



(11)

EP 4 502 505 A1

(12)

EUROPEAN PATENT APPLICATION
published in accordance with Art. 153(4) EPC

(43) Date of publication:
05.02.2025 Bulletin 2025/06

(21) Application number: **23780897.7**

(22) Date of filing: **30.03.2023**

(51) International Patent Classification (IPC):
F25B 39/00 ^(2006.01) **F28D 1/053** ^(2006.01)
F28F 1/32 ^(2006.01) **F28F 21/08** ^(2006.01)
F24F 13/22 ^(2006.01) **F28F 19/06** ^(2006.01)
F24F 1/0067 ^(2019.01) **F24F 1/14** ^(2011.01)
F24F 1/36 ^(2011.01)

(52) Cooperative Patent Classification (CPC):
F24F 1/0067; F24F 1/14; F24F 1/36; F24F 13/22;
F25B 39/00; F28F 1/32; F28F 19/06; F28F 21/08;
F28D 1/053

(86) International application number:
PCT/JP2023/013216

(87) International publication number:
WO 2023/190889 (05.10.2023 Gazette 2023/40)

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB
GR HR HU IE IS IT LI LT LU LV MC ME MK MT NL
NO PL PT RO RS SE SI SK SM TR
Designated Extension States:
BA
Designated Validation States:
KH MA MD TN

(30) Priority: **31.03.2022 JP 2022060705**
27.09.2022 JP 2022153804

(71) Applicant: **DAIKIN INDUSTRIES, LTD.**
Osaka-shi, Osaka 530-0001 (JP)

(72) Inventors:
• **NAKANO, Hiroyuki**
Osaka-shi, Osaka 530-0001 (JP)
• **AGOU, Shouta**
Osaka-shi, Osaka 530-0001 (JP)

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

(54) **AIR CONDITIONER**

(57) An air conditioner (1) includes an outdoor unit (2) including a first heat exchanger (200) and an indoor unit (3) including a second heat exchanger (300). The first heat exchanger (200) includes a first heat transfer tube (210) and a plurality of first fins (220). The second heat exchanger (300) includes a second heat transfer tube (310) and a plurality of second fins (320). The first heat transfer tube (210), the first fins (220), the second heat

transfer tube (310), and the second fins (320) are made of aluminum or an aluminum alloy. A first sacrificial layer (212) is provided on a surface of the first heat transfer tube (210). The first sacrificial layer (212) is lower in potential than a base material of the first heat transfer tube (210) and lower in potential than the first fins (220). A fin pitch (P1) of the first fins (220) is larger than a fin pitch (P2) of the second fins (220).

EP 4 502 505 A1

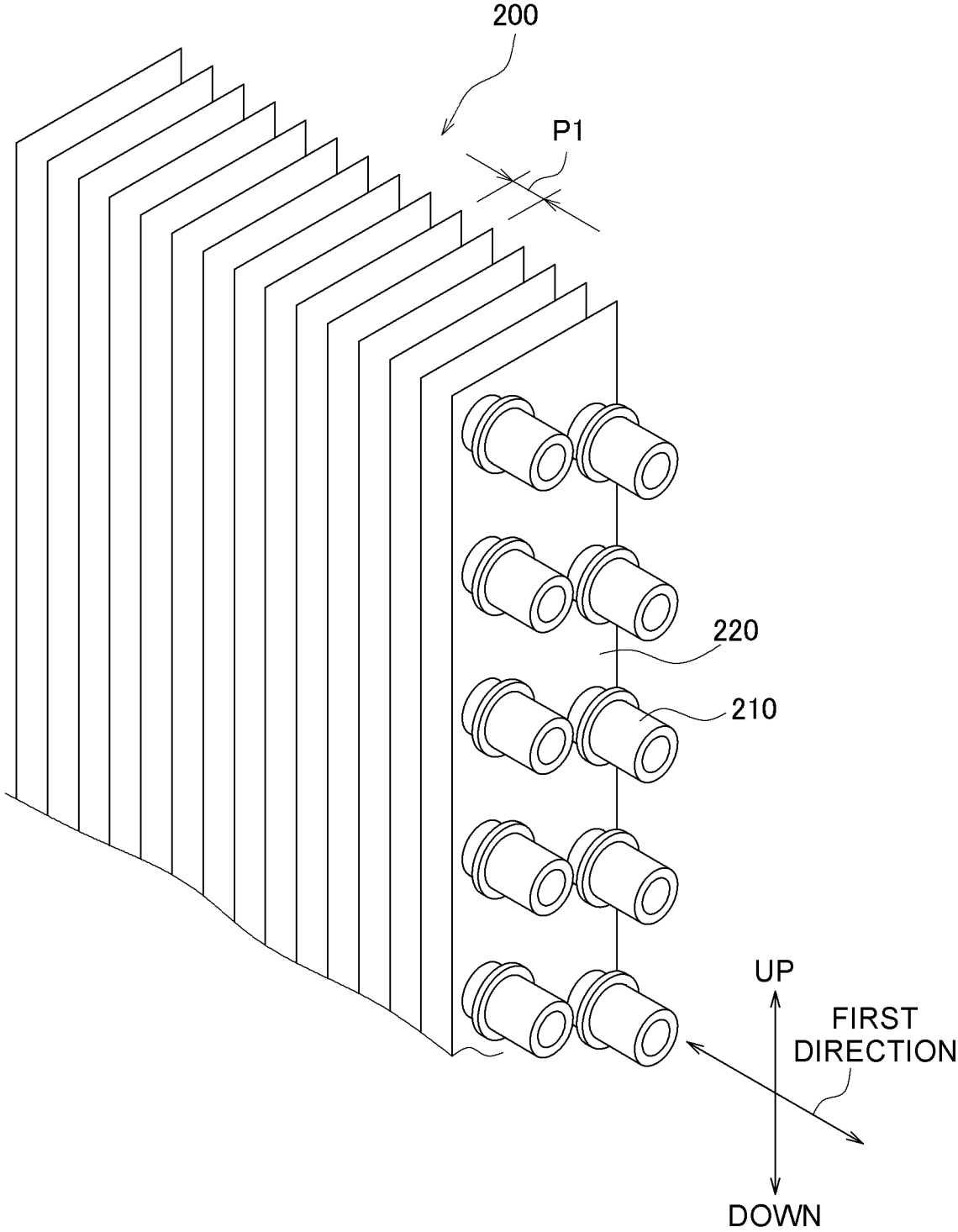


FIG. 4

Description

TECHNICAL FIELD

[0001] The present disclosure relates to an air conditioner.

BACKGROUND ART

[0002] Conventionally, as disclosed in Patent Literature 1 (JP 2001-304783 A), an air conditioner configured by connecting an indoor unit including an indoor heat exchanger and an outdoor unit including an outdoor heat exchanger is known. In the indoor heat exchanger and the outdoor heat exchanger of Patent Literature 1, a heat transfer tube penetrates a plurality of fins.

SUMMARY OF THE INVENTION

<Technical Problem>

[0003] When the heat transfer tube of the indoor heat exchanger and the outdoor heat exchanger in Patent Literature 1 are made of aluminum or an aluminum alloy, there is a problem that the heat transfer tube is more easily corroded than a heat transfer tube including copper.

<Solution to Problem>

[0004] An air conditioner according to a first aspect includes an outdoor unit and an indoor unit. The outdoor unit includes a first heat exchanger. The first heat exchanger includes a first heat transfer tube and a plurality of first fins. The first heat transfer tube is made of aluminum or an aluminum alloy. The plurality of first fins is made of aluminum or an aluminum alloy. The indoor unit includes a second heat exchanger. The second heat exchanger includes a second heat transfer tube and a plurality of second fins. The second heat transfer tube is made of aluminum or an aluminum alloy. The plurality of second fins is made of aluminum or an aluminum alloy. A first sacrificial layer is provided on a surface of the first heat transfer tube. The first sacrificial layer is lower in potential than a base material of the first heat transfer tube and lower in potential than the first fins. A fin pitch of the first fins is larger than a fin pitch of the second fins.

[0005] In the air conditioner according to the first aspect, since the first sacrificial layer which is lower in potential than the base material is provided in the first heat transfer tube made of aluminum or an aluminum alloy, corrosion of the base material can be suppressed. However, the first sacrificial layer, which is lower in potential than the first fin made of aluminum or an aluminum alloy, may be corroded due to the first fins.

[0006] Thus, in the air conditioner according to the first aspect, since the first heat exchanger of the outdoor unit is more susceptible to salt damage than the second heat

exchanger of the indoor unit, the fin pitch of the first fins of the first heat exchanger is made larger than the fin pitch of the second fins of the second heat exchanger. As a result, a surface area of the first fin in contact with the first sacrificial layer of the first heat transfer tube can be reduced. As a result, corrosion of the first sacrificial layer can be suppressed.

[0007] An air conditioner according to a second aspect is the air conditioner according to the first aspect, in which the first heat transfer tube and the second heat transfer tube have a cylindrical shape.

[0008] Workability is required for the first fin and the second fin attached to the first heat transfer tube and the second heat transfer tube having a cylindrical shape. In the air conditioner according to the second aspect, since the first fin is higher in potential than the first sacrificial layer, it is possible to suppress deterioration in workability of the first fin. Therefore, the air conditioner of the present disclosure is suitably used for the air conditioner including the first heat exchanger having the cylindrical first heat transfer tube and the second heat exchanger having the cylindrical second heat transfer tube.

[0009] An air conditioner according to a third aspect is the air conditioner according to the first or second aspect, in which a first surface layer containing a resin is provided on a surface of the first fin.

[0010] In the air conditioner according to the third aspect, a corrosion rate of the first sacrificial layer can be reduced by an electric resistance between the first surface layer containing a resin and the first heat transfer tube.

[0011] An air conditioner according to a fourth aspect is the air conditioner according to the third aspect, in which a second surface layer containing a resin is provided on a surface of the second fin. A thickness of the first surface layer is larger than a thickness of the second surface layer.

[0012] In the air conditioner according to the fourth aspect, the electric resistance between the first surface layer of the outdoor unit and the first heat transfer tube, which are susceptible to salt damage, can be made larger than an electric resistance between the second surface layer of the indoor unit and the second heat transfer tube. Therefore, the corrosion rate of the first sacrificial layer can be further reduced.

[0013] An air conditioner according to a fifth aspect is the air conditioner according to any of the first to fourth aspects, in which a second sacrificial layer is provided on a surface of the second heat transfer tube. The second sacrificial layer is lower in potential than a base material of the second heat transfer tube and lower in potential than the second fins.

[0014] In the air conditioner according to the fifth aspect, since the second sacrificial layer which is lower in potential than the base material is provided in the second heat transfer tube made of aluminum or an aluminum alloy, corrosion of the base material can be suppressed. In addition, since the second sacrificial layer is lower in

potential than the second fins, it is possible to suppress deterioration in workability of the second fins.

[0015] An air conditioner according to a sixth aspect is the air conditioner according to any of the first to fifth aspects, in which a difference between the fin pitch of the first fins and the fin pitch of the second fins is 0.1 mm or more and 0.3 mm or less.

[0016] In the air conditioner according to the sixth aspect, the corrosion of the first sacrificial layer can be further suppressed by setting the pitch difference to 0.1 mm or more and 0.3 mm or less.

