(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) **EP 4 502 526 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: **23780898.5**

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

(51) International Patent Classification (IPC):
F28F 19/06 *(2006.01)* ***F24F 1/0067*** *(2019.01)*
F24F 1/14 *(2011.01)* ***F28F 1/32*** *(2006.01)*
F28F 21/08 *(2006.01)* ***F28D 1/053*** *(2006.01)*

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

(86) International application number:
PCT/JP2023/013217

(87) International publication number:
WO 2023/190890 (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 2022060706**

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(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 higher in potential than the first fins (220). A rate of zinc content of the first fin (220) is higher than a rate of zinc content of the second fin (320).

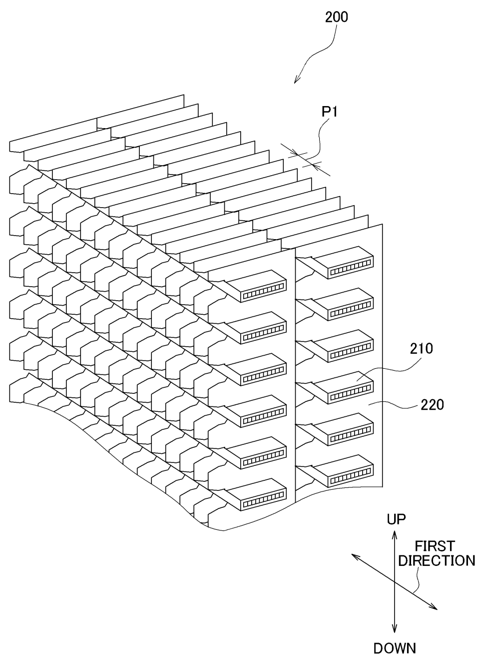

FIG. 4

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Description

TECHNICAL FIELD

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

BACKGROUND ART

[0002] Conventionally, as disclosed in Patent Literature 1 (WO 2017/141943 A), a heat exchanger including a heat transfer tube through which a refrigerant flows and a fin fixed to the heat transfer tube is known. The heat exchanger of Patent Literature 1 includes an aluminum tube as a heat transfer tube and an aluminum fin as a fin, a natural potential on a surface of the aluminum tube is higher than a natural potential on a surface of the aluminum fin, and a potential difference between the two is from 30 mV to 200 mV.

SUMMARY OF THE INVENTION

<Technical Problem>

[0003] However, the present inventor has found a problem that the heat exchanger of Patent Literature 1 cannot be used for an indoor unit in some cases.

<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 s 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 higher in potential than the first fins. The first fins contain zinc. A rate of zinc content of the first fin is higher than a rate of zinc content of the second fin.

[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. Since the first sacrificial layer is higher in potential than the first fins, corrosion of the first sacrificial layer for suppressing corrosion of the base material can be suppressed.

[0006] However, when the fins contain zinc in order to be lower in potential, the fins are cured, and thus workability of the fins is deteriorated. Therefore, in the air conditioner according to the first aspect, focusing on the fact that the first fins of the outdoor unit is not required to have workability as compared with the second fins of the indoor unit, the rate of zinc content of the first fin is set to be higher than the rate of zinc content of the second fin. As a result, workability of the second fin of the indoor unit can be secured, and thus the second heat exchanger including the second fins can be used for the indoor unit.

[0007] An air conditioner according to a second aspect is the air conditioner according to the first aspect, in which a rate of zinc content of the first fin is 2% by mass or more.

[0008] In the air conditioner according to the second aspect, by setting the rate of zinc content of the first fin of the outdoor unit to 2% by mass or more, it is possible to provide the first sacrificial layer having a potential that can suppress corrosion of the base material.

[0009] An air conditioner according to a third aspect is the air conditioner according to the first or second aspect, in which the fin pitch of the second fins is larger than the fin pitch of the first fins.

[0010] Since the second fin has a lower rate of zinc content than the first fin, the second fin are easily corroded. Therefore, in the air conditioner according to the third aspect, by making the fin pitch of the second fins larger than the fin pitch of the first fins, a surface area of the second fins in contact with the second heat transfer tubes can be reduced. As a result, corrosion of the second fins can be suppressed.

[0011] An air conditioner according to a fourth aspect is the air conditioner according to the third aspect, 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.

[0012] In the air conditioner according to the fourth aspect, the corrosion of the second fins can be further suppressed by setting the pitch difference to 0.1 mm or more and 0.3 mm or less.

[0013] An air conditioner according to a fifth aspect is the air conditioner according to the first to fourth aspects, in which a potential of the first fins is lower than a potential of the second fins.

[0014] The first heat exchanger of the outdoor unit is more susceptible to salt damage than the second heat exchanger of the indoor unit. Therefore, in the air conditioner according to the fifth aspect, by making the potential of the first fins lower than the potential of the second fins, the first fins are sacrificed in the first heat transfer tube, and therefore it is possible to further suppress corrosion of the first heat transfer tube.

[0015] An air conditioner according to a sixth aspect is the air conditioner according to the first to fifth aspects, in which the second sacrificial layer that is lower in potential than a base material of the second heat transfer tube and lower in potential than the second fins is provided on the surface of the second heat transfer tube.

[0016] The second heat exchanger of the indoor unit is less susceptible to salt damage than the first heat exchanger of the outdoor unit. Therefore, in the air conditioner according to the sixth aspect, even if the second sacrificial layer of the indoor unit is made lower in potential than the second fins, corrosion of the base material can be suppressed. In addition, it is possible to further suppress a decrease in workability of the second fins.

[0017] An air conditioner according to a seventh aspect is the air conditioner according to the first to sixth aspects, in which the first heat transfer tube has a flat shape. The second heat transfer tube has a cylindrical shape.

[0018] The fins attached to the cylindrical heat transfer tube are required to have workability as compared with the fins attached to the flat heat transfer tube. Therefore, in the air conditioner according to the seventh aspect, the second heat transfer tube of the indoor unit is required to have workability as compared with the first heat transfer tube of the outdoor unit. As a result, the air conditioner of the present disclosure is suitably used.

[0019] An air conditioner according to an eight 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 s 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 higher in potential than the first fins. An elongation of the second fin is larger than an elongation of the first fin.

