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(71) Applicant: **MITSUBISHI HEAVY INDUSTRIES THERMAL SYSTEMS, LTD.**
Tokyo 108-8215 (JP)

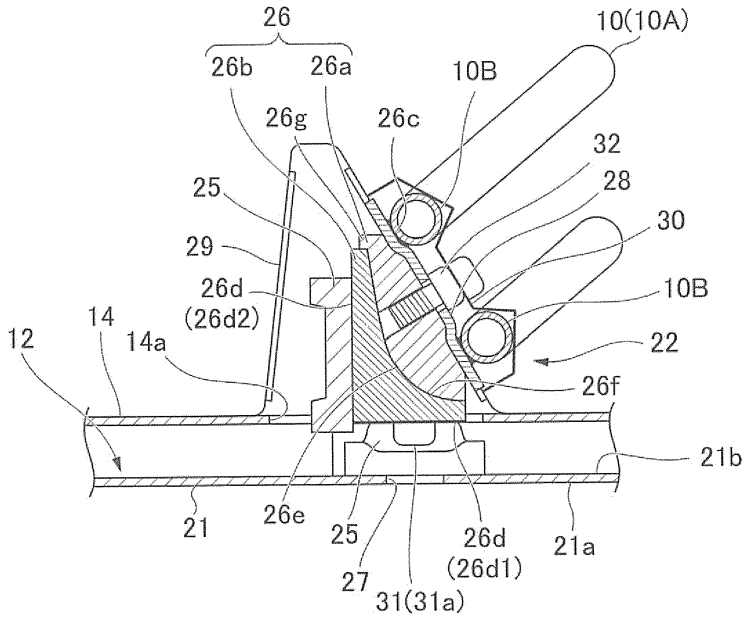
(72) Inventors:
- **OISHI, Tsuyoshi**
  TOKYO 108-8215 (JP)
- **TAKEUCHI, Nobuyuki**
  TOKYO 108-8215 (JP)
- **MURAKAMI, Kenichi**
  TOKYO 108-8215 (JP)

(74) Representative: **Cabinet Beau de Loménie**
158, rue de l'Université
75340 Paris Cedex 07 (FR)

(54) COMPOSITE PIPE, REFRIGERATING APPARATUS, AND METHOD FOR MANUFACTURING COMPOSITE PIPE

(57) The present invention provides a composite pipe which includes a metallic refrigerant pipe (10); a plate-like joining portion (28) formed of the same type of metal as the refrigerant pipe (10) and having one surface to which a pipe wall of the refrigerant pipe (10) is joined; and a metallic cooling body (26) having a front surface (26c) which comes into contact with the other surface of the joining portion (28) and a back surface (26d) which is provided on the opposite side to the front surface (26c) and comes into contact with the heat generation component (25). The refrigerant pipe (10) is joined to the one surface of the joining portion (28) by brazing.

FIG. 3



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Description

BACKGROUND OF THE INVENTION

Field of the Invention

[0001] The present invention relates to a composite pipe, a refrigerating apparatus, and a method for manufacturing the composite pipe.

Description of Related Art

[0002] Conventionally, an apparatus which cools a heat generation component of a substrate unit by a cooling jacket supporting a copper pipe through which a coolant flows to a heat generation component being mounted is known. In such an apparatus, a heat transfer sheet is interposed between the cooling jacket and the pipe to reduce the thermal resistance between the cooling jacket and the pipe.

[0003] Such a heat transfer sheet is disclosed in Patent Document 1. In the invention of Patent Document 1, positional displacement, breakage or the like of the heat transfer sheet is inhibited by holding the heat transfer sheet in a sheet holding portion.

[Patent Documents]

[0004] [Patent Document 1] Japanese Unexamined Patent Application, First Publication No. 2015-233074

SUMMARY OF THE INVENTION

[0005] However, in the apparatus for cooling the heat generation component as disclosed in Patent Document 1, a refrigerant pipe such as a copper pipe may become damaged by corrosion, and there is a risk of leakage of refrigerant when the damage is significant. That is, in a case where the refrigerant pipe and the cooling jacket are made of dissimilar metals, there is a portion in which a pipe wall of the refrigerant pipe and the cooling jacket come into direct contact with each other, and when moisture is present at the contact position, damage to the refrigerant pipe due to dissimilar metal contact corrosion is likely to occur.

[0006] An object of the present invention is to provide a composite pipe, a refrigerating apparatus, and a method for manufacturing the composite pipe that are capable of inhibiting corrosion.

[0007] A composite pipe according to a first aspect of the present invention includes a metallic refrigerant pipe; a plate-like joining portion formed of the same type of metal as the refrigerant pipe and having one surface to which a pipe wall of the refrigerant pipe is joined; and a metallic cooling body having a front surface which comes into contact with the other surface of the joining portion and a back surface which is provided on the opposite side to the front surface and comes into contact with the heat generation component.

[0008] According to this configuration, the pipe wall of the metallic refrigerant pipe is joined to the one surface of the joining portion formed of the same kind of metal, and the other surface of the joining portion is in contact with the metallic cooling body. Therefore, the pipe wall of the refrigerant pipe does not directly come into contact with the cooling body.