[0017] An air conditioner according to a seventh aspect is the air conditioner according to any of the first to sixth aspects, in which the fin pitch of the first fins is more than 1.0 times and less than 1.3 times the fin pitch of the second fins.

[0018] In the air conditioner according to the seventh aspect, by setting a ratio of the fin pitch of the first fins to the fin pitch of the second fins (the fin pitch of the first fins/the fin pitch of the second fins) to more than 1.0 and less than 1.3, the corrosion of the first sacrificial layer can be further suppressed.

[0019] An air conditioner according to an eighth aspect is the air conditioner according to any of the first to seventh aspects, in which a second sacrificial layer is provided on a surface of the second heat transfer tube. The second sacrificial layer is lower in potential than the base material of the second heat transfer tube. A thickness of the first sacrificial layer and a thickness of the second sacrificial layer are the same.

[0020] In the air conditioner according to the eighth aspect, since the first sacrificial layer of the first heat transfer tube and the second sacrificial layer of the second heat transfer tube can be made common, a production efficiency of the first heat exchanger and the second heat exchanger can be improved.

[0021] An air conditioner according to a ninth aspect is the air conditioner according to any of the first to eighth aspects, in which an outer diameter of the first transfer tube and an outer diameter of the second heat transfer tube are the same.

[0022] In the air conditioner according to the ninth aspect, since the outer diameter of the first heat transfer tube and the outer diameter of the second heat transfer tube can be made common, the production efficiency of the first heat exchanger and the second heat exchanger can be improved.

[0023] An air conditioner according to a tenth aspect is the air conditioner according to any of the first to ninth aspects, in which a material of the first transfer tube and a material of the second heat transfer tube are the same.

[0024] In the air conditioner according to the tenth aspect, since the material of the first heat transfer tube and the material of the second heat transfer tube can be made common, the production efficiency of the first heat exchanger and the second heat exchanger can be improved.

[0025] An air conditioner according to an eleventh

aspect is the air conditioner according to any of the first to tenth aspects, in which the outdoor unit further includes a first drain pan that receives water. The indoor unit further includes a second drain pan that receives water. A plurality of the first heat transfer tubes and a plurality of the second heat transfer tubes are provided. A lowermost end of the plurality of first heat transfer tubes is located above a water level of the first drain pan. A lowermost end of the plurality of second heat transfer tubes is located above a water level of the second drain pan.

[0026] In the air conditioner according to the eleventh aspect, it is possible to prevent the water in the first drain pan from adhering to the first heat transfer tube, and it is possible to prevent the water in the second drain pan from adhering to the second heat transfer tube. Therefore, corrosion of the first heat transfer tube due to water in the first drain pan can be suppressed, and corrosion of the second heat transfer tube due to water in the second drain pan can be suppressed.

[0027] An air conditioner according to a twelfth aspect is the air conditioner according to any of the first to eleventh aspects, in which the plurality of first fins is stacked in a first direction in which the first heat transfer tubes extend, and includes a first collar through which the first heat transfer tube passes. The first collar portion includes the first upright portion, the flat portion, the second upright portion, and the flange. The first upright portion extends in the first direction from the fin body. The flat portion extends from the first upright portion toward the first heat transfer tube. The second upright portion extends from the flat portion along the first heat transfer tube. The flange extends outward from the second upright portion. One flat portion is in contact with the flange of another adjacent first fin. The plurality of second fins is stacked in a second direction in which the second heat transfer tubes extend, and includes a second collar through which the second heat transfer tube passes. The second collar includes a first upright portion, a flat portion, a second upright portion, and a flange. The first upright portion extends in the second direction from the fin body. The flat portion extends from the first upright portion toward the second heat transfer tube. The second upright portion extends from the flat portion along the second heat transfer tube. The flange extends outward from the second upright portion. One flat portion is in contact with the flange of another adjacent second fin.

[0028] In the air conditioner according to the twelfth aspect, since a gap is generated in the first collar of the first fin and the second collar of the second fin to be stacked, the problem of corrosion is serious. Therefore, the air conditioner of the present disclosure is suitably used for the air conditioner including the first heat exchanger having the first fin and the second heat exchanger having the second fin having such a structure.

[0029] An air conditioner according to a thirteenth aspect is the air conditioner according to any of the first to twelfth aspects, in which the plurality of first fins is stacked in a first direction in which the first heat transfer tubes

extend, and includes a first collar through which the first heat transfer tube passes. The first collar includes a second upright portion and a flange. The second upright portion extends along the first heat transfer tube. The flange extends outward from the second upright portion. The plurality of second fins is stacked in a second direction in which the second heat transfer tubes extend, and includes a second collar through which the second heat transfer tube passes. The second collar includes a second upright portion and a flange. The second upright portion extends along the second heat transfer tube. The flange extends outward from the second upright portion. A coupling portion between the flange and the second upright portion of each of the first collar and the second collar has a curved shape with a curvature radius of 0.2 mm or more.

[0030] In the air conditioner according to the thirteenth aspect, since a gap is generated in the collars (here, the coupling portion between the second upright portion and the flange) of the first fin and the second fin to be stacked, the problem of corrosion is serious. Therefore, the air conditioner of the present disclosure is suitably used for the air conditioner including the first heat exchanger having the first fin and the second heat exchanger having the second fin having such a structure.

[0031] An air conditioner according to a fourteenth aspect is the air conditioner according to any of the first to fourth aspects, in which a second sacrificial layer is provided on a surface of the second heat transfer tube. The second sacrificial layer is lower in potential than the base material of the second heat transfer tube and higher in potential than the second fins.

[0032] In the air conditioner according to the fourteenth aspect, since the second sacrificial layer which is lower in potential than the base material is provided in the second heat transfer tube made of aluminum or an aluminum alloy, corrosion of the base material can be suppressed. Since the second sacrificial layer is higher in potential than the second fin, even when the fin pitch is smaller, corrosion of the second sacrificial layer by the second fin can be suppressed.

[0033] An air conditioner according to a fifteenth aspect is the air conditioner according to any of the first to fourteenth aspects, in which a rate of zinc content of the first fin is higher than a rate of zinc content of the second fin.

[0034] In the air conditioner according to the fifteenth aspect, since the rate of zinc content of the first fin of the outdoor unit susceptible to salt damage is higher than the rate of zinc content of the second fin of the indoor unit, the potential of the first fin can be lowered. Therefore, a potential difference between the first fin and the first sacrificial layer can be reduced. As a result, corrosion of the first sacrificial layer can be further suppressed.

BRIEF DESCRIPTION OF THE DRAWINGS

[0035]

FIG. 1 is an external view of an air conditioner according to an embodiment of the present disclosure.

FIG. 2 is a schematic diagram of an outdoor unit.

FIG. 3 is a schematic diagram of an indoor unit.

FIG. 4 is a perspective view of a first heat exchanger.

FIG. 5 is a sectional view of first and second heat transfer tubes.

FIG. 6 is a sectional view of a first heat exchanger and a second heat exchanger.

FIG. 7 is a plan view of a first fin and a second fin.

FIG. 8 is a perspective view of the second heat exchanger.

FIG. 9 is a sectional view of the first heat transfer tube and the second heat transfer tube according to a modification.

FIG. 10 is a sectional view of the first fin according to an embodiment.

FIG. 11 is a sectional view of the second fin according to an embodiment.

DESCRIPTION OF EMBODIMENTS

[0036] An air conditioner according to an embodiment of the present disclosure will be described with reference to the drawings. In the following description, expressions indicating directions such as "up", "down", and the like are appropriately used, and these expressions indicate directions in a state of normal use, and the present disclosure is not limited thereto.

(1) Overall configuration

[0037] As illustrated in FIG. 1, an air conditioner 1 according to an embodiment of the present disclosure includes an outdoor unit 2, an indoor unit 3, and a connection pipe 4. The outdoor unit 2 is installed outdoors. The indoor unit 3 is installed indoors. Here, the indoor unit 3 is attached to an indoor wall surface or the like. The connection pipe 4 connects the outdoor unit 2 and the indoor unit 3. Such an air conditioner 1 can perform a cooling operation, a heating operation, and the like indoors.

[0038] As illustrated in FIG. 2, the outdoor unit 2 includes a first heat exchanger 200, a first fan 21, a first drain pan 22, and the like. The first fan 21 sucks outdoor air into the outdoor unit 2, supplies the outdoor air to the first heat exchanger 200, and then discharges the out-

door air to the outside of the outdoor unit 2. The first heat exchanger 200 exchanges heat between the outdoor air and a refrigerant. The first heat exchanger 200 is a heat exchanger that functions as a radiator for the refrigerant during the cooling operation, and functions as an evaporator for the refrigerant during the heating operation. The first drain pan 22 receives water.

[0039] As illustrated in FIG. 3, the indoor unit 3 includes a second heat exchanger 300, a second fan 31, a second drain pan 32, and the like. The second fan 31 sucks indoor air into the indoor unit 3, supplies the indoor air to the second heat exchanger 300, and then discharges the indoor air to the outside of the indoor unit 3. The second heat exchanger 300 exchanges heat between the refrigerant and the indoor air. The second heat exchanger 300 is a heat exchanger that functions as an evaporator for the refrigerant during the cooling operation, and functions as a radiator for the refrigerant during the heating operation. The second drain pan 32 receives water.

(2) Detailed configuration

(2-1) First heat exchanger

[0040] As illustrated in FIG. 4, the first heat exchanger 200 includes a plurality of first heat transfer tubes 210 and a plurality of first fins 220. The first heat transfer tubes 210 and the first fins 220 are made of aluminum or an aluminum alloy. The first heat exchanger 200 according to the present embodiment is a cross-fin-tube heat exchanger.

(2-1-1) First heat transfer tube

[0041] The first heat transfer tubes 210 each allow the refrigerant to flow therethrough. The first heat transfer tube 210 has a cylindrical shape. Here, the first heat transfer tube 210 is a round tube. The first heat transfer tube 210 is provided with a through hole through which the refrigerant that exchanges heat with the outdoor air in the first heat exchanger 200 passes. The through hole of the first heat transfer tube 210 penetrates along a first direction. Here, the first direction is a longitudinal direction.

[0042] As illustrated in FIG. 5, the first heat transfer tube 210 includes a first base material 211 and a first sacrificial layer 212. The first sacrificial layer 212 is provided on a surface of the first heat transfer tube 210. The first sacrificial layer 212 may be provided on the entire surface of the first heat transfer tube 210, or may be provided on a part of the surface of the first heat transfer tube 210 as illustrated in FIG. 5. In other words, the first sacrificial layer 212 may be formed on an entire exposed outer surface, or may be formed on a part of the exposed outer surface as illustrated in FIG. 5. The first sacrificial layer 212 is formed in a part in a thickness direction from the outer surface of the first heat transfer tube 210 toward an inner surface through which the

refrigerant flows, and is not formed in an entire thickness. In other words, in the first heat transfer tube 210, the first sacrificial layer 212 is not formed on at least a part of the inner surface through which the refrigerant flows. In the present embodiment, the first sacrificial layer 212 is not formed on the entire inner surface of the first heat transfer tube 210.