[0020] In the air conditioner according to the eighth 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. Since the first sacrificial layer is higher in potential than the first fins, corrosion of the first sacrificial layer for suppressing corrosion of the base material can be suppressed.

[0021] However, when the fins are lower in potential, the fins are cured, and thus workability of the fins is deteriorated. Therefore, in the air conditioner according to the eighth aspect, focusing on the fact that the first fins of the outdoor unit are not required to have workability as compared with the second fins of the indoor unit, the elongation of the second fins is made larger than the elongation of the first fins. As a result, workability of the second fins of the indoor unit can be secured, and thus the second heat exchanger including the second fins can be used for the indoor unit.

BRIEF DESCRIPTION OF THE DRAWINGS

[0022]

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 a first heat transfer tube.

FIG. 6 is a perspective view of a second heat exchanger.

FIG. 7 is a sectional view of a second heat transfer tube.

FIG. 8 is a sectional view of a second fin.

FIG. 9 is a plan view of a second fin.

DESCRIPTION OF EMBODIMENTS

[0023] 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

[0024] 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.

[0025] 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 outdoor 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.

[0026] 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

[0027] 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 of a microchannel heat exchanger.

(2-1-1) First heat transfer tube

[0028] The first heat transfer tubes 210 each allow the refrigerant to flow therethrough. As illustrated in FIGS. 4 and 5, the first heat transfer tube 210 has a flat shape. Here, the first heat transfer tube 210 is a flat porous tube. In the first heat transfer tube 210, a plurality of through holes through which the refrigerant heat-exchanged with the outdoor air in the first heat exchanger 200 passes is aligned in a predetermined direction. The plurality of through holes penetrates along a first direction. Here, the first direction is a longitudinal direction.

[0029] 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 (not illustrated). 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 (not illustrated). 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.

[0030] The first sacrificial layer 212 is lower in potential than the first base material 211 of the first heat transfer tube 210 and higher 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, 132 mV. The potential difference between the potential of the first fin 220 and the potential of the first sacrificial layer 212 is, for example, 61 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.

[0031] As illustrated in FIG. 4, the plurality of first heat transfer tubes 210 is aligned in an up-down direction. A lowermost end of the plurality of first heat transfer tubes 210 is located above a water level of the first drain pan 22 (see FIG. 2).

(2-1-2) First fin

[0032] 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.

[0033] The first fin 220 is lower in potential than the first base material 211 of the first heat transfer tube 210 and lower in potential than the first sacrificial layer 212. In other words, the first base material 211, the first sacrificial layer 212, and the first fin 220 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, 193 mV.

[0034] The first fin 220 contains a metal such as zinc in order to lower the potential. The metal is not limited, but the first fin 220 according to the present embodiment contains zinc. A rate of zinc content of the first fins 220 is preferably 2% by mass or more. An upper limit value of the rate of zinc content of the first fins 220 is not limited, but is, for example, 6% in terms of workability.

[0035] Here, the "rate of zinc content" described in the present specification is a value measured by, for example, an emission spectroscopic analysis method.

[0036] The first fin 220 according to the present embodiment further contains magnesium (Mg) and copper (Cu).

[0037] 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.

[0038] The first fin 220 is a flat plate-shaped member. The first fin 220 has a notch through which the first heat transfer tube 210 passes. The notches are aligned in the first direction. Note that the first fin 220 may have a collar.

(2-1-3) Fillet

[0039] The first heat exchanger 200 of the outdoor unit 2 may further include a fillet that connects the first heat transfer tubes 210 and the first fins 220. The potential of the fillet is not limited, but in the present embodiment, the first base material 211, the first sacrificial layer 212, the fillet, and the first fin 220 have higher potentials in that order.

(2-2) Second heat exchanger

[0040] As illustrated in FIG. 6, 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

[0041] 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.

[0042] As illustrated in FIG. 7, 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 (not illustrated), or may be provided on a part of the surface of the second heat transfer tube 310. In other words, the second sacrificial layer 312 may be formed on an entire exposed outer surface (not illustrated), or may be formed on a part of the exposed outer surface. 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.

[0043] 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.

[0044] As illustrated in FIG. 6, 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).

(2-2-2) Second fin

[0045] 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.

[0046] 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.

[0047] The second fin 320 contains a metal such as zinc in order to lower the potential. The second fin 320 may or is not required to contain zinc. Specifically, the rate of zinc content of the second fins 320 is, for example, 0% by mass or more and 1% by mass or less.

[0048] The plurality of second fins 320 is stacked in the second direction (see FIG. 6) 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. 6) 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.

[0049] As illustrated in FIGS. 8 and 9, 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.

[0050] 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.

[0051] 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.

[0052] 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.

[0053] 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.

[0054] 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.

[0055] 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.

[0056] In this manner, the second fin 320 according to the present embodiment is required to have high workability.

(2-3) Relationship between first fin and second fin

[0057] Next, a relationship between the first fin 220 of the first heat exchanger 200 and the second fin 320 of the second heat exchanger 300 will be described.

(2-3-1) Elongation

[0058] An elongation of the second fin 320 is larger than an elongation of the first fin 220. Here, "elongation" of the present disclosure conforms to JIS H4000.

(2-3-2) Rate of zinc content

[0059] A rate of zinc content of the first fins 220 is higher than a rate of zinc content of the second fins 320. For example, the rate of zinc content of the first fins 220 is higher than the rate of zinc content of the second fins 320 by 1% by mass or more.

(2-3-3) Potential

[0060] The potential of the first fin 220 is lower than the potential of the second fin 320. For example, the potential of the first fin 220 is lower than the potential of the second fin 320 by 10 mV or more. The potential is adjusted by, for example, a type, content by rate, content by amount, or the like of a metal that is lower in potential.

(2-3-4) Pitch

[0061] The fin pitch P2 of the second fins 320 illustrated in FIG. 6 is larger than the fin pitch P1 of the first fins 220 illustrated in FIG. 4. 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.

[0062] 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 P2 - fin pitch P 1) is 0.1 mm or more and 0.3 mm or less.

