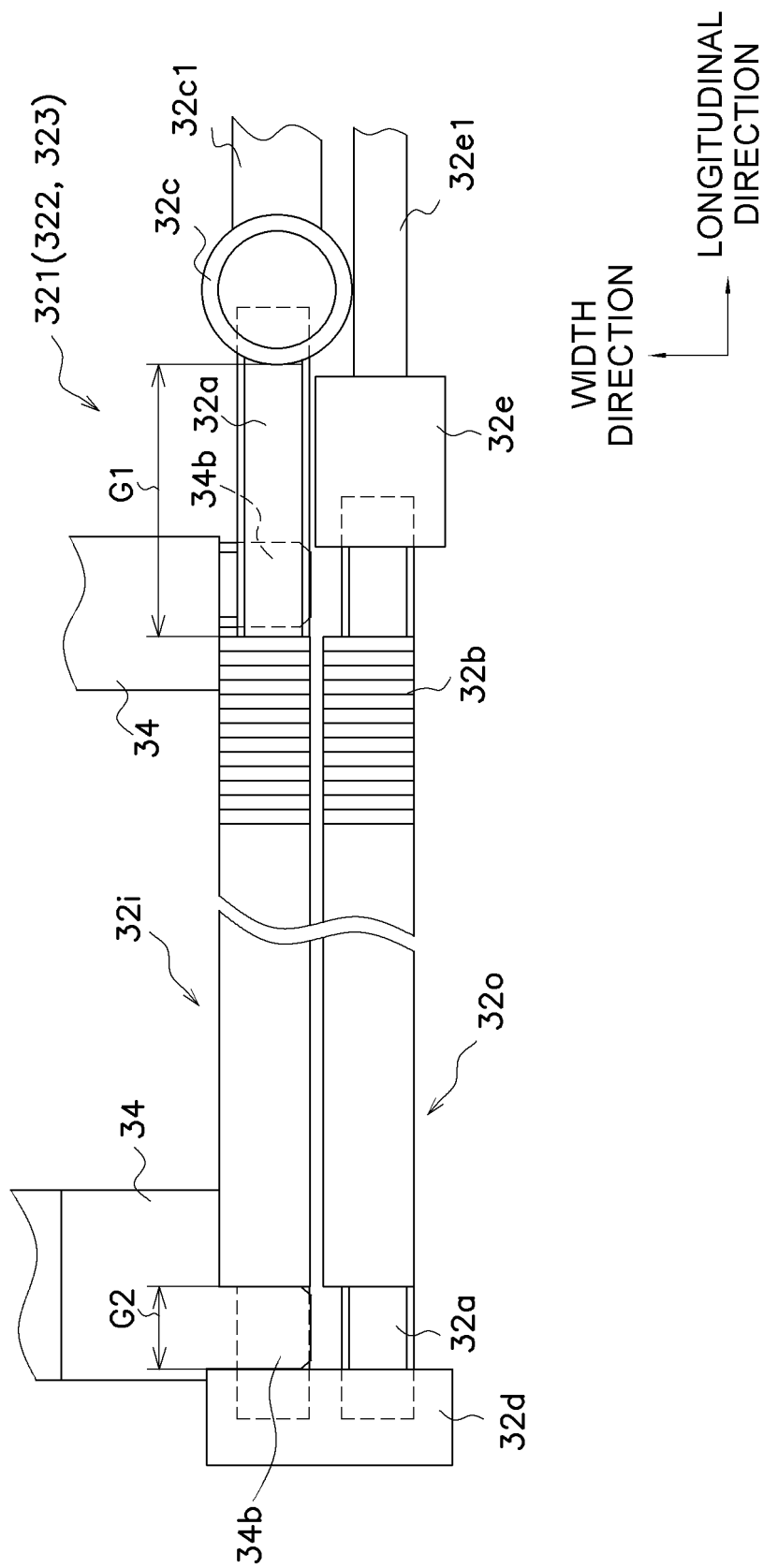


FIG. 7

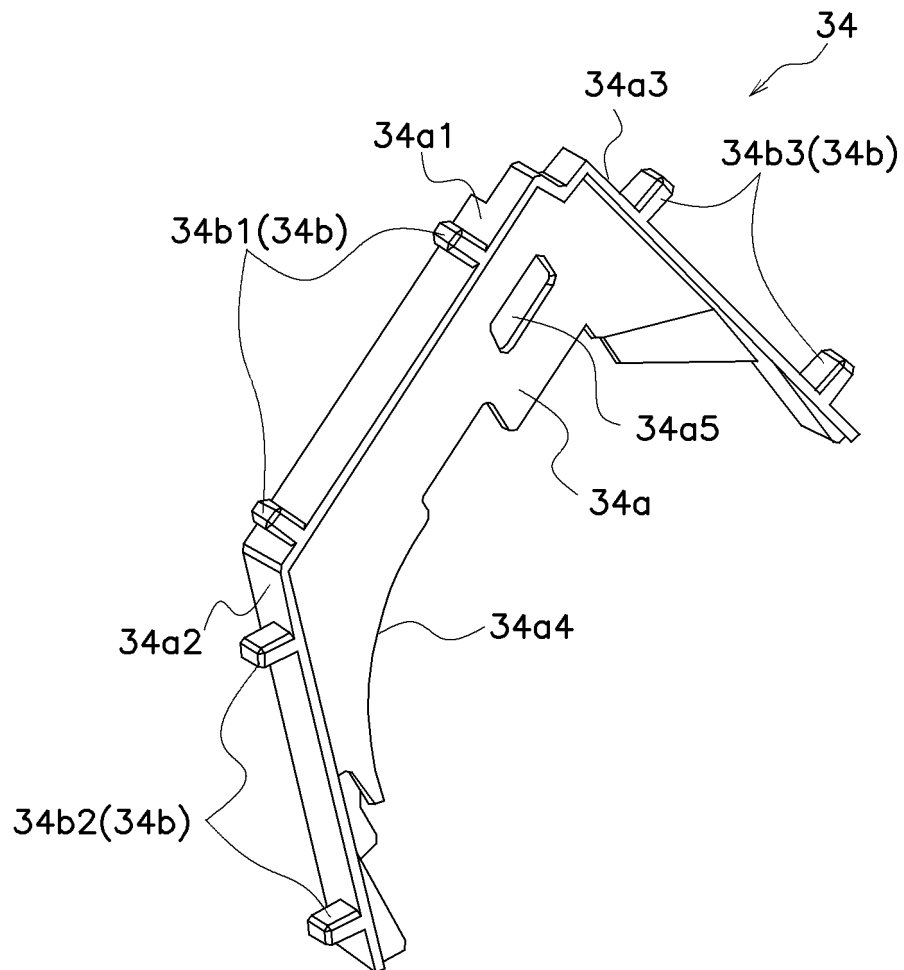


FIG. 8

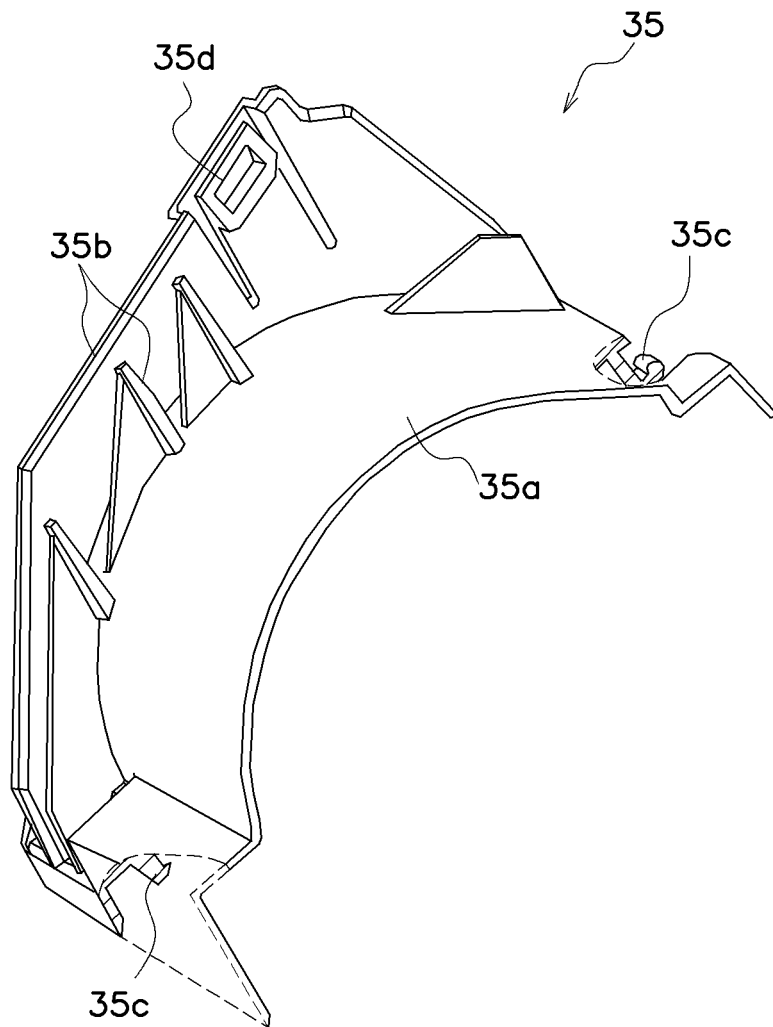


FIG. 9

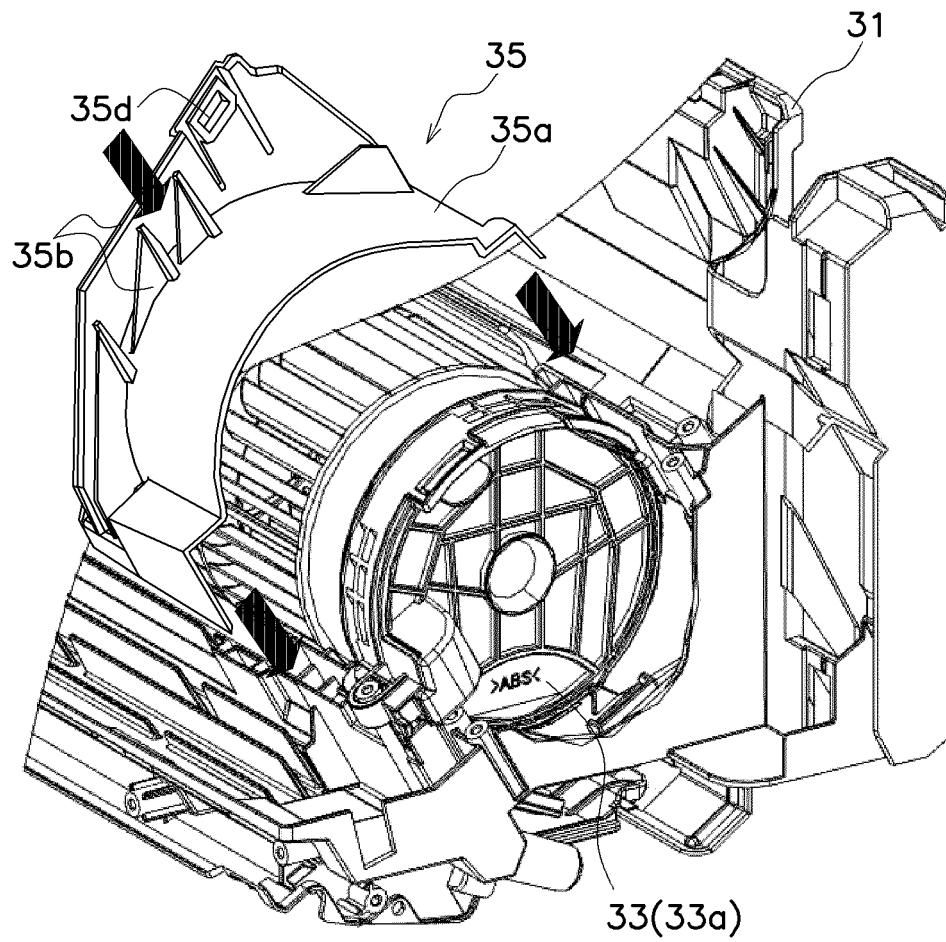


FIG. 10

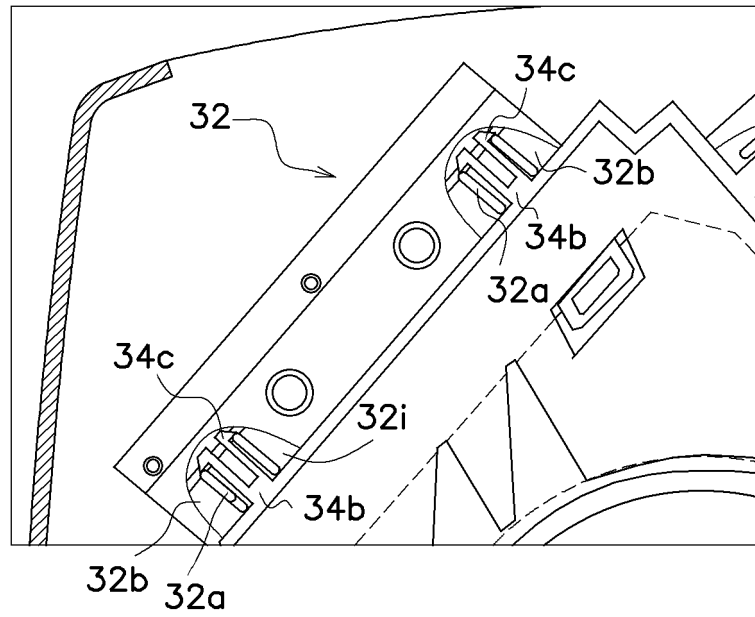


FIG. 11

INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2022/045107

A. CLASSIFICATION OF SUBJECT MATTER

F24F 1/0063(2019.01)i; **F25B 39/00**(2006.01)i; **F28D 1/053**(2006.01)i; **F28F 1/02**(2006.01)i; **F28F 1/32**(2006.01)i
 FI: F24F1/0063; F28F1/02 B; F28D1/053 A; F28F1/32 B; F28F1/32 N; F25B39/00 D

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)

F24F1/0063; F25B39/00; F28D1/053; F28F1/02; F28F1/32

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

Published examined utility model applications of Japan 1922-1996
 Published unexamined utility model applications of Japan 1971-2023
 Registered utility model specifications of Japan 1996-2023
 Published registered utility model applications of Japan 1994-2023

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

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 10605547 B2 (VALEO SYSTEMES THERMIQUES) 31 March 2020 (2020-03-31) specification, column 2, lines 16-67, fig. 1-4	1-2, 4-6, 11
Y		11-12
A		3, 7-10
X	JP 2016-133256 A (DAIKIN INDUSTRIES, LTD.) 25 July 2016 (2016-07-25) paragraphs [0105]-[0130], fig. 1-18	1-2, 6
X	Microfilm of the specification and drawings annexed to the request of Japanese Utility Model Application No. 142618/1983 (Laid-open No. 050379/1985) (MATSUSHITA SEIKO CO., LTD.) 09 April 1985 (1985-04-09), specification, p. 3, line 7 to p. 5, line 6, fig. 3-4	1-2, 5-6
Y		3-4, 7-12
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INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
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