[0043] The first sacrificial layer 212 is lower in potential than the first base material 211 of the first heat transfer tube 210 and lower in potential than the first fin 220. The potential difference between the potential of the first sacrificial layer 212 and the potential of the first base material 211 is, for example, 226 mV. The potential difference between the potential of the first sacrificial layer 212 and the potential of the first fin 220 is, for example, 180 mV. The first sacrificial layer 212 contains a metal such as zinc (Zn) in order to lower the potential. The first sacrificial layer 212 according to the present embodiment is a zinc diffusion layer sprayed with zinc. The first sacrificial layer 212 on the outer surface side prevents a progress of corrosion of the first base material 211 on the inner surface side in the first heat transfer tube 210.

[0044] As illustrated in FIG. 4, the plurality of first heat transfer tubes 210 is aligned in an up-down direction. A lowermost end of each of the plurality of first heat transfer tubes 210 is located above a water level of the first drain pan 22 (see FIG. 2). Here, the lowermost end of each of the plurality of first heat transfer tubes 210 is located above a highest water level when the first drain pan 22 receives a maximum amount of water.

(2-1-2) First fin

[0045] The first fin 220 increases a heat transfer area between the first heat transfer tube 210 and the outdoor air to promote heat exchange between the refrigerant and the outdoor air. The first fin 220 is in contact with the first heat transfer tube 210.

[0046] The first fin 220 is lower in potential than the first base material 211 of the first heat transfer tube 210 and higher in potential than the first sacrificial layer 212. In other words, the first base material 211, the first fin 220, and the first sacrificial layer 212 have higher potentials in that order. The potential difference between the potential of the first fin 220 and the potential of the first base material 211 is, for example, 46 mV. The first fin 220 according to the present embodiment contains zinc.

[0047] The rate of zinc content of the first fin 220 is preferably 0.5 mass% or more. The "rate of zinc content" described in the present specification is a value measured by, for example, an emission spectroscopic analysis method.

[0048] As illustrated in FIG. 10, the first fin 220 includes a first body 220a and a first surface layer 220b. The first surface layer 220b is provided on a surface of the first body 220a. Here, the first surface layers 220b are provided on both surfaces extending in an extending direc-

tion of the first body 220a.

[0049] A thickness W220b of the first surface layer 220b is smaller than a thickness W220a of the first body 220a. Each thickness of the first fin 220 is a maximum value of a distance in the first direction from the outer surface toward the inside.

[0050] The first surface layer 220b contains a resin. The resin has electric resistance. An electrical conductivity of the first surface layer 220b is smaller than an electrical conductivity of the first body 220a. The first surface layer 220b is a layer formed by performing a surface treatment on the surface of the first body 220a. The first surface layer 220b imparts hydrophilicity, corrosion resistance, and the like to the first fin 220. The first surface layer 220b may be a single layer or a plurality of layers.

[0051] An electric resistance value of the first surface layer 220b is preferably $1 \times 10^4 \Omega$ or more and $1 \times 10^{10} \Omega$ or less, and more preferably $1 \times 10^5 \Omega$ or more and $1 \times 10^8 \Omega$ or less.

[0052] The plurality of first fins 220 is stacked in the first direction (see FIG. 4) in which the first heat transfer tubes 210 extend. Here, the plurality of first fins 220 extends in the up-down direction so as to cross (be orthogonal to in FIG. 4) the first heat transfer tubes 210. In the present embodiment, the plurality of first fins 220 is disposed in parallel and at equal intervals. In other words, the plurality of first fins 220 is aligned in the first direction at a predetermined fin pitch P1.

[0053] The plurality of first fins 220 each includes a fin body 221 and a first collar 222. The fin body 221 is a flat plate-shaped member. The first collar 222 allows the first heat transfer tube 210 to pass therethrough. Specifically, the first collar 222 has a through hole through which the first heat transfer tube 210 passes.

[0054] As illustrated in FIGS. 6 and 7, the first collar 222 includes a first upright portion 223, a flat portion 224, a second upright portion 225, and a flange 226. The first upright portion 223, the flat portion 224, the second upright portion 225, and the flange 226 are constituted by one member. Here, the first upright portion 223, the flat portion 224, the second upright portion 225, and the flange 226 are constituted by nesting.

[0055] The first upright portion 223 extends in the first direction from the fin body 221. Here, the first upright portion 223 is orthogonal to the fin body 221. A coupling portion between the first upright portion 223 and the fin body 221 has a curved (R) shape.

[0056] The flat portion 224 extends from the first upright portion 223 toward the first heat transfer tube 210. Here, the flat portion 224 is orthogonal to the first upright portion 223. A coupling portion between flat portion 224 and first upright portion 223 has a curved shape.

[0057] The second upright portion 225 extends from the flat portion 224 along the first heat transfer tube 210. The second upright portion 225 is in contact with the first heat transfer tube 210. Here, the second upright portion 225 is orthogonal to the flat portion 224. A coupling

portion between second upright portion 225 and flat portion 224 has a curved shape.

[0058] The flange 226 extends outward from the second upright portion 225. Here, the flange 226 is orthogonal to the second upright portion 225. The coupling portion between the flange 226 and the second upright portion 225 has a curved shape. The coupling portion has a curvature radius of 0.2 mm or more.

[0059] One flat portion 224 is in contact with the flange 226 of another adjacent first fin 220. The flat portion 224 and the flange 226 extend in the same direction.

(2-2) Second heat exchanger

[0060] As illustrated in FIG. 8, the second heat exchanger 300 includes a plurality of second heat transfer tubes 310 and a plurality of second fins 320. The second heat transfer tubes 310 and the second fins 320 are made of aluminum or an aluminum alloy. The second heat exchanger 300 according to the present embodiment is a cross-fin-tube heat exchanger.

(2-2-1) Second heat transfer tube

[0061] The second heat transfer tubes 310 each allow the refrigerant to flow therethrough. The second heat transfer tube 310 has a cylindrical shape. Here, the second heat transfer tube 310 is a round tube. The second heat transfer tube 310 is provided with a through hole through which the refrigerant that exchanges heat with the indoor air in the second heat exchanger 300 passes. The through hole of the second heat transfer tube 310 penetrates along a second direction. Here, the second direction is a longitudinal direction.

[0062] As illustrated in FIG. 5, the second heat transfer tube 310 includes a second base material 311 and a second sacrificial layer 312. The second sacrificial layer 312 is provided on a surface of the second heat transfer tube 310. The second sacrificial layer 312 may be provided on the entire surface of the second heat transfer tube 310, or may be provided on a part of the surface of the second heat transfer tube 310 as illustrated in FIG. 5. In other words, the second sacrificial layer 312 may be formed on an entire exposed outer surface, or may be formed on a part of the exposed outer surface as illustrated in FIG. 5. The second sacrificial layer 312 is formed in a part in a thickness direction from the outer surface of the second heat transfer tube 310 toward an inner surface through which the refrigerant flows, and is not formed in an entire thickness. In other words, in the second heat transfer tube 310, the second sacrificial layer 312 is not formed on at least a part of the inner surface through which the refrigerant flows. In the present embodiment, the second sacrificial layer 312 is not formed on the entire inner surface of the second heat transfer tube 310.

[0063] The second sacrificial layer 312 is lower in potential than the second base material 311 of the second

heat transfer tube 310 and lower in potential than the second fin 320. The second sacrificial layer 312 contains a metal such as zinc in order to lower the potential. The second sacrificial layer 312 according to the present embodiment is a zinc diffusion layer sprayed with zinc. The second sacrificial layer 312 on the outer surface side prevents a progress of corrosion of the second base material 311 on the inner surface side in the second heat transfer tube 310.

[0064] As illustrated in FIG. 8, the plurality of second heat transfer tubes 310 is aligned in an up-down direction. A lowermost end of each of the plurality of second heat transfer tubes 310 is located above a water level of the second drain pan 32 (see FIG. 3). Here, the lowermost end of each of the plurality of second heat transfer tubes 310 is located above a highest water level when the second drain pan 32 receives a maximum amount of water.

(2-2-2) Second fin

[0065] The second fin 320 increases a heat transfer area between the second heat transfer tube 310 and the indoor air to promote heat exchange between the refrigerant and the indoor air. The second fin 320 is in contact with the second heat transfer tube 310.

[0066] The second fin 320 is lower in potential than the second base material 311 of the second heat transfer tube 310 and higher in potential than the second sacrificial layer 312. In other words, the second base material 311, the second fin 320, and the second sacrificial layer 312 have higher potentials in that order. The second fin 320 according to the present embodiment contains zinc.

[0067] As illustrated in FIG. 11, the second fin 320 includes a second body 320a and a second surface layer 320b. The second surface layer 320b is provided on a surface of the second body 320a. Here, the second surface layers 320b are provided on both surfaces extending in an extending direction of the second body 320a.

[0068] A thickness W320b of the second surface layer 320b is smaller than a thickness W320a of the second body 320a. Each thickness of the second fin 320 is a maximum value of a distance in the second direction from the outer surface toward the inside.

[0069] The second surface layer 320b contains a resin. The resin has electric resistance. An electrical conductivity of the second surface layer 320b is smaller than an electrical conductivity of the second body 320a. The second surface layer 320b is a layer formed by performing a surface treatment on the surface of the second body 320a. The second surface layer 320b imparts hydrophilicity, corrosion resistance, and the like to the second fin 320. The second surface layer 320b may be a single layer or a plurality of layers.

[0070] The plurality of second fins 320 is stacked in the second direction (see FIG. 8) in which the second heat transfer tubes 310 extend. Here, the plurality of second fins 320 extends in the up-down direction so as to cross

(be orthogonal to in FIG. 8) the second heat transfer tubes 310. In the present embodiment, the plurality of second fins 320 is disposed in parallel and at equal intervals. In other words, the plurality of second fins 320 is aligned in the second direction at a predetermined fin pitch P2.

[0071] In FIG. 6, for convenience, the second direction and the first direction are illustrated as the same direction, but the second direction may be different from the first direction.

[0072] The plurality of second fins 320 each includes a fin body 321 and a second collar 322. The fin body 321 is a flat plate-shaped member. The second collar 322 allows the second heat transfer tube 310 to pass therethrough. Specifically, the second collar 322 has a through hole through which the second heat transfer tube 310 passes.

[0073] As illustrated in FIGS. 6 and 7, the second collar 322 includes a first upright portion 323, a flat portion 324, a second upright portion 325, and a flange 326. The first upright portion 323, the flat portion 324, the second upright portion 325, and the flange 326 are constituted by one member. Here, the first upright portion 323, the flat portion 324, the second upright portion 325, and the flange 326 are constituted by nesting.

[0074] The first upright portion 323 extends in the second direction from the fin body 321. Here, the first upright portion 323 is orthogonal to the fin body 321. A coupling portion between the first upright portion 323 and the fin body 321 has a curved (R) shape.

[0075] The flat portion 324 extends from the first upright portion 323 toward the second heat transfer tube 310. Here, the flat portion 324 is orthogonal to the first upright portion 323. A coupling portion between flat portion 324 and first upright portion 323 has a curved shape.

[0076] The second upright portion 325 extends from the flat portion 324 along the second heat transfer tube 310. The second upright portion 325 is in contact with the second heat transfer tube 310. Here, the second upright portion 325 is orthogonal to the flat portion 324. A coupling portion between second upright portion 325 and flat portion 324 has a curved shape.

[0077] The flange 326 extends outward from the second upright portion 325. Here, the flange 326 is orthogonal to the second upright portion 325. The coupling portion between the flange 326 and the second upright portion 325 has a curved shape. The coupling portion has a curvature radius of 0.2 mm or more.