[0009] Further, even if the joining portion and the cooling body made of dissimilar metals are in direct contact with each other, dissimilar metal contact corrosion occurs only between the joining portion and the cooling body, and corrosion docs not reach refrigerant pipe. Therefore, irrespective of what kind of metal the cooling body is formed, it is possible to inhibit occurrence of dissimilar metal contact corrosion in the refrigerant pipe.

[0010] According to the composite pipe of the second aspect of the present invention, in the first aspect, the refrigerant pipe may be joined to the one surface of the joining portion by brazing.

[0011] According to this configuration, since the joining portion and the refrigerant pipe are joined by brazing, the facing portions of the one surface of the joining portion and the refrigerant pipe are accurately joined via a braze of the same kind of metal. Therefore, it is possible to prevent corrosion from occurring between the one surface of the joining portion and the refrigerant pipe, while securing sufficient thermal conductivity between the one surface of the joining portion and the refrigerant pipe.

[0012] Further, the plate-like joining portion and the cooling body are attached in contact with each other. Thus, a contact area between the joining portion and the cooling body can be increased. Therefore, it is possible to secure sufficient thermal conductivity between the refrigerant pipe and the cooling body. Therefore, it is not necessary to provide a heat transfer accelerating member such as a heat transfer sheet or grease between the joining portion and the cooling body.

[0013] According to the composite pipe of a third aspect of the present invention, in the first or second aspect, the joining portion may be screwed onto the cooling body.

[0014] With such a configuration, it is possible to further improve the contact state between the cooling body and the joining portion.

[0015] According to the refrigerating apparatus of a fourth aspect of the present invention, in the first to third aspects, a heat generation component mounted on a circuit board provided so that the back surface of the cooling body comes into contact with the heat generation component may be further included.

[0016] According to this configuration, it is possible to cool the heat generation component with the cooling body, while inhibiting corrosion reaching the refrigerant pipe.

[0017] A method for manufacturing a composite pipe according to a fifth aspect of the present invention is a method for installing the composite pipe in the first to third aspects, the method including joining the pipe wall

of the refrigerant pipe to the one surface of the joining portion formed of the same type of metal as the refrigerant pipe; and bringing the cooling body into contact with the other surface of the joining portion.

[0018] According to this configuration, it is possible to cool the heat generation component with the cooling body, while inhibiting corrosion reaching the refrigerant pipe.

[0019] According to the present invention, it is possible to provide a composite pipe, a refrigerating apparatus, and a method for manufacturing the composite pipe capable of inhibiting corrosion of the refrigerant pipe and preventing damage.

BRIEF DESCRIPTION OF THE DRAWINGS

[0020]

FIG. 1 is a refrigerant circuit diagram of an air conditioner according to a first embodiment of the present invention.

FIG. 2A is a partially exploded perspective view of a controller of the air conditioner according to the embodiment of the present invention.

FIG. 2B is a cross-sectional view taken along line A-A of FIG. 2A.

FIG. 3 is a cross-sectional view of a main part of the air conditioner according to the embodiment of the present invention.

FIG. 4 is a cross-sectional view schematically showing a composite pipe and a heat generation component of the air conditioner according to the embodiment of the present invention.

FIG. 5 is a cross-sectional view showing a method for manufacturing the composite pipe of the air conditioner according to an embodiment of the present invention.

DETAILED DESCRIPTION OF THE INVENTION

[0021] An air conditioner (refrigerating apparatus) 1 according to an embodiment of the present invention will be described.

[0022] An air conditioner 1 shown in FIG. 1 mainly includes a compressor 2, a four-way switching valve 3, an outdoor fan 4, an outdoor heat exchanger 5, an electronic expansion valve (EEV) 6, an indoor fan 7, an indoor heat exchanger 8, and an accumulator 9. These devices are connected by a refrigerant pipe 10 to constitute a refrigeration cycle 11 in a closed cycle. Among these components, the compressor 2, the four-way switching valve 3, the outdoor fan 4, the outdoor heat exchanger 5, the electronic expansion valve (EEV) 6, and the accumulator 9 are accommodated in a casing 23 of an outdoor unit, and the indoor fan 7 and the indoor heat exchanger 8 are accommodated in a casing (not shown) of an indoor unit.

[0023] The compressor 2 is a device that compresses refrigerant.

[0024] The four-way switching valve 3 is a device that switches a circulation direction of the refrigerant.

[0025] The outdoor heat exchanger 5 is a device which allows exchange of heat between the refrigerant and the outside air from the outdoor fan 4.

[0026] The electronic expansion valve (EEV) 6 is a device that adiabatically expands the refrigerant.

[0027] The indoor heat exchanger 8 is a device which allows exchange of heat between the refrigerant and the inside air from the indoor fan 7. The accumulator 9 is a device which separates the liquid phase of the refrigerant that has not evaporated in the evaporator to prevent the liquid phase from flowing into the compressor 2.

[0028] Furthermore, the air conditioner 1 further includes a controller 12 that controls the operation of the air conditioner 1 on the basis of an operation command from an operation unit such as a remote controller. The controller 12 is accommodated in the casing 23 of the outdoor unit.

[0029] For example, the controller 12 is equipped with an inverter that controls the rotation speed of the compressor 2. The controller 12 has the function of switching the four-way switching valve 3 depending on the operation mode and further controlling the rotation speed of the outdoor fan 4 and the indoor fan 7, the opening degree of the electronic expansion valve 6, and the like.