[0063] The fin pitch P1 of the first fins 220 is, for example, 1.2 mm or more and 1.4 mm or less. The fin pitch P2 of the second fins 320 is, for example, 1.3 mm or more and 1.5 mm or less.

(3) Characteristics

[0064] (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 higher in potential than the first fin 220. The first fins 220 contain zinc. A rate of zinc content of the first fin 220 is higher than a rate of zinc content of the second fins 320.

[0065] 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. Since the first sacrificial layer 212 is higher in potential than the first fin 220, corrosion of the first sacrificial layer 212 for suppressing corrosion of the first base material 211 can be suppressed.

[0066] However, when the first fin 220 and the second fin 320 contain zinc in order to be lower in potential, the first fin 220 and the second fin 320 are cured, and thus their workability is deteriorated. The present inventor has focused on the fact that the second fin 320 of the indoor unit 3 has a high degree of processing difficulty for reasons such as compactness and bending. In other words, the present inventor has paid attention to the fact that the first fin 220 of the outdoor unit 2 is not required to have workability as compared with the second fin 320 of the indoor unit 3. Therefore, in the air conditioner 1 according to the present embodiment, the rate of zinc content of the first fin 220 is higher than the rate of zinc content of the second fin 320. As a result, workability of the second fin 320 of the indoor unit 3 can be secured, and thus the second heat exchanger 300 including the second fin 320 can be used for the indoor unit 3.

(3-2) In the air conditioner 1 according to the present embodiment, the first fins 220 have a rate of zinc content of 2% by mass or more. As a result, it is possible to provide the first sacrificial layer 212 having a potential that can suppress corrosion of the first base material 211.

(3-3) In the air conditioner 1 according to the present embodiment, the fin pitch P2 of the second fins 320 is larger than the fin pitch P1 of the first fins 220.

[0067] Since the second fins 320 have less a rate of zinc content than the first fins 220, the second fins are easily corroded. Therefore, here, by making the fin pitch P2 of the second fins 320 larger than the fin pitch P1 of the first fins 220, the number of the second fins 320 can be reduced, and a surface area of the second fins 320 in contact with the second heat transfer tubes 310 can be reduced. As a result, corrosion of the second fins 320 can be suppressed.

[0068] As described above, the second fin 320 of the indoor unit 3 is required to have high workability. Therefore, by reducing the number of second fins 320, it is possible to reduce a burden associated with processing.

[0069] Furthermore, by reducing the fin pitch P1 of the first fins 220 of the first heat exchanger 200 of the outdoor unit 2, it is possible to secure a large number of first fins 220. It is therefore possible to suppress a decrease in performance of the air conditioner 1 as a whole.

[0070] In addition, in the outdoor unit 2 that is more susceptible to salt damage, it is possible to increase an area of the first fin 220 to be a sacrifice of the first heat transfer tube 210. As a result, corrosion of the first heat transfer tube 210 can be further suppressed.

(3-4) In the air conditioner 1 according to the present embodiment, a difference (P2 - P1) 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 second fin 320 can be further suppressed.

(3-5) In the air conditioner 1 according to the present embodiment, the potential of the first fins 220 is lower than the potential of the second fins 320.

[0071] The first heat exchanger 200 of the outdoor unit 2 is more susceptible to salt damage than the second heat exchanger 300 of the indoor unit 3. Therefore, here, by making the potential of the first fins 220 lower than the potential of the second fins 320, the first fins 220 are sacrificed in the first heat transfer tube210, and therefore it is possible to further suppress corrosion of the first heat transfer tube 210.

[0072] (3-6) In the air conditioner 1 according to the present embodiment, the second sacrificial layer 312 that 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 is provided on the surface of the second heat transfer tube 310.

[0073] The second heat exchanger 300 of the indoor unit 3 is less susceptible to salt damage than the first heat exchanger 200 of the outdoor unit 2. Therefore, here, even if the second sacrificial layer 312 of the indoor unit 3 is made lower in potential than the second fins 320, corrosion of the second base material 311 can be suppressed. In addition, it is possible to further suppress a decrease in workability of the second fin 320.

[0074] (3-7) In the air conditioner 1 according to the present embodiment, the first heat transfer tube 210 has a flat shape. The second heat transfer tube 310 has a cylindrical shape.

[0075] The second fin 320 attached to the cylindrical second heat transfer tube 310 is required to have higher workability than the first fin 220 attached to the flat first heat transfer tube 210. In this manner, the second heat transfer tube 310 of the indoor unit 3 is required to have higher workability than the first heat transfer tube 210 of the outdoor unit 2. 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 heat transfer tube 210 of a flat shape and the second heat exchanger 300 having the second heat transfer tube 310 of a cylindrical shape.

[0076] (3-8) 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 is 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 is 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 higher in potential than the first fin 220. An elongation of the second fin 320 is larger than an elongation of the first fin 220.

[0077] 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. Since the first sacrificial layer 212 is higher in potential than the first fin 220, corrosion of the first sacrificial layer 212 for suppressing corrosion of the first base material 211 can be suppressed.

[0078] However, when the first fin 220 and the second fin 320 are lower in potential, the first fin 220 and the second fin 320 are cured, and thus their workability is deteriorated. Therefore, in the air conditioner 1 according to the present embodiment, focusing on the fact that the first fin 220 of the outdoor unit 2 is not required to have workability as compared with the second fin 320 of the indoor unit 3, the elongation of the second fin 320 is made larger than the elongation of the first fin 220. As a result, workability of the second fin 320 of the indoor unit 3 can be secured, and thus the second heat exchanger 300 including the second fin 320 can be used for the indoor unit 3.

(4) Modifications

(4-1) Modification 1

[0079] 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, but the present disclosure is not limited thereto. In this modification, a clad material is used as the base material and the sacrificial layer.

[0080] 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.

(4-2) Modification 2

[0081] 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.

(4-3) Modification 3

[0082] In the above-embodiment and Modifications 1 and 2, the second heat transfer tube 310 of the indoor unit 3 includes the second sacrificial layer 312, but in this modification, the second sacrificial layer 312 is omitted. In this case, since the second heat transfer tubes 310 are higher in potential than the second fins 320, corrosion of the second heat transfer tubes 310 can be still suppressed.