[0078] One flat portion 324 is in contact with the flange 326 of another adjacent second fin 320. The flat portion 324 and the flange 326 extend in the same direction.

(2-3) Relationship between first heat exchanger and second heat exchanger

(2-3-1) Fin pitch

[0079] The fin pitch P1 of the first fins 220 illustrated in FIG. 4 is larger than the fin pitch P2 of the second fins 320

illustrated in FIG. 8. Here, the fin pitch P1 is a distance between the adjacent first fins 220. Specifically, the fin pitch P1 is a distance between opposing faces of the adjacent first fins 220. Similarly, the fin pitch P2 is a distance between the adjacent second fins 320. Specifically, the fin pitch P2 is a distance between opposing faces of the adjacent second fins 320.

[0080] A difference between the fin pitch P1 of the first fins 220 and the fin pitch P2 of the second fins 320 is 0.1 mm or more and 0.3 mm or less. In other words, a pitch difference (fin pitch P1 - fin pitch P2) is 0.1 mm or more and 0.3 mm or less.

[0081] The fin pitch P1 of the first fins 220 is more than 1.0 times and less than 1.3 times the fin pitch P2 of the second fins 320. In other words, a fin pitch ratio (the fin pitch P1 of the first fins 220/the fin pitch P2 of the second fins 320) is more than 1.0 and less than 1.3.

[0082] For example, the fin pitch P1 of the first fins 220 is 1.4 mm or more and 1.5 mm or less. The fin pitch P2 of the second fins 320 is 1.2 mm or more and 1.4 mm or less.

(2-3-2) Heat transfer tube

[0083] The outer diameter of the first heat transfer tube 210 and the outer diameter of the second heat transfer tube 310 are the same. Here, the inner diameter of the first heat transfer tube 210 and the inner diameter of the second heat transfer tube 310 are the same.

[0084] The material of the first heat transfer tube 210 and the material of the second heat transfer tube 310 are the same. Specifically, the material of the first base material 211 and the material of the second base material 311 are the same. The material of the first sacrificial layer 212 and the material of the second sacrificial layer 312 are the same.

[0085] A thickness of the first sacrificial layer 212 and a thickness of the second sacrificial layer 312 are the same. The thicknesses of the first and second sacrificial layers 212 and 312 are a maximum thickness. Here, the thickness of the first base material 211 and the thickness of the second base material 311 are the same. The thicknesses of the first and second base materials 211 and 311 are a maximum thickness.

[0086] In such a manner, in the present embodiment, the first heat transfer tube 210 and the second heat transfer tube are the same. Therefore, when the air conditioner 1 is manufactured, cylindrical heat transfer tubes made of the same material and having the same size are manufactured as the first heat transfer tube 210 and the second heat transfer tube 310, and then the heat transfer tubes are processed in accordance with the shapes of the first heat exchanger 200 and the second heat exchanger 300. Accordingly, the cost of the first heat transfer tube 210 and the second heat transfer tube 310 can be reduced.

(2-3-3) Fin

[0087] The material of the first fin 220 and the material of the second fin 320 may be the same, but preferably, the rate of zinc content of the first fin 220 is larger than the rate of zinc content of the second fin 320, and for example, the rate of zinc content of the first fin 220 is larger than the rate of zinc content of the second fin 320 by 0.2 mass% or more.

[0088] The insulation performance of the first surface layer 220b of the first fin 220 and the insulation performance of the second surface layer 320b of the second fin 320 are the same. In other words, the electrical conductivity of the first surface layer 220b of the first fin 220 and the electrical conductivity of the second surface layer 320b of the second fin 320 are the same. "Same" includes a ratio of the electrical conductivities of 10% or less. Specifically, for example, the electrical conductivity of the first surface layer 220b and the electrical conductivity of the second surface layer 320b may be completely the same, and a case where the ratio of the electrical conductivity of the first surface layer 220b to the electrical conductivity of the second surface layer 320b (the electrical conductivity of the first surface layer 220b/the electrical conductivity of the second surface layer 320b) is 1.1 times or less is included.

[0089] For example, the thickness of the first fin 220 and the thickness of the second fin 320 may be the same, but are different in the present embodiment. Here, the thickness of the first fin 220 is smaller than the thickness of the second fin.

[0090] The thickness W220a of the first body 220a of the first fin 220 illustrated in FIG. 10 is smaller than the thickness W320a of the second body 320a of the second fin 320 illustrated in FIG. 11.

[0091] The thickness W220b of the first surface layer 220b of the first fin 220 illustrated in FIG. 10 is larger than the thickness W320b of the second surface layer 320b of the second fin 320 illustrated in FIG. 11. The thickness W220b of the first surface layer 220b is preferably 1.1 times or more, more preferably 1.2 times or more, and still more preferably 1.5 times or more the thickness W320b of the second surface layer 320b.

[0092] The electric resistance value of the first surface layer 220b is preferably 1.2 times or more the electric resistance value of the second surface layer 320b.

(3) Characteristics

[0093] (3-1)

The air conditioner 1 according to the present embodiment includes the outdoor unit 2 and the indoor unit 3. The outdoor unit 2 includes the first heat exchanger 200. The first heat exchanger 200 includes the first heat transfer tube 210 and the plurality of first fins 220. The first heat transfer tubes 210 are made of aluminum or an aluminum alloy. The plurality of first fins 220 is made of aluminum or an aluminum alloy. The indoor unit 3 includes the second

heat exchanger 300. The second heat exchanger 300 includes the second heat transfer tube 310 and the plurality of second fins 320. The second heat transfer tubes 310 are made of aluminum or an aluminum alloy. The plurality of second fins 320 is made of aluminum or an aluminum alloy. The first sacrificial layer 212 is provided on the surface of the first heat transfer tube 210. The first sacrificial layer 212 is lower in potential than the first base material 211 of the first heat transfer tube 210 and lower in potential than the first fin 220. The fin pitch P1 of the first fins 220 is larger than the fin pitch P2 of the second fins 320.

[0094] In the air conditioner 1 according to the present embodiment, since the first sacrificial layer 212 which is lower in potential than the first base material 211 is provided in the first heat transfer tube 210 made of aluminum or an aluminum alloy, corrosion of the first base material 211 can be suppressed. However, the first sacrificial layer 212 is lower in potential than the first fin 220 made of aluminum or an aluminum alloy. Therefore, when a water droplet adheres across the first fin 220 and the first sacrificial layer 212, a potential difference is generated, and the first sacrificial layer 212 is consumed by the first fin 220. If rapidly consumed, the first sacrificial layer 212 fails to protect the first base material 211.

[0095] Thus, in the air conditioner 1 according to the present embodiment, since the first heat exchanger 200 of the outdoor unit 2 installed outdoors is more susceptible to salt damage than the second heat exchanger 300 of the indoor unit 3 installed indoors, the fin pitch P1 of the first fins 220 of the first heat exchanger 200 is made larger than the fin pitch P2 of the second fins 320 of the second heat exchanger 300. Therefore, by reducing the number of the first fins 220, a surface area of the first fins 220 in contact with the first sacrificial layer 212 of the first heat transfer tube 210 can be reduced. As a result, when a water droplet adheres across the first fin 220 and the first sacrificial layer 212, and a potential difference is generated, the consumption of the first sacrificial layer 212 by first fin 220 can be prevented. In this manner, in the present embodiment, corrosion of the first sacrificial layer 212 can be suppressed.

[0096] In addition, by reducing the fin pitch P2 of the second fins 320 of the second heat exchanger 300 of the indoor unit 3 which is not easily affected by salt damage, it is possible to secure a large number of second fins 320. It is therefore possible to suppress a decrease in performance of the air conditioner 1 as a whole.

[0097] (3-2)

In the air conditioner 1 according to the present embodiment, the first heat transfer tube 210 and the second heat transfer tube 310 have a cylindrical shape. Workability is required for the first fin 220 attached to the first heat transfer tube 210 having a cylindrical shape and the second fin 320 attached to the second heat transfer tube 310. Here, since the first fin 220 is higher in potential than the first sacrificial layer 212, it is possible to suppress deterioration in workability of the first fin 220. Therefore,

the air conditioner 1 according to the present embodiment can be suitably used for the air conditioner 1 including the first heat exchanger 200 having the cylindrical first heat transfer tube 210 and the second heat exchanger 300 having the cylindrical second heat transfer tube 310.

[0098] (3-3)

In the air conditioner 1 according to the present embodiment, the first surface layer 220b containing resin is provided on the surface of the first fin 220.

[0099] Here, the corrosion rate of the first sacrificial layer 212 can be reduced by the electric resistance between the first surface layer 220b containing resin and the first heat transfer tube 210.

[0100] (3-4)

In the air conditioner 1 according to the present embodiment, the second surface layer 320b containing resin is provided on the surface of the second fin 320. The thickness W220b of the first surface layer 220b is larger than the thickness W320b of the second surface layer 320b.

[0101] Here, the electric resistance between the first surface layer 220b of the outdoor unit 2 and the first heat transfer tube 210, which are susceptible to salt damage, can be made larger than an electric resistance between the second surface layer 320b of the indoor unit 3 and the second heat transfer tube 310. Therefore, the corrosion rate of the first sacrificial layer 212 can be further reduced.

[0102] (3-5)

In the air conditioner 1 according to the present embodiment, the second sacrificial layer 312 is provided on the surface of the second heat transfer tube 310. The second sacrificial layer 312 is lower in potential than the second base material 311 of the second heat transfer tube 310 and lower in potential than the second fin 320.

[0103] Here, since the second sacrificial layer 312 which is lower in potential than the second base material 311 is provided in the second heat transfer tube 310 made of aluminum or an aluminum alloy, corrosion of the second base material 311 can be suppressed. In addition, since the second sacrificial layer 312 is lower in potential than the second fin 320, it is possible to suppress deterioration in workability of the second fin 320.

[0104] (3-6)

In the air conditioner 1 according to the present embodiment, a difference (P1 - P2) between the fin pitch P1 of the first fins 220 and the fin pitch P2 of the second fins 320 is 0.1 mm or more and 0.3 mm or less. As a result, corrosion of the first sacrificial layer 212 can be further suppressed.

[0105] (3-7)

In the air conditioner 1 according to the present embodiment, the fin pitch P1 of the first fins 220 is more than 1.0 times and less than 1.3 times the fin pitch P2 of the second fins 320. As a result, corrosion of the first sacrificial layer 212 can be further suppressed.

[0106] (3-8)

In the air conditioner 1 according to the present embodi-

ment, the thickness of the first sacrificial layer 212 and the thickness of the second sacrificial layer 312 are the same. In such a manner, since the first sacrificial layer 212 of the first heat transfer tube 210 and the second sacrificial layer 312 of the second heat transfer tube 310 can be made common, a production efficiency of the first heat exchanger 200 and the second heat exchanger 300 can be improved.

[0107] (3-9)

In the air conditioner 1 according to the present embodiment, the outer diameter of the first heat transfer tube 210 and the outer diameter of the second heat transfer tube 310 are the same. In such a manner, since the outer diameter of the first heat transfer tube 210 and the outer diameter of the second heat transfer tube 310 can be made common, a production efficiency of the first heat exchanger 200 and the second heat exchanger 300 can be improved.