[0030] Here, as shown in FIGS. 2A and 2B, the casing 23 has a board accommodating portion 14 therein. The controller 12 is attached to the board accommodating portion 14. The board accommodating portion 14 is disposed in the casing 23 of the outdoor unit with intervals between an inner surface on a front side of the casing 23 and an inner surface on a back side. Here, the front side means the front side when the outdoor unit is installed, and the back side indicates the back side when the outdoor unit is installed.

[0031] The controller 12 includes a board 21 (circuit board) attached to the board accommodating portion 14. In the present embodiment, a front surface 21a of the board 21 is disposed toward the front side and a back surface 21b of the board 21 is disposed toward the back side.

[0032] The board 21 includes various electronic components such as an active converter, a diode module, and a power transistor that constitute an inverter. A part of the various electronic components are mounted on the front surface 21a of the board 21. Further, a heat generation component 25 among the electronic components is mounted on the back surface 21b of the board 21.

[0033] As shown in FIG. 3, in the refrigerant pipe 10, a part 10A provided between the electronic expansion valve 6 and the indoor heat exchanger 8 is disposed on the back surface 21b side of the board 21 and on the back side of the board accommodating portion 14 inside the casing 23. In the part 10A, a pair of tubular portions 10B are provided by forming the refrigerant pipe 10 into a U shape as shown in FIG. 2A. As a result, the refrigerant pipe 10 has a pair of tubular portions 10B and a joining

portion 28 disposed between the tubular portions 10B to support the tubular portions 10B.

[0034] The pair of tubular portions 10B are disposed side by side in an inclined direction with respect to a depth direction (a direction from the front side to the back side) of the casing 23. More specifically, with respect to one tubular portion 10B, the other tubular portion 10B is disposed on the side of the side surface 24, which is the back side in the casing and an end surface of the casing 23 in the width direction.

[0035] The joining portion 28 is formed of the same material as the tubular portion 10B in a plate shape. The joining portion 28 is provided to be inclined obliquely with the tubular portions 10B along a direction in which the pair of tubular portions 10B are aligned. The pair of tubular portions 10B of the refrigerant pipe 10 are joined to the joining portion 28 by brazing or the like, respectively. Further, the joining portion 28 is fitted between the tubular portions 10B to protrude toward the tubular portions 10B between the tubular portions 10B.

[0036] The tubular portions 10B of the refrigerant pipe 10 are clamped at a predetermined position and in a predetermined direction, by an inclined surface of a bracket 29 having a substantially triangular shape in a top view and provided to protrude from the board accommodating portion 14 to the back surface side below the joining portion 28, and a clamping piece 30 facing the inclined surface.

[0037] Here, in the casing 23, a cooling block (cooling body) made of metal (metal with good thermal conductivity such as aluminum) which comes into contact with the pair of tubular portions 10B and the heat generation component 25 of the controller 12 is provided on the back surface 21b side of the board 21.

[0038] The cooling block 26 includes a first block 26a attached to the refrigerant pipe 10, a second block 26b attached to the heat generation component 25, and a block attachment and detachment screw 31 which allows mounting of the first block 26a and the second block 26b such that they are in contact with each other in a heat transferable manner.

[0039] The first block 26a includes a refrigerant pipe attachment surface (front surface) 26c that is provided obliquely to the back surface 21b of the board 21 and attached to the tubular portion 10B of the refrigerant pipe 10 along the inclined direction of the joining portion 28, a opposite abutting surface 26e which abuts against the second block 26b, and a refrigerant pipe attachment and detachment screw 32 which detachably attaches the joining portion 28 to the refrigerant pipe attachment surface 26c.

[0040] The refrigerant pipe attachment surface 26c has a shape corresponding to the joining portion 28 of the refrigerant pipe 10. That is, the refrigerant pipe attachment surface 26c has a shape that protrudes toward the side surface 24 between the tubular portions 10B.

[0041] In the present embodiment, the opposite abutting surface 26e has a curved shape that is convex from the joining portion 28 toward the back surface 21b of the board 21, but may be a simple flat surface, or may be formed in a stepwise shape when viewed from above. A positioning protrusion 26g protruding in the width direction of the casing 23 is provided on the opposite abutting surface 26e. The positioning protrusion 26g is provided at a position close to the end portion of the opposite abutting surface 26e away from the board 21.

[0042] The second block 26b has two heat generation component attachment surfaces (back surfaces) 26d to which the heat generation component 25 is attached, and an opposite abutting surface 26f which abuts against the opposite abutting surface 26e of the first block 26a.

[0043] One (a surface 26d1) of the two heat generation component attachment surfaces 26d faces the back surface 21b of the board 21, and the other (a surface 26d2) faces the width direction of the casing 23. That is, the two heat generation component attachment surfaces 26d are provided in a direction along the board 21 and a direction of rising from the board 21. Here, the board accommodating portion 14 is provided with an opening portion 14a. The heat generation component 25 on the back surface 21b of the board 21 protrudes to the back side of the board accommodating portion 14 through the opening portion 14a. Further, the heat generation component 25 disposed along the board 21 and mounted on the board 21, and the heat generation component 25 disposed to stand up from the board 21 and mounted on the board 21 are attached to the heat generation component attachment surface 26d by mounting screws (not shown) or the like, respectively.