(4-4) Modification 4

[0083] In the above-embodiment, the first heat exchanger 200 is a microchannel heat exchanger, and the second heat exchanger 300 is a cross-fin-tube heat exchanger, but the present invention is not limited thereto. The first heat exchanger 200 may be a cross-fin-tube heat exchanger, and the second heat exchanger 300 may be a microchannel heat exchanger. When both the first heat exchanger 200 and the second heat exchanger 300 are microchannel heat exchangers or cross-fin type heat exchangers, the first heat transfer tubes 210 and the second heat transfer tubes 310 can be made common.

[0084] 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

[0085]

- 1: air conditioner
- 2: outdoor unit
- 3: indoor unit
- 200: first heat exchanger
- 210: first heat transfer tube
- 211: first base material (base material)
- 212: first sacrificial layer
- 220: first fin
- 300: second heat exchanger
- 310: second heat transfer tube
- 311: second base material (base material)
- 312: second sacrificial layer
- 320: second fin
- P1, P2: fin pitch

CITATION LIST

PATENT LITERATURE

[0086] Patent Literature 1: WO 2017/141943 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 higher in potential than the first fins is provided on a surface of the first heat transfer tube,
the first fins contain zinc, and
a rate of zinc content of the first fin is higher than a rate of zinc content of the second fin.

2. The air conditioner according to claim 1, wherein the rate of zinc content of the first fin is 2% by mass or more.

3. The air conditioner according to claim 1 or 2, wherein a fin pitch (P2) of the second fins is larger than a fin pitch (P1) of the first fins.

4. The air conditioner according to claim 3, 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.

5. The air conditioner according to any one of claims 1 to 4, wherein a potential of the first fin is lower than a potential of the second fin.

6. The air conditioner according to any one of claims 1 to 5, 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 fins is provided on a surface of the second heat transfer tube.

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

the first heat transfer tube has a flat shape, and
the second heat transfer tube has a cylindrical shape.

8. 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 higher in potential than the first fin is provided on a surface of the first heat transfer tube, and
an elongation of the second fin is larger than an elongation of the first fin.