[0108] (3-10)

In the air conditioner 1 according to the present embodiment, the material of the first heat transfer tube 210 and the material of the second heat transfer tube 310 are the same. In such a manner, since the material of the first heat transfer tube 210 and the material of the second heat transfer tube 310 can be made common, the production efficiency of the first heat exchanger 200 and the second heat exchanger 300 can be improved.

[0109] (3-11)

In the air conditioner 1 according to the present embodiment, the outdoor unit 2 further includes the first drain pan 22 that receives water. The indoor unit 3 further includes the second drain pan 32 that receives water. The plurality of first heat transfer tubes 210 and the plurality of second heat transfer tubes 310 are provided. The lowermost end of the plurality of first heat transfer tubes 210 is located above the water level of the first drain pan 22. The lowermost end of the plurality of second heat transfer tubes 310 is located above the water level of the second drain pan 32.

[0110] As a result, it is possible to prevent the water in the first drain pan 22 from adhering to the first heat transfer tube 210, and it is possible to prevent the water in the second drain pan 32 from adhering to the second heat transfer tube 310. Therefore, corrosion of the first heat transfer tube 210 due to water in the first drain pan 22 can be suppressed, and corrosion of the second heat transfer tube 310 due to water in the second drain pan 32 can be suppressed.

[0111] (3-12)

In the air conditioner 1 according to the present embodiment, the plurality of first fins 220 is stacked in the first direction in which the first heat transfer tubes 210 extend, and includes the first collar 222 through which the first heat transfer tube 210 passes. The first collar 222 includes the first upright portion 223, the flat portion 224, the second upright portion 225, and the flange 226. The first upright portion 223 extends in the first direction from the fin body 221. The flat portion 224 extends from the first

upright portion 223 toward the first heat transfer tube 210. The second upright portion 225 extends from the flat portion 224 along the first heat transfer tube 210. The flange 226 extends outward from the second upright portion 225. One flat portion 224 is in contact with the flange 226 of another adjacent first fin 220.

[0112] The plurality of second fins 320 is stacked in the second direction in which the second heat transfer tubes 310 extend, and includes the second collar 322 through which the second heat transfer tube passes. The second collar 322 includes the first upright portion 323, the flat portion 324, the second upright portion 325, and the flange 326. The first upright portion 323 extends in the second direction from the fin body 321. The flat portion 324 extends from the first upright portion 323 toward the second heat transfer tube 310. The second upright portion 325 extends from the flat portion 324 along the second heat transfer tube 310. The flange 326 extends outward from the second upright portion 325. One flat portion 324 is in contact with the flange 326 of another adjacent second fin 320.

[0113] When the first fin 220 and the second fin 320 have such a structure, a gap is generated between the first collar 222 of the first fin 220 and the second collar 322 of the second fin 320 which are stacked. Specifically, for example, a gap is generated between the coupling portion between the first upright portion 223 and the flat portion 224 of one first fin 220 and the flange 226 of another first fin 220. The problem of corrosion becomes more serious due to adhesion of water droplets to the gap.

[0114] However, since the air conditioner 1 according to the present embodiment can suppress corrosion of the first sacrificial layer 212 by the first fin 220, the problem of corrosion can be solved even if the first fin 220 and the second fin 320 have the above-described structure. Therefore, the air conditioner 1 according to the present embodiment can be suitably used for the air conditioner 1 including the first heat exchanger 200 having the first fin 220 structured as described above and the second heat exchanger 300 having the second fin 320 structured as described above.

[0115] (3-13)

In the air conditioner 1 according to the present embodiment, the coupling portion between the second upright portion 225 of the first collar 222 and the flange 226 and the coupling portion between the second upright portion 325 of the second collar 322 and the flange 326 have a curved shape with a curvature radius of 0.2 mm or more.

[0116] When the first fin 220 and the second fin 320 have such a structure, a gap is generated in each coupling portion between the second upright portions 225 and 325 of the first fin 220 and the second fin 320, which are stacked, and the flanges 226 and 326. The problem of corrosion becomes more serious due to adhesion of water droplets to the gap.

[0117] However, the air conditioner 1 according to the present embodiment can suppress corrosion of the first

sacrificial layer 212 by the first fin 220, and thus can be suitably used for the air conditioner 1 including the first heat exchanger 200 having the first fin 220 structured as described above and the second heat exchanger 300 having the second fin 320 structured as described above.

[0118] (3-14)

In the air conditioner 1 according to the present embodiment, the rate of zinc content of the first fin 220 is preferably higher than the rate of zinc content of the second fin 320.

[0119] Here, since the rate of zinc content of the first fin 220 of the outdoor unit 2 susceptible to salt damage is higher than the rate of zinc content of the second fin 320 of the indoor unit 3, the potential of the first fin 220 can be lowered. Therefore, the potential difference between the first fin 220 and the first sacrificial layer 212 can be reduced. As a result, corrosion of the first sacrificial layer 212 can be further suppressed.

(4) Modifications

(4-1) Modification 1

[0120] In the above-described embodiment, in the second heat exchanger 300 of the indoor unit 3, the second base material 311, the second fin 320, and the second sacrificial layer 312 are higher in potential in that order, but the present disclosure is not limited thereto. In this modification, the second base material 311, the second sacrificial layer 312, and the second fin 320 are higher in potential in that order in the second heat exchanger 300 of the indoor unit 3. The potentials of the second base material 311, the second sacrificial layer 312, and the second fin 320 are adjusted by the content of a metal lower in potential, such as zinc, for example.

[0121] In this manner, in the air conditioner according to this modification, the second sacrificial layer 312 is lower in potential than the second base material 311 of the second heat transfer tube 310 and higher in potential than the second fin 320. As a result, since the second sacrificial layer 312 which is lower in potential than the second base material 311 is provided in the second heat transfer tube 310 made of aluminum or an aluminum alloy, corrosion of the second base material 311 can be suppressed. Since the second sacrificial layer 312 is higher in potential than the second fin 320, even when the fin pitch P2 of the second fin 320 is smaller, corrosion of the second sacrificial layer 312 by the second fin 320 can be suppressed.

(4-2) Modification 2

[0122] In the above-described embodiment, the first sacrificial layer 212 of the first heat transfer tube 210 and the second sacrificial layer 312 of the second heat transfer tube 310 have been described by taking a diffusion layer sprayed with zinc as an example as illustrated in FIG. 5, but the present disclosure is not limited thereto. In

this modification, as illustrated in FIG. 9, a clad material is used as the base material and the sacrificial layer.

[0123] Specifically, the first heat transfer tube 210 is formed by using a clad material in which a metal to be the first base material 211 and a metal to be the first sacrificial layer 212 are bonded together. The second heat transfer tube 310 is formed by using a clad material in which a metal to be the second base material 311 and a metal to be the second sacrificial layer 312 are bonded together.

(4-3) Modification 3

[0124] In the above-described embodiment, as illustrated in FIGS. 10 and 11, the surface layer is provided in both the first fin 220 and the second fin 320, but the present disclosure is not limited thereto. In this modification, the first fin 220 is provided with the first surface layer 220b, but the second fin 320 is not provided with the second surface layer 320b. In the air conditioner of the present disclosure, the surface layer is not required to be provided in both the first fin 220 and the second fin 320.

[0125] The embodiments of the present disclosure have been described above. It will be understood that various changes to modes and details can be made without departing from the gist and scope of the present disclosure recited in the claims.

REFERENCE SIGNS LIST

[0126]

- 1: air conditioner
- 2: outdoor unit
- 3: indoor unit
- 22: first drain pan
- 32: second drain pan
- 200: first heat exchanger
- 210: first heat transfer tube
- 211: first base material (base material)
- 212: first sacrificial layer
- 220: first fin
- 220b: first surface layer
- 221, 321: fin body
- 222: first collar
- 223, 323: first upright portion
- 224, 324: flat portion
- 225, 325: second upright portion
- 226, 326: flange
- 300: second heat exchanger
- 310: second heat transfer tube
- 311: second base material (base material)
- 312: second sacrificial layer
- 320: second fin
- 320b: second surface layer
- 322: second collar
- P1, P2: fin pitch
- W220b, W320b: thickness

CITATION LIST

PATENT LITERATURE

[0127] Patent Literature 1: JP 2001-304783 A

Claims

1. An air conditioner (1) comprising:
an outdoor unit (2) including a first heat exchanger (200) having

a first heat transfer tube (210) made of aluminum or an aluminum alloy, and
a plurality of first fins (220) made of aluminum or an aluminum alloy; and an indoor unit (3) including a second heat exchanger (300) having a second heat transfer tube (310) made of aluminum or an aluminum alloy, and

a plurality of second fins (320) made of aluminum or an aluminum alloy, wherein

a first sacrificial layer (212) that is lower in potential than a base material (211) of the first heat transfer tube and lower in potential than the first fins is provided on a surface of the first heat transfer tube, and

a fin pitch (P1) of the first fins is larger than a fin pitch (P2) of the second fins.

2. The air conditioner according to claim 1, wherein the first heat transfer tube and the second heat transfer tube have a cylindrical shape.

3. The air conditioner according to claim 1 or 2, wherein a first surface layer (220b) containing a resin is provided on a surface of the first fin.

4. The air conditioner according to claim 3, wherein

a second surface layer (320b) containing a resin is provided on a surface of the second fin, and a thickness (W220b) of the first surface layer is larger than a thickness (W320b) of the second surface layer.

5. The air conditioner according to any one of claims 1 to 4, wherein a second sacrificial layer (312) that is lower in potential than a base material (311) of the second heat transfer tube and lower in potential than the second fin is provided on a surface of the second heat transfer tube.

6. The air conditioner according to any one of claims 1

to 5, wherein a difference between the fin pitch of the first fins and the fin pitch of the second fins is 0.1 mm or more and 0.3 mm or less.

7. The air conditioner according to any one of claims 1 to 6, wherein the fin pitch of the first fins is more than 1.0 times and less than 1.3 times the fin pitch of the second fins.

8. The air conditioner according to any one of claims 1 to 7, wherein

the second sacrificial layer that is lower in potential than the base material of the second heat transfer tube is provided on the surface of the second heat transfer tube, and a thickness of the first sacrificial layer and a thickness of the second sacrificial layer are same.

9. The air conditioner according to any one of claims 1 to 8, wherein an outer diameter of the first heat transfer tube and an outer diameter of the second heat transfer tube are same.

10. The air conditioner according to any one of claims 1 to 9, wherein a material of the first heat transfer tube and a material of the second heat transfer tube are same.

11. The air conditioner according to any one of claims 1 to 10, wherein

the outdoor unit further includes a first drain pan (22) that receives water, the indoor unit further includes a second drain pan (32) that receives water, a plurality of the first heat transfer tubes and a plurality of the second heat transfer tubes are provided, a lowermost end of the plurality of first heat transfer tubes is located above a water level of the first drain pan, and a lowermost end of the plurality of second heat transfer tubes is located above a water level of the second drain pan.

12. The air conditioner according to any one of claims 1 to 11, wherein

the plurality of first fins is stacked in a first direction in which the first heat transfer tube extends and includes a first collar (222) through which the first heat transfer tube passes, the first collar includes

a first upright portion (223) extending in the first direction from a fin body (221),

a flat portion (224) extending from the first upright portion toward the first heat transfer tube,

a second upright portion (225) extending from the flat portion along the first heat transfer tube, and

a flange (226) extending outward from the second upright portion,

one of the flat portions (224) is in contact with the flange (226) of another adjacent first fin of the first fins, and

the plurality of second fins is stacked in a second direction in which the second heat transfer tube extends and includes a second collar (322) through which the second heat transfer tube passes, the second collar includes

a first upright portion (323) extending from the fin body in the second direction,

a flat portion (324) extending from the second upright portion toward the second heat transfer tube,

a second upright portion (325) extending from the flat portion along the second heat transfer tube, and

a flange (326) extending outward from the second upright portion, and

one of the flat portions (324) is in contact with the flange (326) of another adjacent second fin of the second fins.