[0044] The opposite abutting surface 26f has a shape running along the opposite abutting surface 26e. In other words, in the present embodiment, the opposite abutting surface 26f has a curved shape that is concave toward the back surface 21b of the board 21. Thus, the opposite abutting surface 26f and the opposite abutting surface 26e come into surface contact with each other. When the opposite abutting surface 26f and the opposite abutting surface 26e come into surface contact with each other, the end portion of the second block 26b on the side away from the board 21 abuts against the positioning protrusion 26g.

[0045] The block attachment and detachment screw 31 is disposed at a position corresponding to the attaching and detaching through hole 27 penetrating the board 21. A head portion 31a of the block attachment and detachment screw 31 is exposed to the front surface 21a of the board 21. When the block attachment and detachment screw 31 is screwed into the first block 26a through the second block 26b, the second block 26b and the first block 26a are fixed in a state in which the opposite abutting surfaces 26f and 26e are in contact with each other. The head portion 31a is formed to be smaller than the attaching and detaching through hole 27 so that the block attachment and detachment screw 31 can pass through the attaching and detaching through hole 27 of the board 21 from the front surface 21a side of the board 21. As a

result, the block attachment and detachment screw 31 can be manipulated from the front surface 21a side of the board 21, and the first block 26a and the second block 26b are detachable.

[0046] Next, the joining portion 28 will be described in detail referring to FIG. 4.

[0047] The joining portion 28 is a metal member formed in a plate shape as described above. The shape of the joining portion 28 is not particularly limited, but a flat plate shape having a plate thickness of, for example, 0.5 mm to 10 mm can be used. The joining portion 28 is made of the same kind of metal as the refrigerant pipe 10. For example, when the refrigerant pipe 10 is constituted by a copper pipe, the joining portion 28 may be made of copper or a copper-based alloy.

[0048] A pipe wall of the refrigerant pipe 10 is joined to one surface of the joining portion 28 by brazing. It is preferable that a braze 34 be made of an alloy of the same kind of metal as that of the refrigerant pipe 10. For example, when the refrigerant pipe 10 is made of a copper pipe, it may be brazed with copper brazing.

[0049] Brazing is performed on both left and right sides orthogonal to the axial direction in a state in which the refrigerant pipe 10 is disposed along the joining portion 28, and brazing is performed continuously substantially over the entire length of the facing portions of the refrigerant pipe 10 (tubular portion 10B) and the joining portion 28.

[0050] The other surface of the plate-like joining portion 28 comes into contact with the refrigerant pipe attachment surface (surface) 26c of the first block 26a.

[0051] A member including the tubular portion 10B which is a part of the refrigerant pipe 10 formed in this manner, the joining portion 28, and the cooling block 26 is referred to as a composite pipe 22.

[0052] Next, a method for manufacturing such a composite pipe 22 will be described.

[0053] First, the pipe wall of the refrigerant pipe 10 is joined to one surface of the plate-like joining portion 28 by brazing. The brazing may be performed continuously over the entire region in the extending direction of the joining portion 28 or may be performed at intervals.

[0054] Thereafter, as shown in FIG. 5, the refrigerant pipe attachment surface 26c of the first block 26a which is formed in advance is brought into contact with the other surface of the joining portion 28 in a heat transferable manner. Therefore, the composite pipe 22 is manufactured.

[0055] According to the air conditioner 1 of the present embodiment described above, the pipe wall of the metallic refrigerant pipe 10 is joined to one surface of the joining portion 28 formed of the same kind of metal, and the other surface of the joining portion 28 is on the cooling block 26. Therefore, the pipe wall of the refrigerant pipe 10 does not directly come into contact with the cooling block 26.

[0056] Therefore, even if the joining portion 28 and the cooling block 26 made of dissimilar metals are in direct contact with each other, dissimilar metal contact corrosion occurs in the joining portion 28 and the cooling block 26, and the dissimilar metal contact corrosion does not occur in the refrigerant pipe 10. Therefore, irrespective of what kind of metal the cooling block 26 is formed, it is possible to inhibit dissimilar metal contact corrosion of the refrigerant pipe 10.

[0057] Therefore, it is possible to prevent the situation in which the refrigerant pipe 10 is damaged by corrosion during use and the refrigerant flows out, and it is possible to improve the durability of the refrigerant pipe 10.

[0058] Even when the joining portion 28 is corroded, it is possible to avoid progress of corrosion to the refrigerant pipe 10 by replacing the joining portion 28.

[0059] According to the composite pipe 22 of the present embodiment, since the joining portion 28 and the refrigerant pipe 10 are joined by brazing, the opposing portions of the one surface of the joining portion 28 and the refrigerant pipe 10 are accurately joined via the braze 34. Therefore, it is easy to ensure sufficient thermal conductivity between one surface of the joining portion 28 and the refrigerant pipe 10.

[0060] Further, since the plate-like joining portion 28 and the cooling block 26 are attached to be in contact with each other, a contact area between the joining portion 28 and the cooling block 26 can be increased. Therefore, it is possible to secure sufficient thermal conductivity between the refrigerant pipe 10 and the cooling block 26. Therefore, it is not necessary to provide a heat transfer accelerating member such as a heat transfer sheet or grease between the joining portion 28 and the cooling block 26.