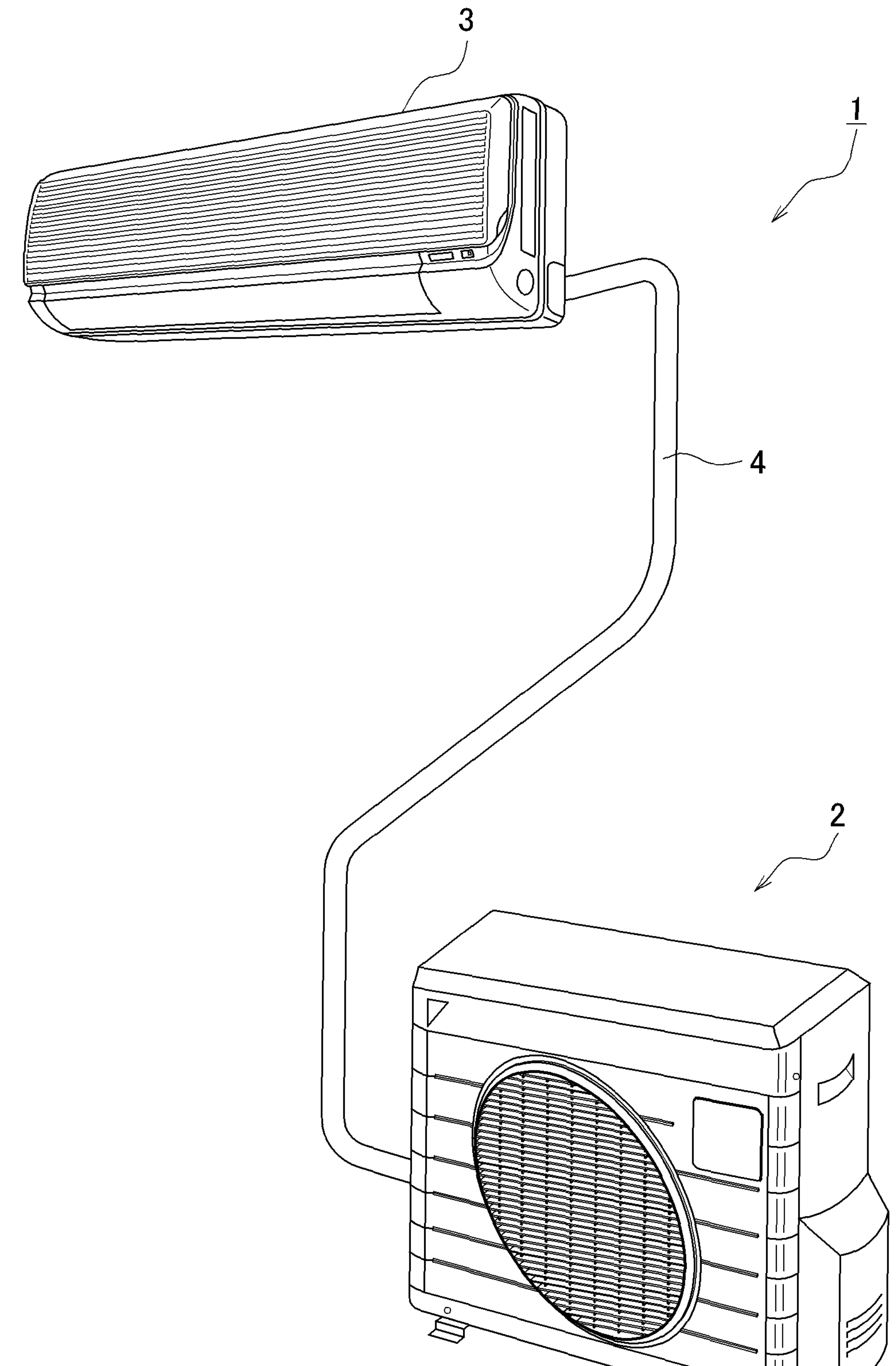

FIG. 1

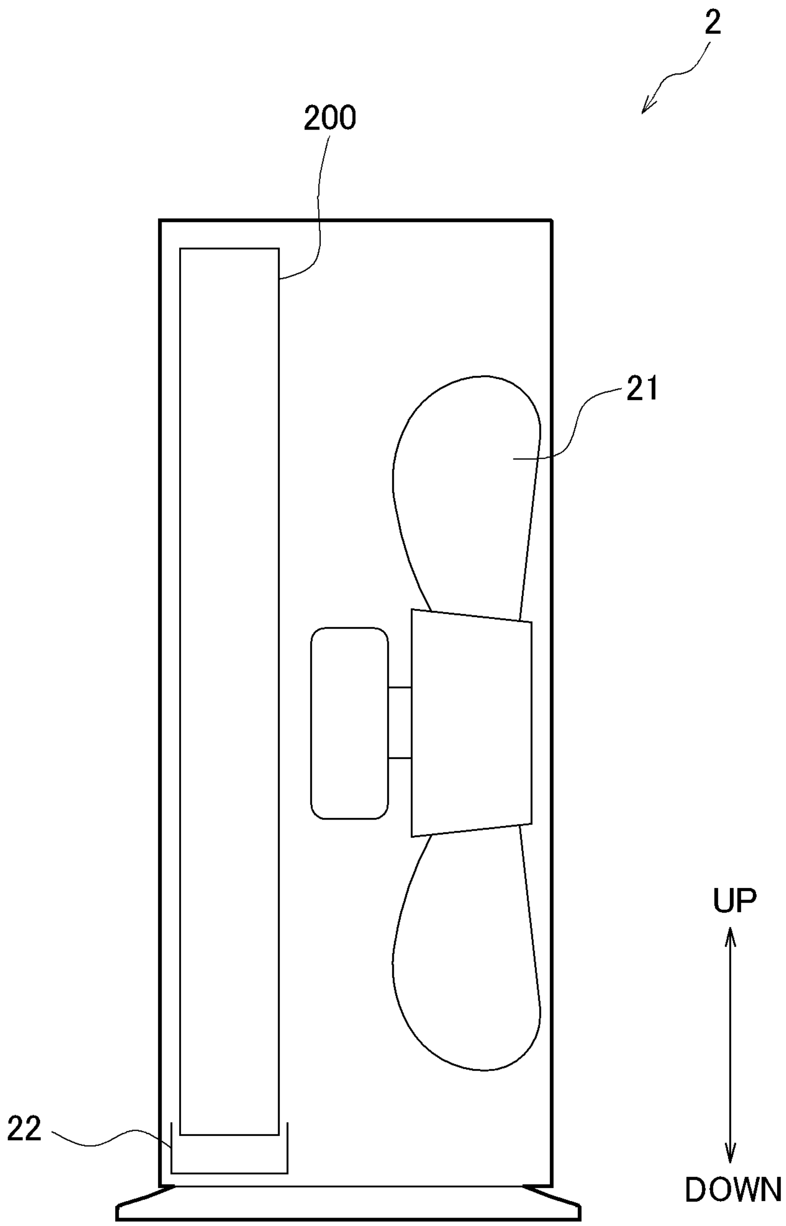

FIG. 2

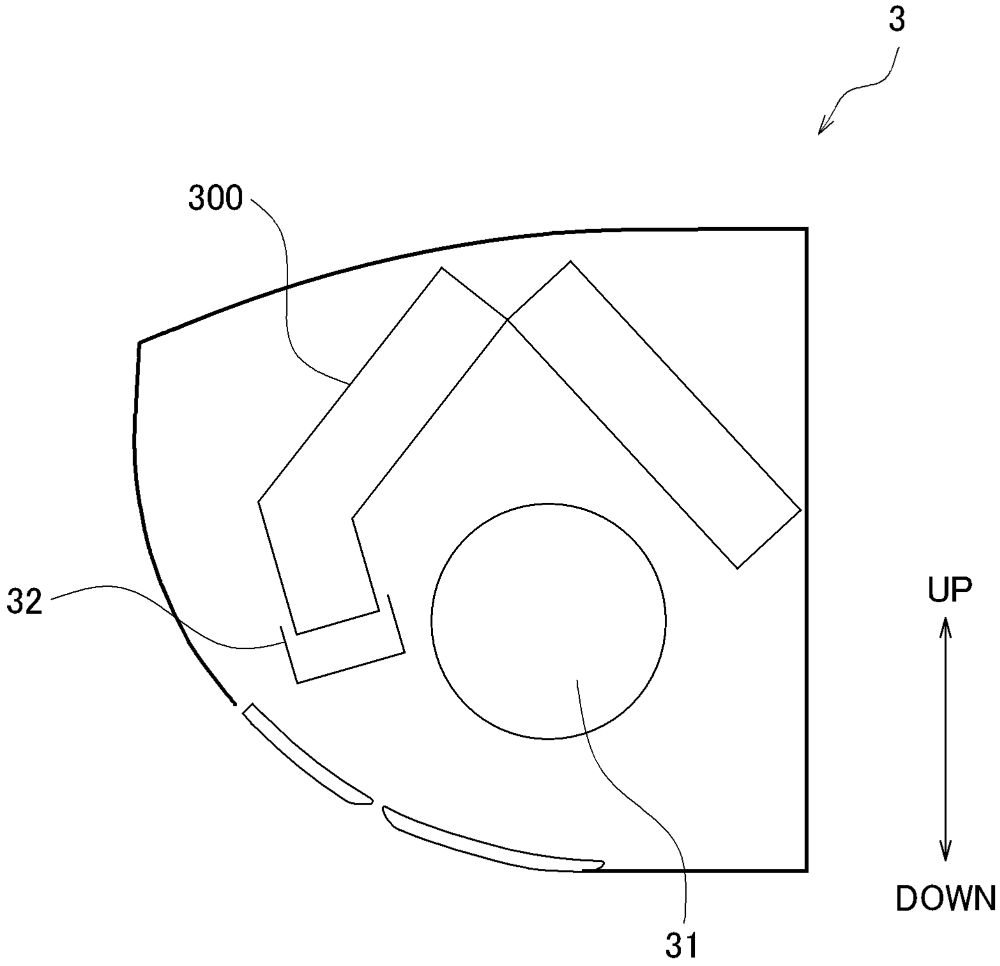

FIG. 3

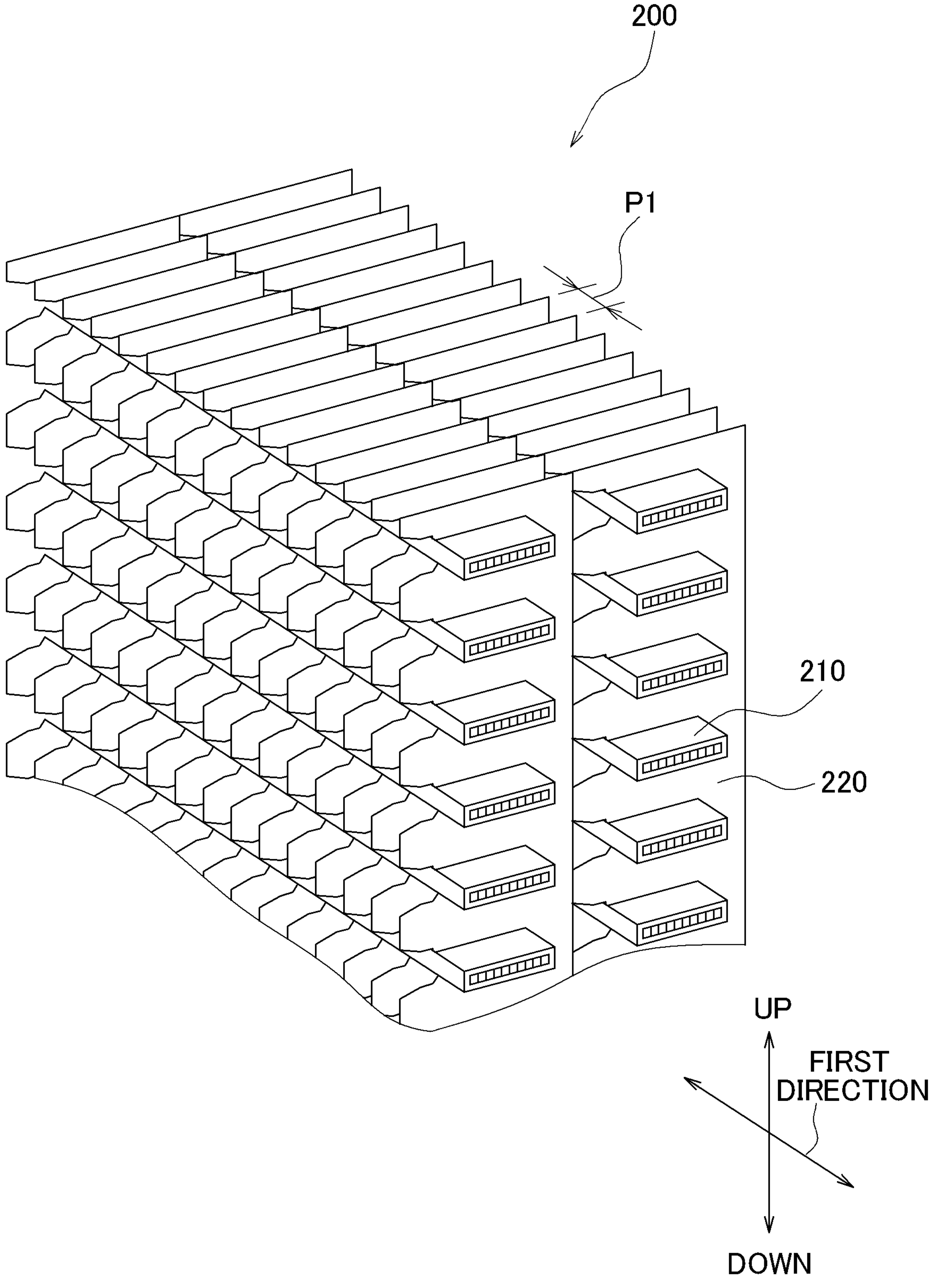

FIG. 4

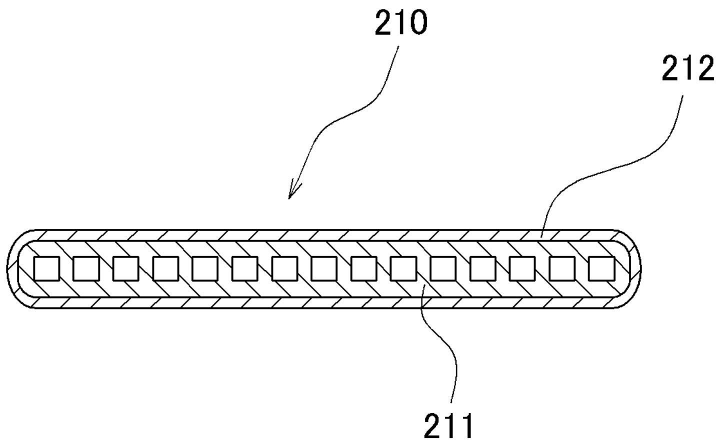

FIG. 5

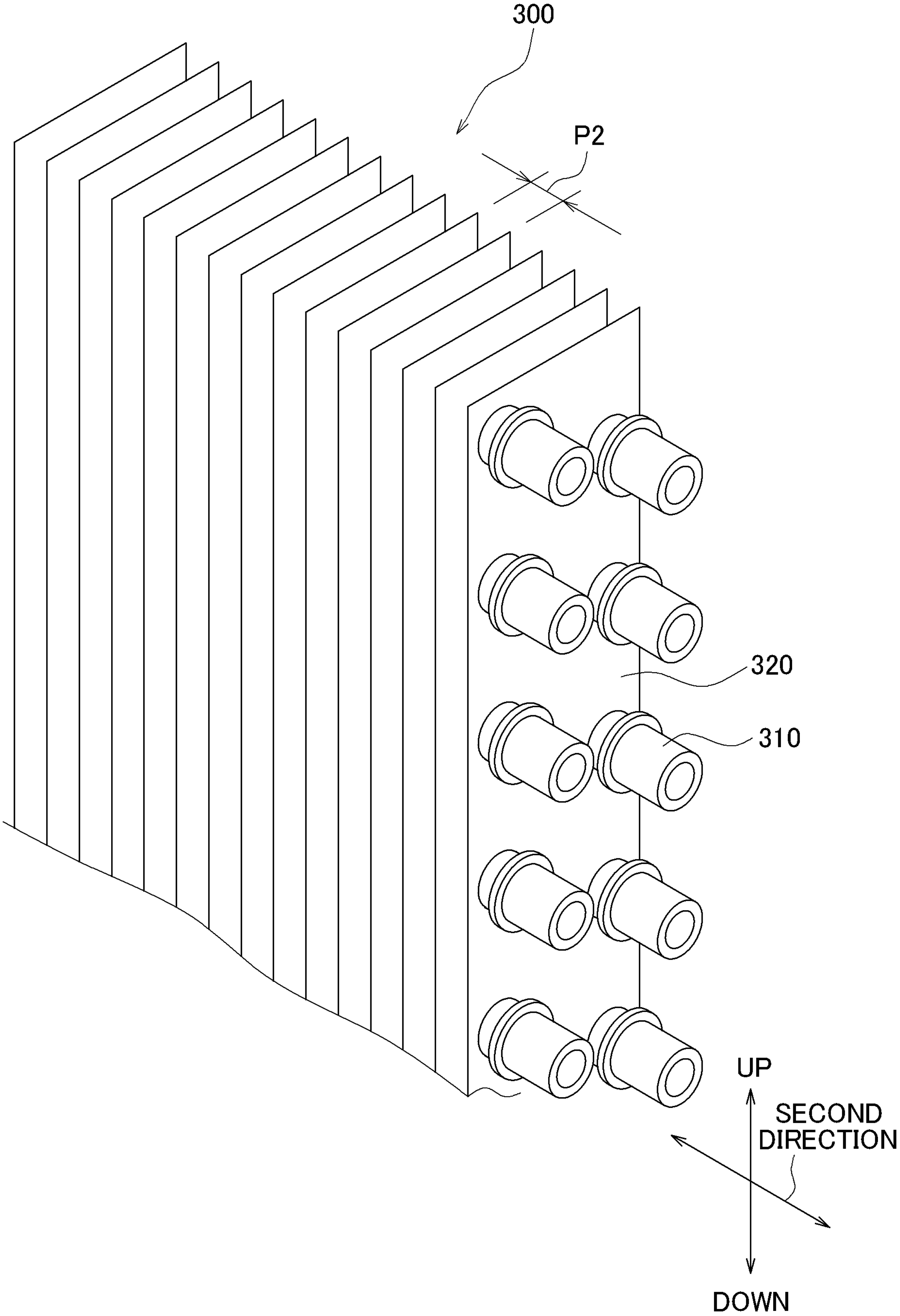

FIG. 6

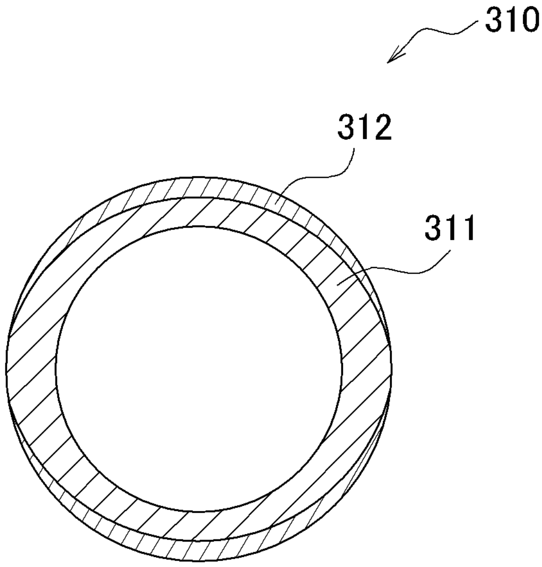

FIG. 7

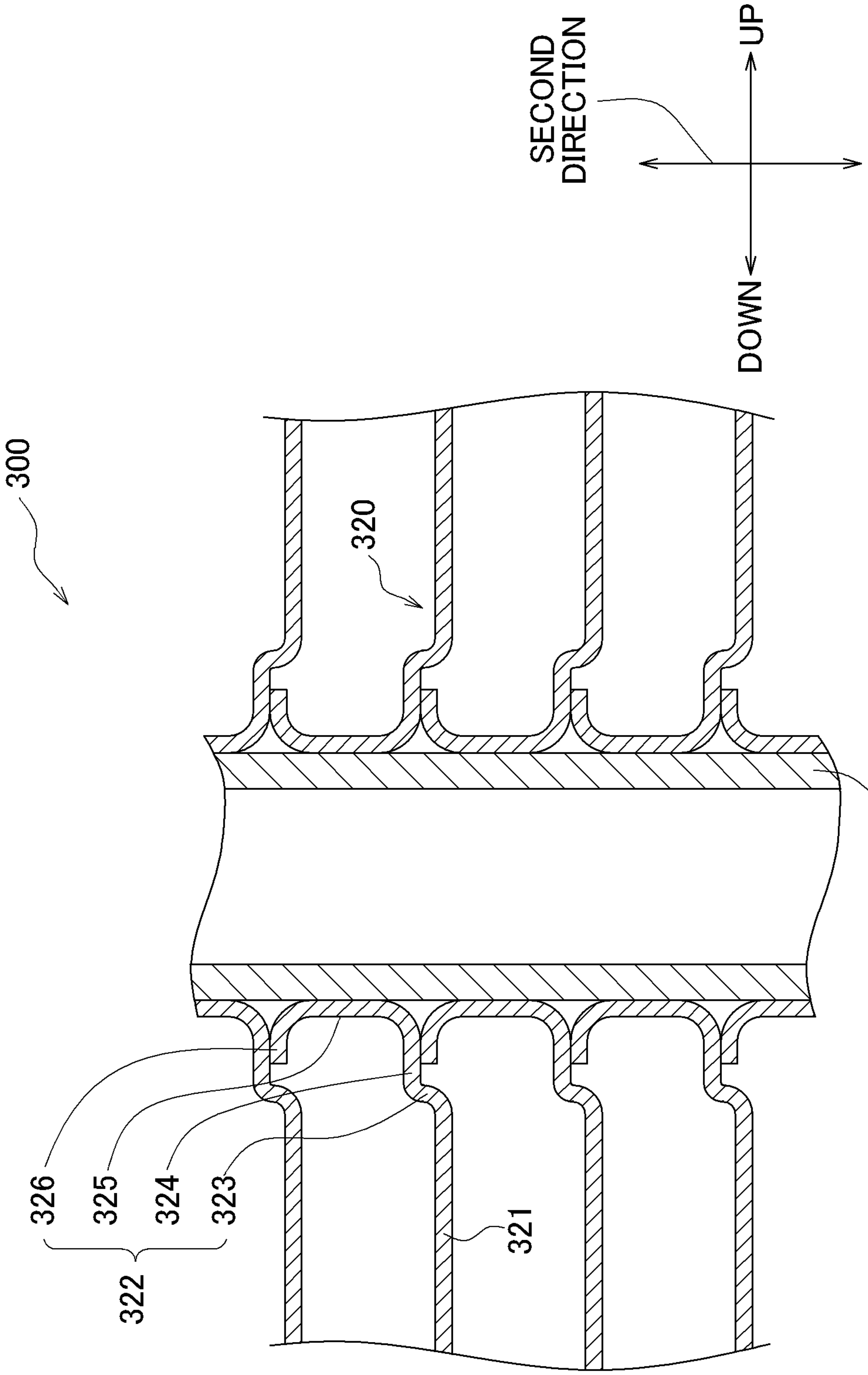

FIG. 8

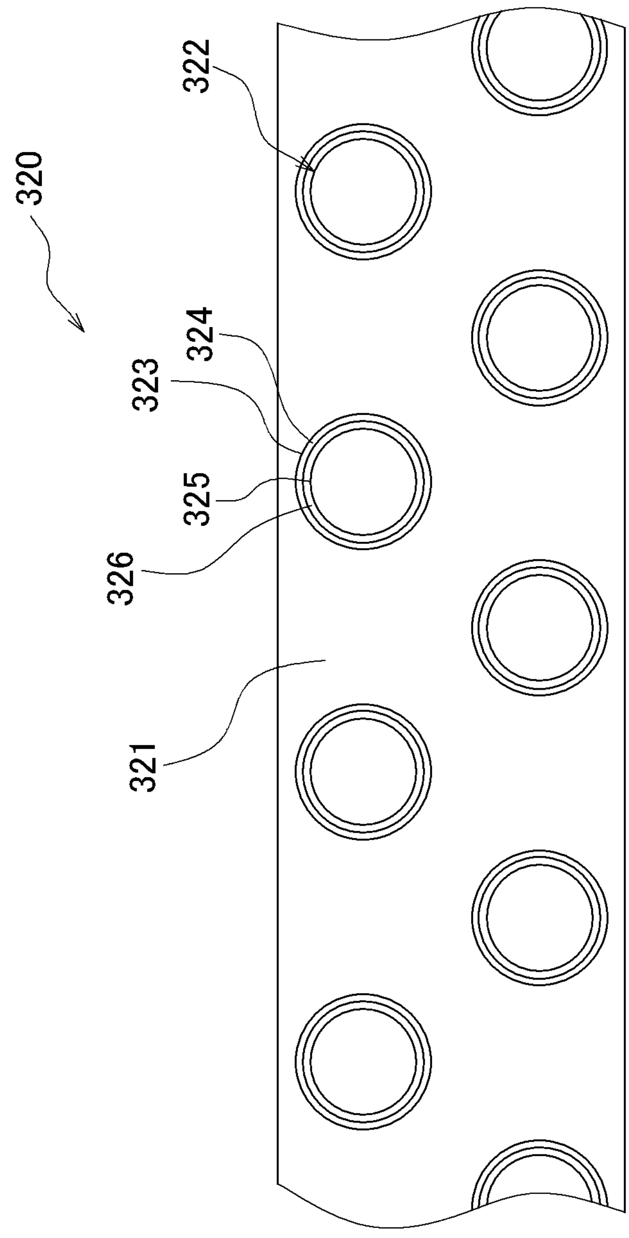

FIG. 9

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2023/013217

A. CLASSIFICATION OF SUBJECT MATTER