13. The air conditioner according to any one of claims 1 to 12, wherein

the plurality of first fins is stacked in a first direction in which the first heat transfer tube extends, and includes a first collar through which the first heat transfer tube passes, and the first collar includes

a second upright portion extending along the first heat transfer tube, and

a flange extending outward from the second upright portion,

the plurality of second fins is stacked in a second direction in which the second heat transfer tube extends and includes a second collar through which the second heat transfer tube passes,

the second collar includes

a second upright portion extending along the second heat transfer tube, and
a flange extending outward from the second

upright portion,
and

a coupling portion between the second upright portion and the flange of each of the first collar and the second collar has a curved shape having a curvature radius of 0.2 mm or more.

14. The air conditioner according to any one of claims 1 to 4, wherein a second sacrificial layer (312) that is lower in potential than a base material (311) of the second heat transfer tube and higher in potential than the second fin is provided on a surface of the second heat transfer tube.

15. The air conditioner according to any one of claims 1 to 14, wherein a rate of zinc content of the first fin is higher than a rate of zinc content of the second fin.

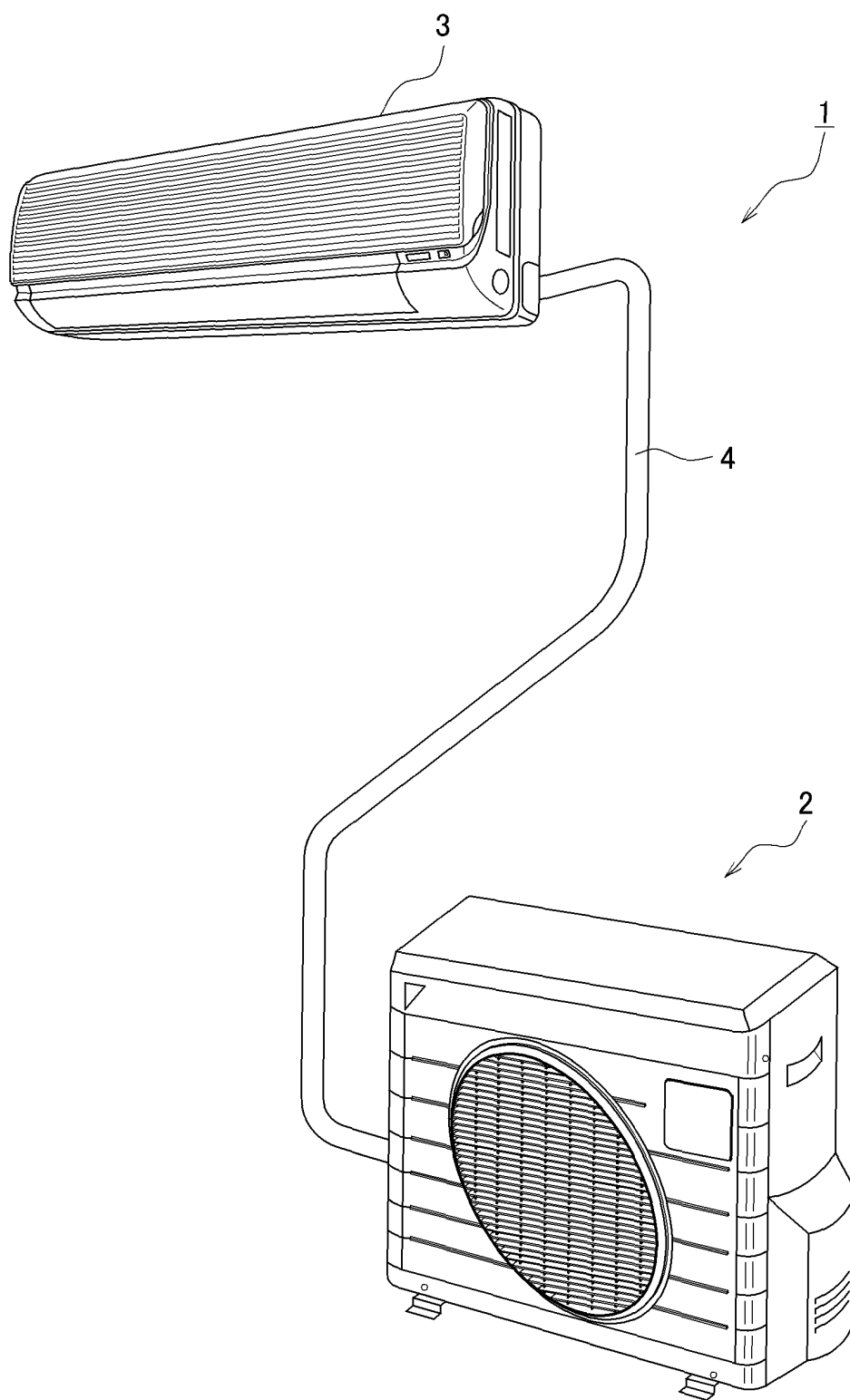


FIG. 1

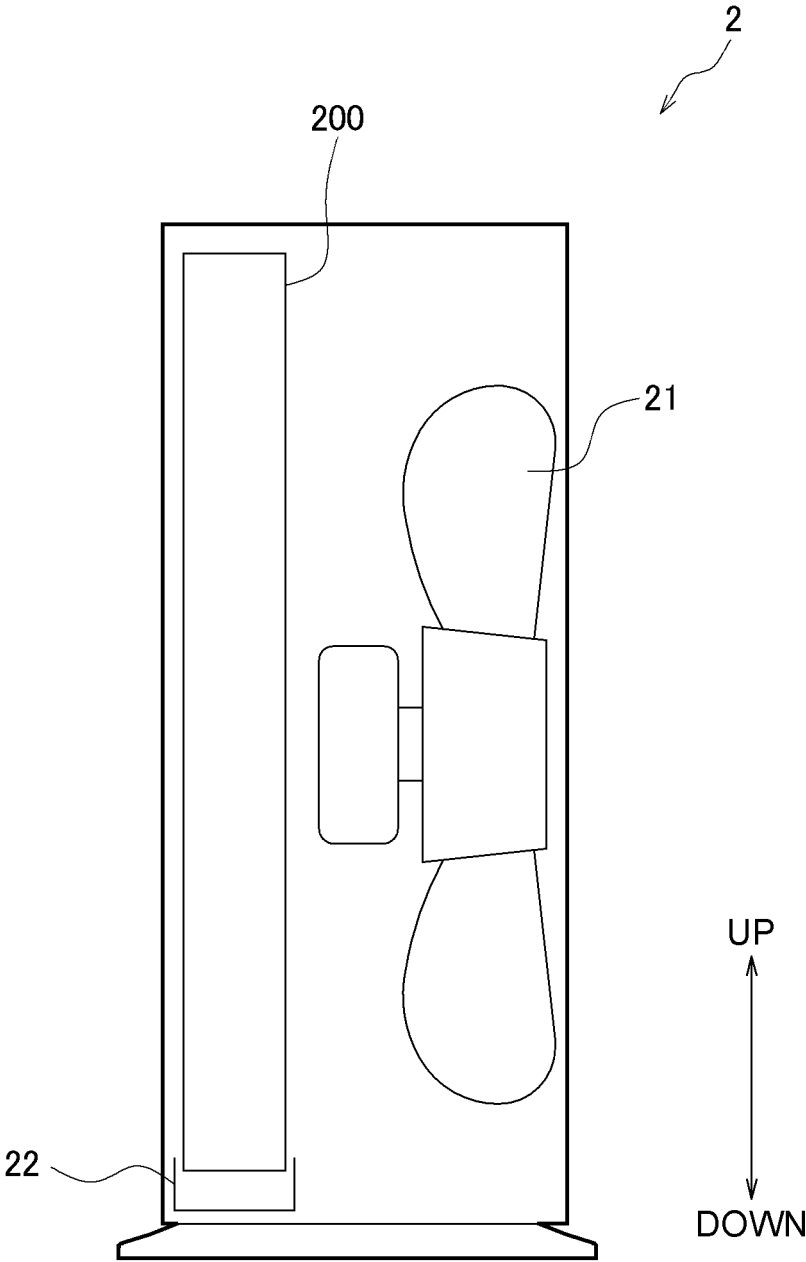


FIG. 2

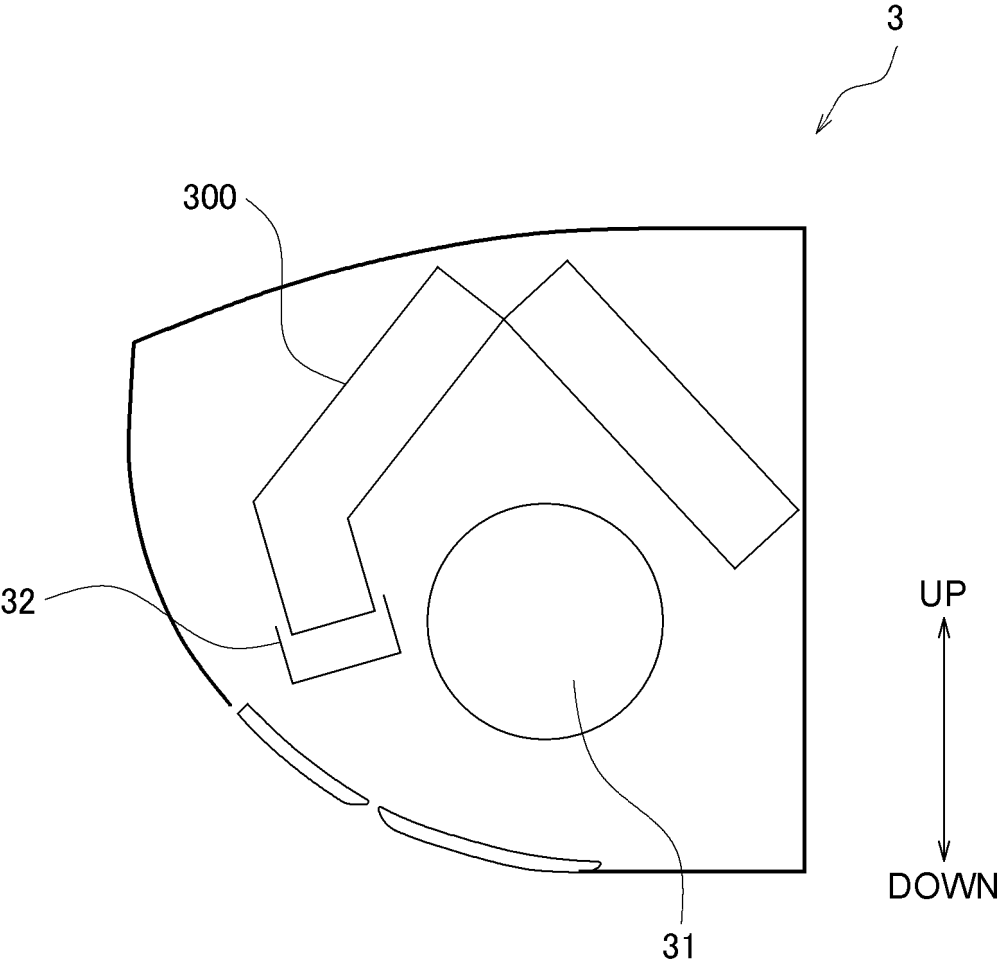


FIG. 3

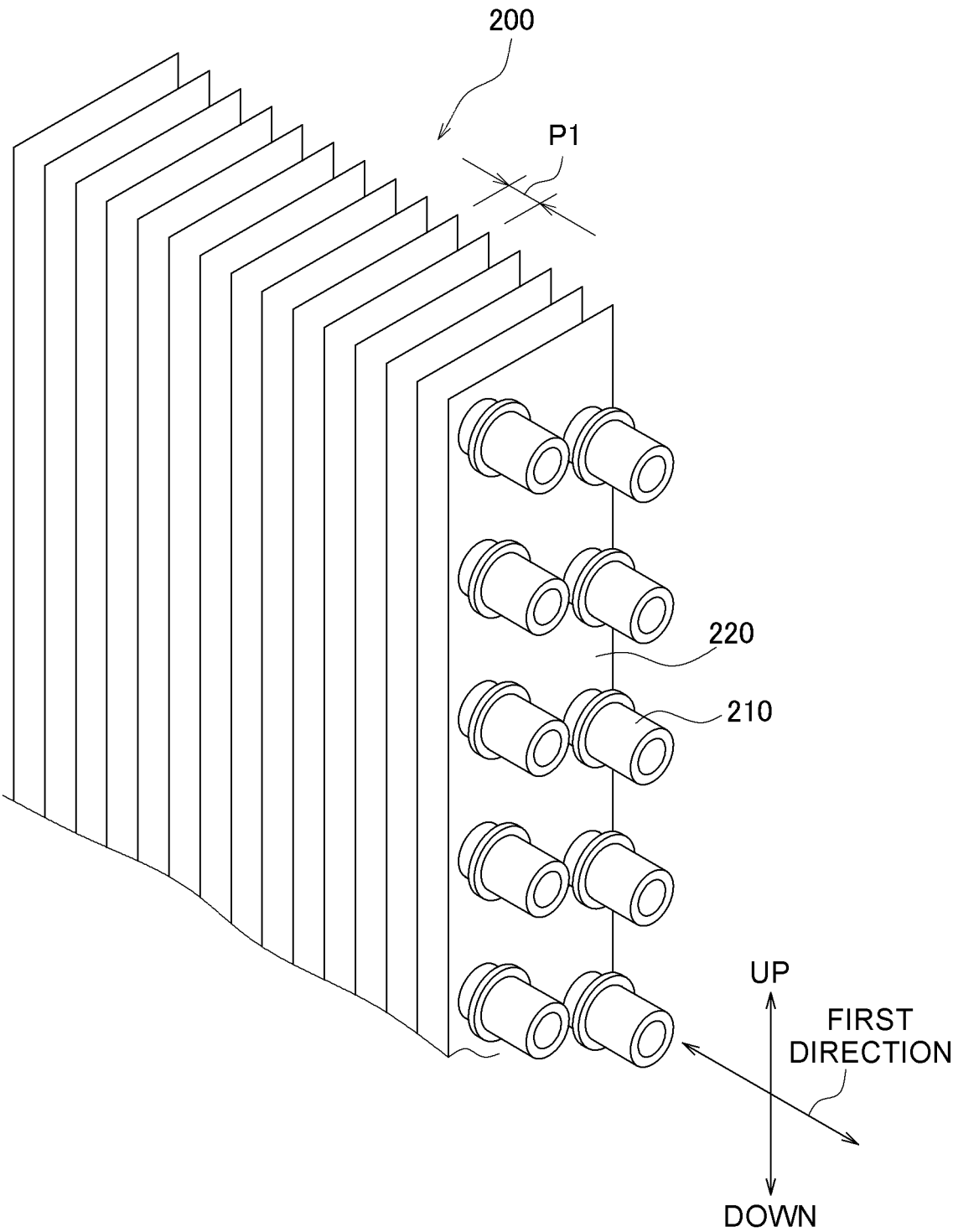