[0061] Further, since the joining portion 28 is fixed to the refrigerant pipe attachment surface 26c by the Refrigerant pipe attachment and detachment screw 32 by screwing, it is possible to further improve the contact state between the cooling block 26 and the joining portion 28.

[0062] Although the embodiments of the present invention have been described in detail with reference to the drawings, the specific configuration is not limited to this embodiment, and design changes and the like within a scope that does not depart from the gist of the present invention are included.

[0063] For example, the portion of the refrigerant pipe 10 disposed in contact with the cooling block 26 is not necessarily limited to the part 10A between the electronic expansion valve 6 and the indoor heat exchanger 8, and may be another portion of the refrigerant pipe 10 that is kept at a temperature at which the heat generation component 25 provided on the controller 12 can be cooled. Such another portion may be, for example, a portion between the electronic expansion valve 6 and the outdoor heat exchanger 5. That is, the composite pipe 22 can be applied to various portions in the refrigeration cycle 11.

[0064] Although the air conditioner 1 has been described as an example of the refrigeration apparatus, the above configuration may be applied to another refrigeration apparatus having a refrigeration cycle.

EXPLANATION OF REFERENCES

[0065]

1 Air conditioner
2 Compressor
3 Four-way switching valve
4 Outdoor fan
5 Outdoor heat exchanger
6 Electronic expansion valve
7 Indoor fan
8 Indoor heat exchanger
9 Accumulator
10 Refrigerant pipe
10A Part
10B Tubular portion
12 Controller
13 Outdoor unit
14 Board accommodating portion
14a Opening portion
21 Board (circuit board)
21a Front surface
21b Back surface
22 Composite pipe
23 Casing
24 Side surface
25 Heat generation component
26 Cooling block (cooling body)
26a First block
26b Second block
26c Refrigerant pipe attachment surface (front surface)
26d (26d1, 26d2) Heat generation component attachment surface (back surface)
26e Opposite abutting surface
26f Opposite abutting surface
27 Attaching and detaching through hole
28 Joining portion
29 Bracket
29a Inclined surface
30 Clamping piece
31 Block attachment and detachment screw
31a Head portion
32 Refrigerant pipe attachment and detachment screw
34 Braze

Claims

1. A composite pipe comprising:

a metallic refrigerant pipe (10);
a plate-like joining portion (28) formed of the same type of metal as the refrigerant pipe (10) and having one surface to which a pipe wall of the refrigerant pipe (10) is joined; and
a metallic cooling body (26) having a front surface (26c) which comes into contact with the other surface of the joining portion (28) and a back surface (26d) which is provided on the opposite side to the front surface (26c) and is intended to come into contact with a heat generation component (25).

2. The composite pipe according to claim 1, wherein the refrigerant pipe (10) is joined to the one surface of the joining portion (28) by brazing.

3. The composite pipe according to claim 1 or 2, wherein the joining portion (28) is screwed onto the cooling body (26).

4. A refrigerating apparatus comprising:

the composite pipe (22) according to any one of claims 1 to 3; and
a heat generation component (25) mounted on a circuit board (21) provided so that the back surface of the cooling body (26) comes into contact with the heat generation component (25).

5. A method for manufacturing the composite pipe according to any one of claims 1 to 3, the method comprising:

joining the pipe wall of the refrigerant pipe (10) to the one surface of the joining portion (28) formed of the same type of metal as the refrigerant pipe (10); and
bringing the cooling body (26) into contact with the other surface of the joining portion (28).