F28F 19/06(2006.01)i; ***F24F 1/0067***(2019.01)i; ***F24F 1/14***(2011.01)i; ***F28F 1/32***(2006.01)i; ***F28F 21/08***(2006.01)i; *F28D 1/053*(2006.01)n
FI: F28F19/06 A; F24F1/0067; F24F1/14; F28F1/32 V; F28F21/08 B; F28D1/053 A; 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; 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	1-8
Y	JP 11-211377 A (KOBE STEEL LTD) 06 August 1999 (1999-08-06) paragraphs [0001], [0030]	1-8
Y	WO 2019/239990 A1 (DAIKIN IND LTD) 19 December 2019 (2019-12-19) paragraph [0130]	3-7
Y	JP 2016-205744 A (DAIKIN IND LTD) 08 December 2016 (2016-12-08) paragraphs [0035], [0041]	7
Y	JP 61-143592 A (SHIBANO, Shozo) 01 July 1986 (1986-07-01) p. 1, lower right column, lines 5-6, p. 2, upper left column, lines 18-19	8

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

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

Date of the actual completion of the international search	Date of mailing of the international search report
29 May 2023	**06 June 2023**

Name and mailing address of the ISA/JP	Authorized officer
Japan Patent Office (ISA/JP) **3-4-3 Kasumigaseki, Chiyoda-ku, Tokyo 100-8915** **Japan**	Telephone No.

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

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/JP2023/013217

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)	
JP 11-211377 A	06 August 1999	(Family: none)	
WO 2019/239990 A1	19 December 2019	JP 2019-215117 A	
JP 2016-205744 A	08 December 2016	US 2018/0135900 A1 paragraphs [0055], [0062] EP 3276289 A1 CN 107429975 A WO 2016/174830 A1	
JP 61-143592 A	01 July 1986	(Family: none)	

Form PCT/ISA/210 (patent family annex) (January 2015)

REFERENCES CITED IN THE DESCRIPTION

Patent documents cited in the description

- WO 2017141943 A **[0002] [0086]**