FIG. 4

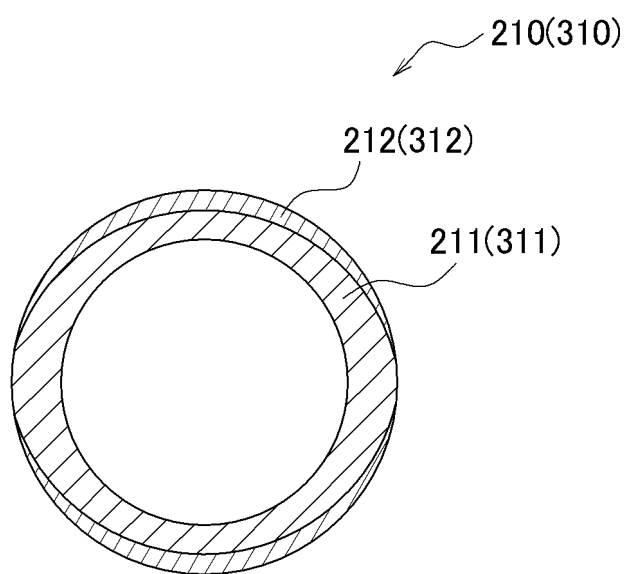


FIG. 5

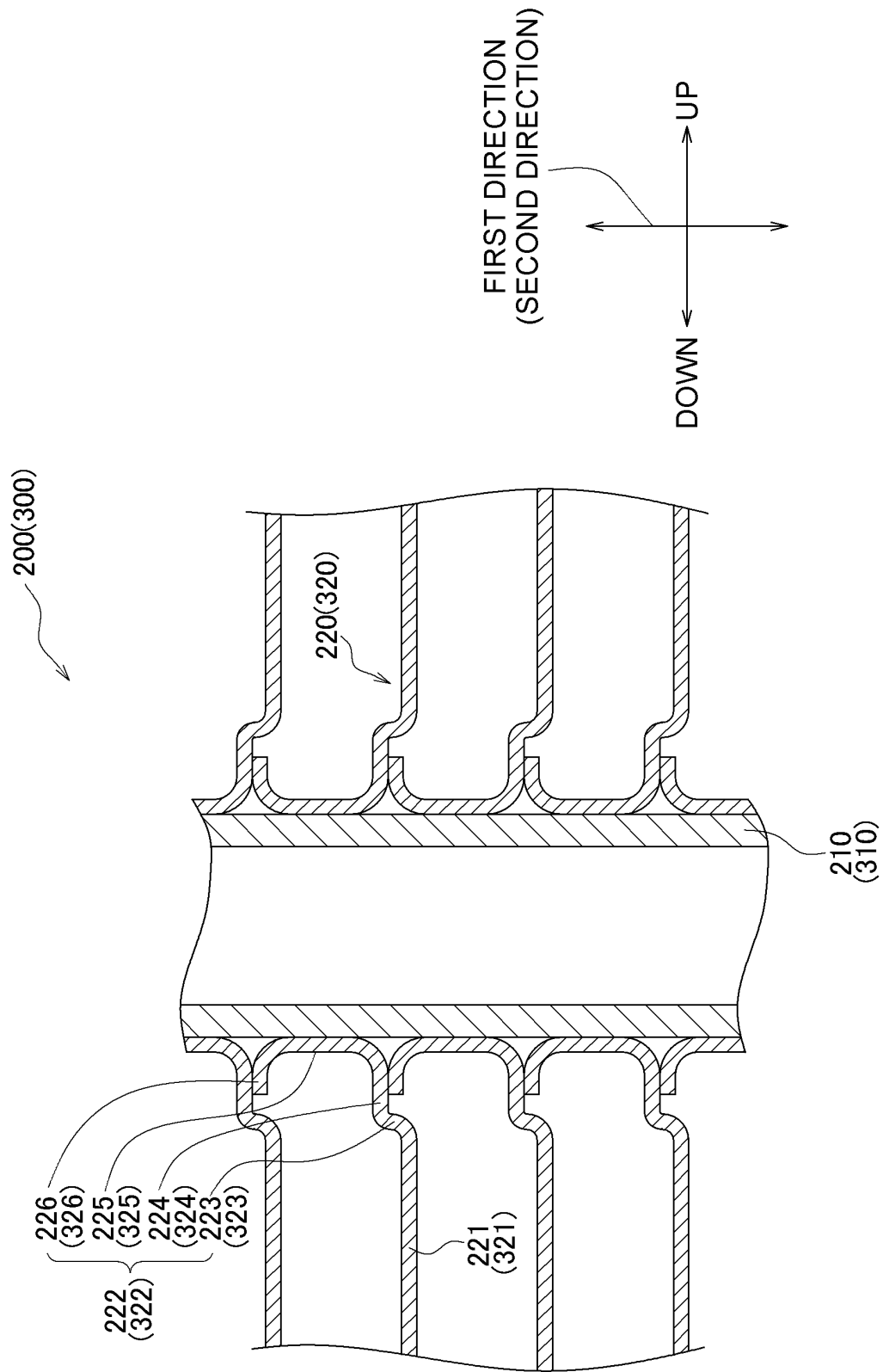


FIG. 6

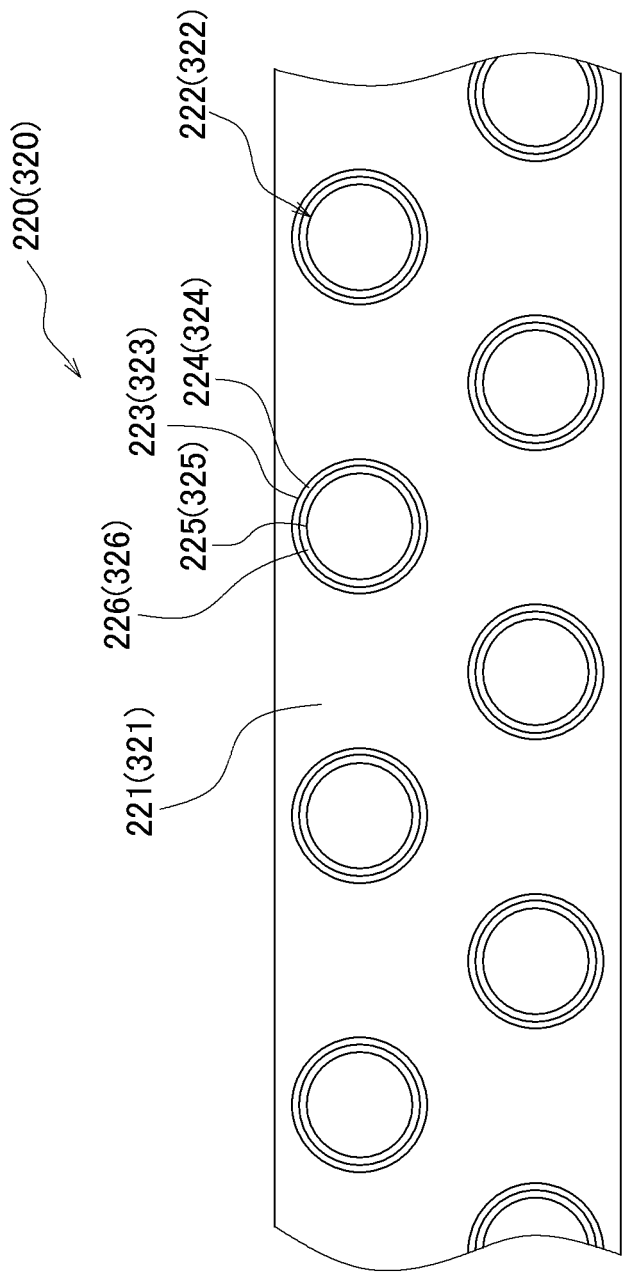


FIG. 7

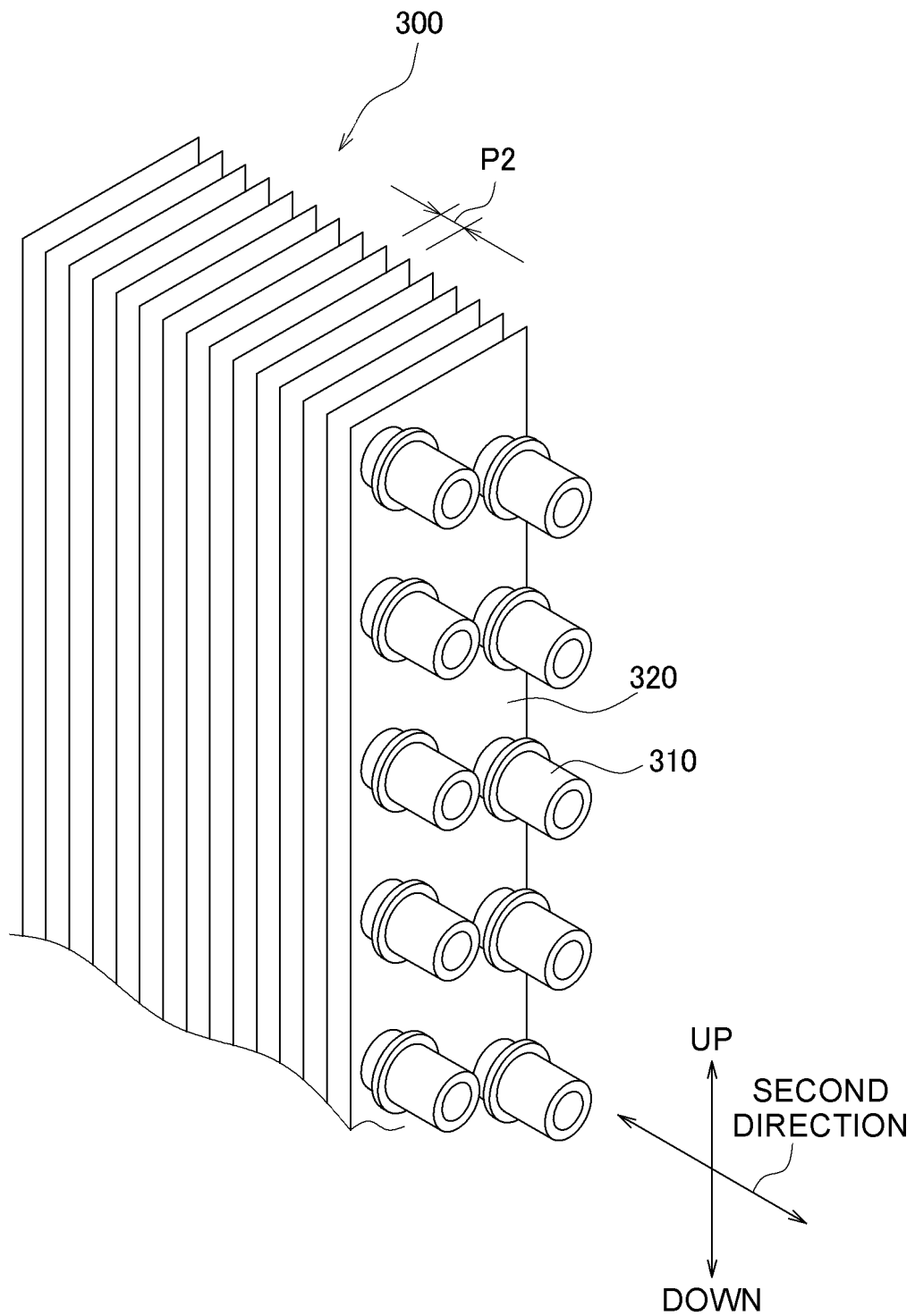


FIG. 8

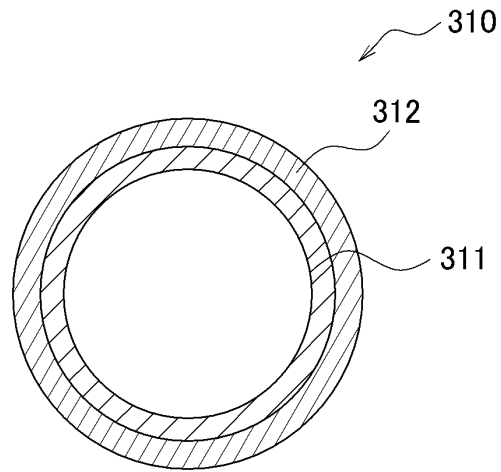


FIG. 9

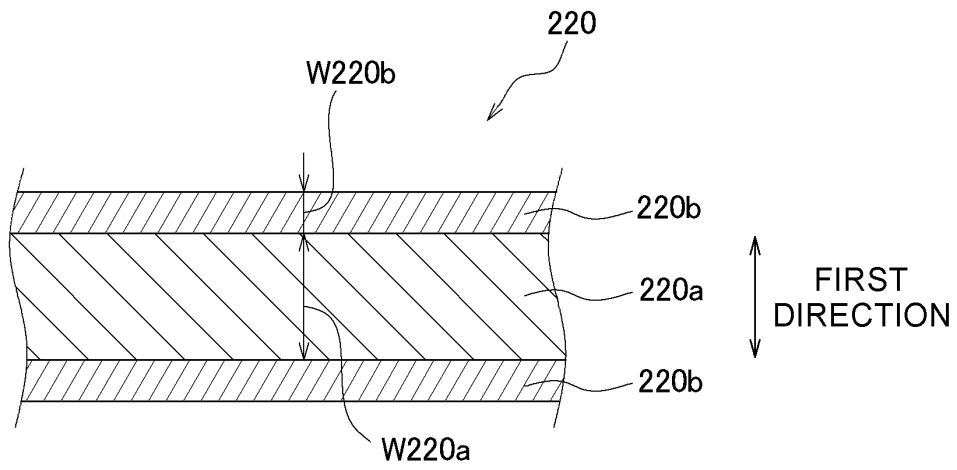


FIG. 10

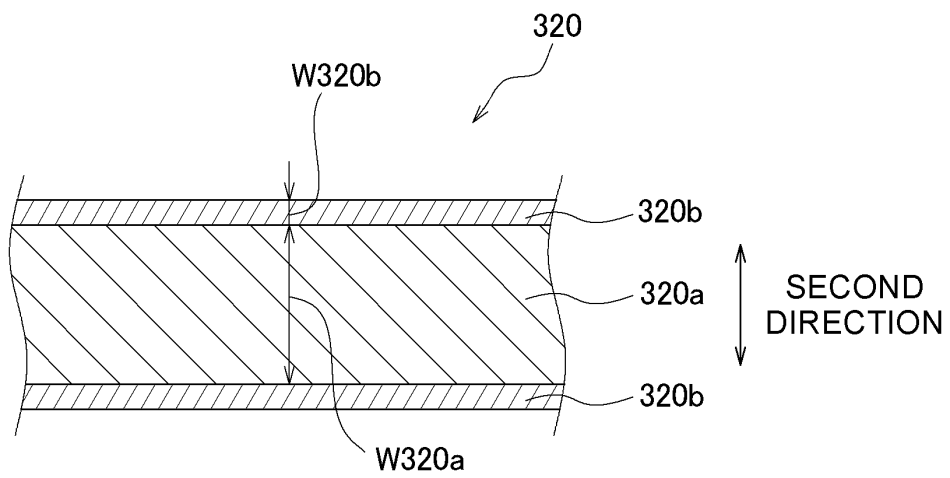


FIG. 11

INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2023/013216

A. CLASSIFICATION OF SUBJECT MATTER

F25B 39/00(2006.01)i; **F28D 1/053**(2006.01)n; **F28F 1/32**(2006.01)i; **F28F 21/08**(2006.01)i; **F24F 13/22**(2006.01)i; **F28F 19/06**(2006.01)i; **F24F 1/0067**(2019.01)i; **F24F 1/14**(2011.01)i; **F24F 1/36**(2011.01)i

FI: F28F19/06 A; F24F1/0007 361D; F24F1/0067; F24F1/14; F24F1/36; F24F13/22 222; F25B39/00 D; F25B39/00 P; F28F1/32 V; F28F21/08 B; F28D1/053 Z

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)

F28F19/06; F24F1/0067; F24F1/14; F24F1/36; F24F13/22; F25B39/00; F28F1/32; F28F21/08; F28D1/053

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.
Y	JP 2020-51731 A (MITSUBISHI ALUMINIUM) 02 April 2020 (2020-04-02) paragraphs [0017]-[0022], fig. 4	1-15
Y	WO 2019/239990 A1 (DAIKIN IND LTD) 19 December 2019 (2019-12-19) paragraph [0130]	1-15
Y	JP 11-211377 A (KOBE STEEL LTD) 06 August 1999 (1999-08-06) paragraphs [0001], [0030]	3-4, 14-15
Y	JP 2018-197634 A (DENSO AIRCOOL CORP) 13 December 2018 (2018-12-13) paragraphs [0015]-[0019], fig. 1-2	11
Y	WO 2015/097821 A1 (TOSHIBA CARRIER CORP) 02 July 2015 (2015-07-02) paragraphs [0035]-[0036], fig. 14	12-13

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