FIG. 1

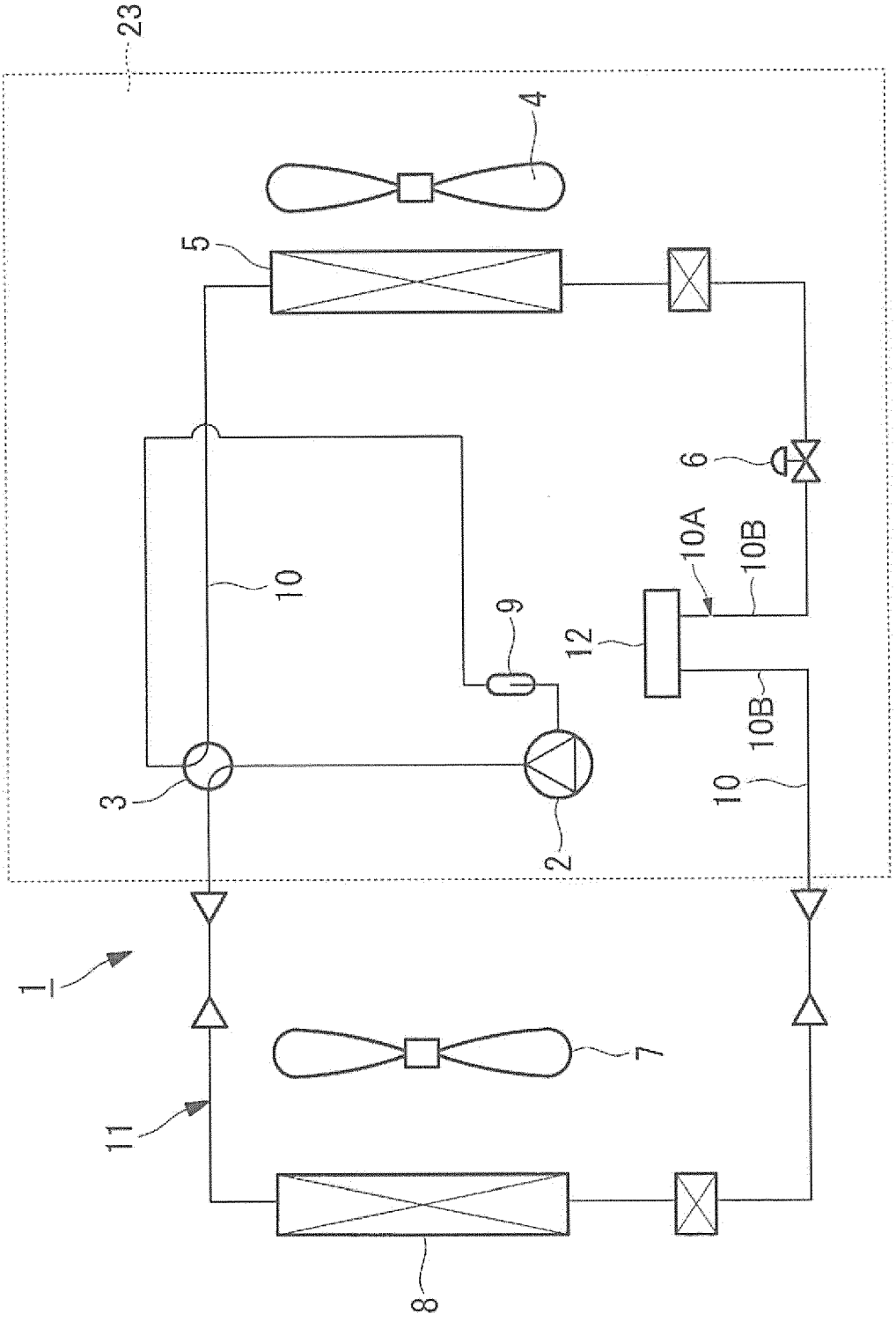
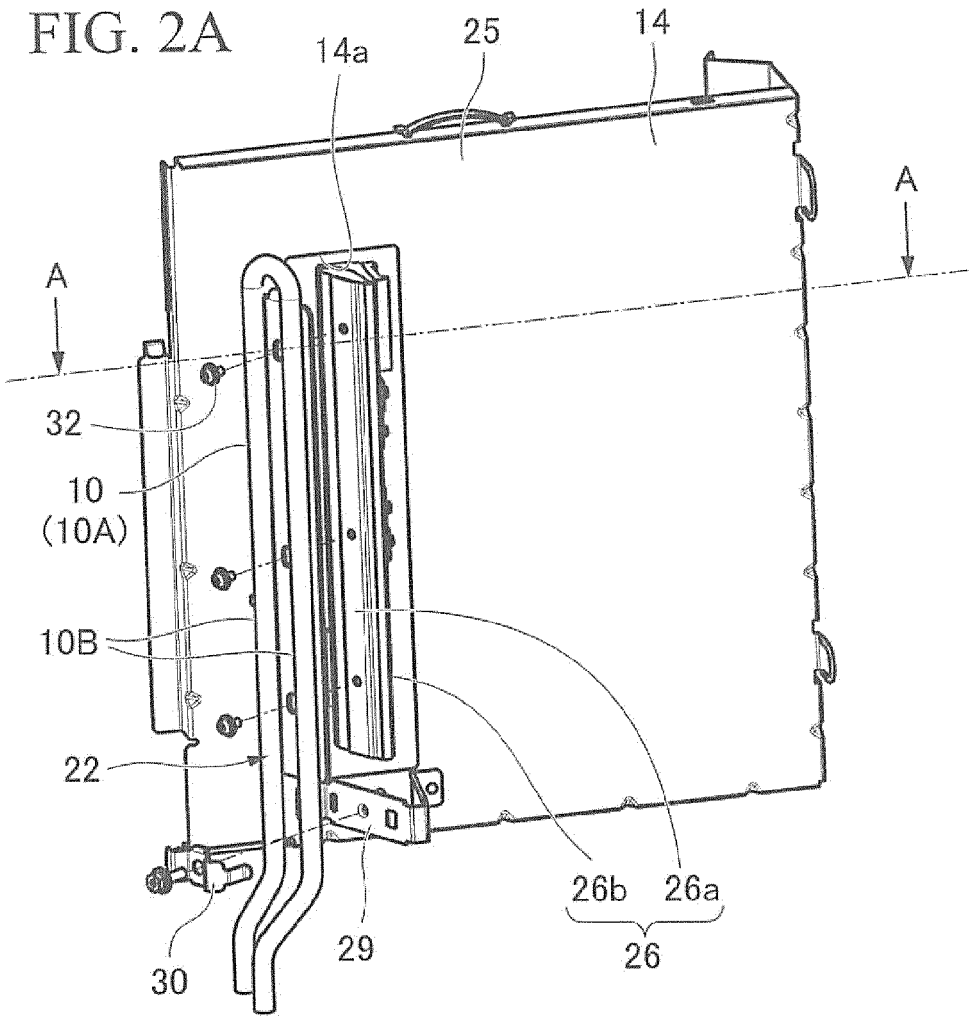


FIG. 2A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10B
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26b
26a
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29
30