* Special categories of cited documents:	"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"A" document defining the general state of the art which is not considered to be of particular relevance	"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"E" earlier application or patent but published on or after the international filing date	"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	"&" document member of the same patent family
"O" document referring to an oral disclosure, use, exhibition or other means	
"P" document published prior to the international filing date but later than the priority date claimed	

Date of the actual completion of the international search

29 May 2023

Date of mailing of the international search report

06 June 2023

Name and mailing address of the ISA/JP

**Japan Patent Office (ISA/JP)
3-4-3 Kasumigaseki, Chiyoda-ku, Tokyo 100-8915
Japan**

Authorized officer

Telephone No.

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/JP2023/013216

Patent document cited in search report	Publication date (day/month/year)	Patent family member(s)	Publication date (day/month/year)
JP 2020-51731 A	02 April 2020	(Family: none)	
WO 2019/239990 A1	19 December 2019	JP 2019-215117 A	
JP 11-211377 A	06 August 1999	(Family: none)	
JP 2018-197634 A	13 December 2018	(Family: none)	
WO 2015/097821 A1	02 July 2015	EP 3091295 A1 paragraphs [0034]-[0035], fig. 14	
		CN 105705870 A	

REFERENCES CITED IN THE DESCRIPTION

This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.

Patent documents cited in the description

- JP 2001304783 A [0002] [0127]