FIG. 2B

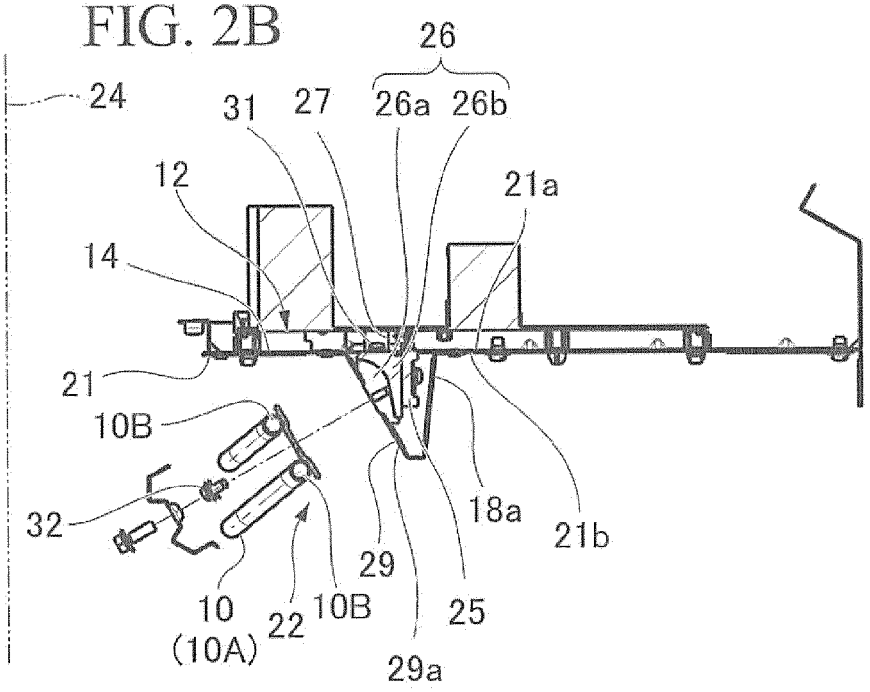
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FIG. 3

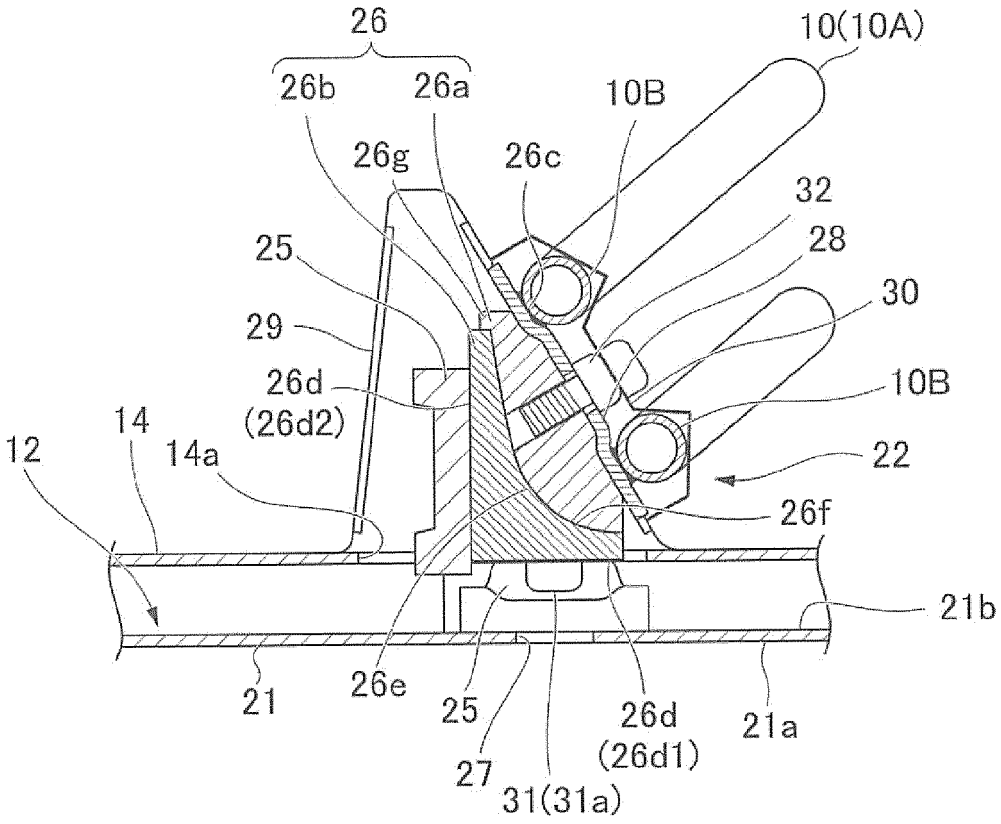
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FIG. 4

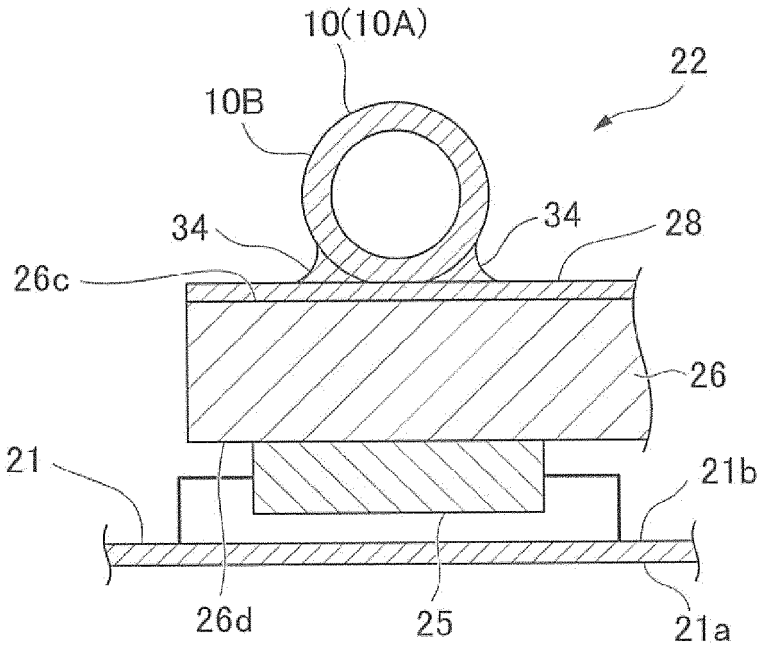
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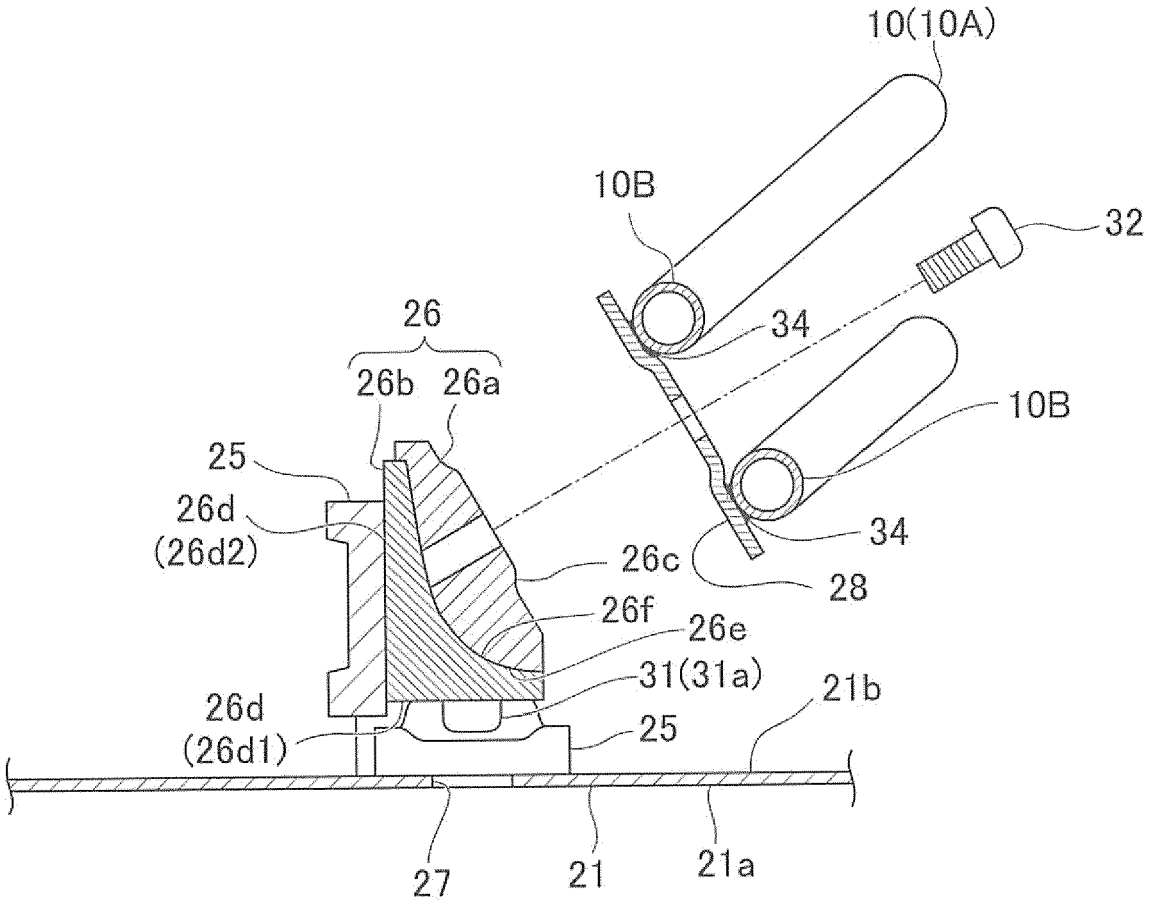
FIG. 5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21a

Europäisches Patentamt
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EUROPEAN SEARCH REPORT

Application Number
EP 18 18 0143

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	JP 2010 114121 A (DAIKIN IND LTD) 20 May 2010 (2010-05-20) * paragraph [0019] * * figures 1-3 *	1-5	INV. F25B31/00
X	EP 2 876 385 A2 (MITSUBISHI HEAVY IND LTD [JP]) 27 May 2015 (2015-05-27) * figures 1-9 *	1-5	

TECHNICAL FIELDS SEARCHED (IPC)

F25B

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	23 October 2018	Dezso, Gabor

CATEGORY OF CITED DOCUMENTS

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This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
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23-10-2018

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EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

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