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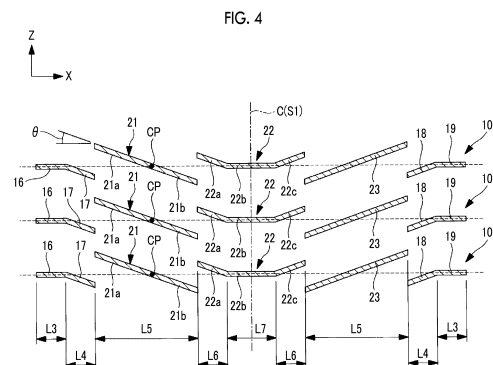
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(54) **FIN FOR HEAT EXCHANGER**

(57) This fin comprises a plate-shaped substrate part (10) having a heat transfer tube passing part, which is a circular shape centered on a central axis C and through which a heat transfer tube passes, and a louver part at which a first slit is formed by a first louver (21). The louver part has a flat section (16), the first louver (21) that is provided on the downstream side of the flat section (16) and protrudes more in the Z-axis direction than the flat section (16), and a second louver (22) that is provided on the downstream side of the first louver (21). The second louver (22) has a linear part (22b) at which the shape of the cross-section thereof when cut in the XZ plane is linear, a second louver upstream part (22a) bending obliquely in the upstream direction from the upstream end of the linear part (22b) and extending linearly, and a second louver downstream part (22c) bending obliquely in the downstream direction from the downstream end of the linear part (22b) and extending linearly. The linear part (22b) is disposed so as to overlap with the heat trans-

fer tube passing part when viewing the cross-section.



Description

Technical Field

[0001] The present disclosure relates to a fin for a heat exchanger.

Background Art

[0002] For example, an indoor unit of an air conditioner includes a heat exchanger that exchanges heat between a refrigerant and air, and a blower that sends air to the heat exchanger. The heat exchanger includes, for example, a heat transfer tube in which the refrigerant flows, and a fin that is provided on an outer peripheral surface of the heat transfer tube. By sending air to the heat transfer tube and the fin by the blower, the heat exchanger exchanges heat between air and the refrigerant through the heat transfer tube and the fin. The fin provided in the above described heat exchanger is, for example, disclosed in PTL 1.

[0003] PTL 1 discloses a plate fin for a heat exchanger in which a plurality of pipe holes are penetrated to be formed therein. A reinforcing region in which a slit is formed, is provided between the pipe holes. A portion of the reinforcing region separated by a longitudinal slit is a reinforcing element that forms separate portions of a sinusoidal waveform and a lancet element displaced from a waveform. The lancet element is displaced from a substrate in a -y direction or a + y direction. Opposing ends of coupling elements are displaced in an opposite direction from the substrate.

Citation List

Patent Literature

[0004] [PTL 1] Japanese Unexamined Patent Application Publication No. H9-166392

Summary of Invention

Technical Problem

[0005] In order to improve energy efficiency of an air conditioner (for example, energy consumption efficiency throughout year), it is effective to improve the energy efficiency in a case where the air conditioner operates at an intermediate capacity (that is, in case where air conditioner operates at half of rated capacity). In a case where the air conditioner operates at the intermediate capacity, since a work load of a compressor is reduced, it is important to reduce a power consumption of a blower provided in an indoor unit.

[0006] However, in the fin described in PTL 1, all the lancet elements and the coupling elements are curved. As a result, since introduced air is not suitably divided, there is a possibility that a pressure loss of air passing

through the fin increases. In a case where the pressure loss of air passing through the fin increases, there is a possibility that the power consumption of the blower that sends air to the fin increases.

[0007] The present disclosure has been made in view of such circumstances, and an object thereof is to provide a fin for a heat exchanger in which it is possible to reduce the pressure loss that occurs in a case where air flows.

10 Solution to Problem

[0008] In order to solve the above problem, a fin for a heat exchanger of the present disclosure adopts the following means.

15 **[0009]** According to an aspect of the present disclosure, there is provided a fin for a heat exchanger that is provided in the heat exchanger exchanging heat between a refrigerant flowing inside a heat transfer tube that extends in a predetermined direction and air flowing outside the heat transfer tube in a direction that intersects with the predetermined direction, and that is attached to the heat transfer tube including a plate-shaped substrate portion that includes a heat transfer tube passing portion having a circular shape centered on a central axial line
25 extending in the predetermined direction and through which the heat transfer tube passes, a louver portion in which a slit is formed by louvers cut and raised in the predetermined direction, and that is provided along a direction in which the air flows, in which the slit communicates one surface side and the other surface side of the substrate portion with each other, the louver portion includes a flat portion, a first louver that is provided on a downstream side of the flat portion and that protrudes with respect to the flat portion in the predetermined direction, and a second louver that is provided on a downstream side of the first louver, the second louver includes a linear portion at which a shape of a cross-section in a case of cutting on a surface that is formed in the predetermined direction and in the direction in which the air
35 flows, extending in the direction in which the air flows, an upstream portion at which the shape of the cross-section is obliquely bent in an upstream direction from an upstream end of the linear portion and extends linearly, and a downstream portion at which the shape of the cross-section is obliquely bent in a downstream direction from a downstream end of the linear portion and extends linearly, and the linear portion is disposed to overlap with the heat transfer tube passing portion in a case where the cross-section is viewed. Advantageous Effects of Invention

[0010] According to the present disclosure, it is possible to reduce a pressure loss that occurs in a case where air flows.

55 Brief Description of Drawings

[0011]

Fig. 1 is a perspective view of a plate fin according to a first embodiment of the present disclosure.

Fig. 2 is a plan view showing a main portion (portion B) of Fig. 1.

Fig. 3 is a cross-sectional view showing a cross-section taken along line A-A of Figs. 1 and 2.

Fig. 4 is an end view taken along line A-A of Figs. 1 and 2.

Fig. 5 is a perspective view of a plate fin according to a second embodiment of the present disclosure.

Fig. 6 is a plan view showing a main portion (portion E) of Fig. 5.

Fig. 7 is a cross-sectional view taken along line D-D of Figs. 5 and 6.

Fig. 8 is an end view taken along the line D-D of Figs. 5 and 6.

Description of Embodiments

[0012] Hereinafter, an embodiment of a fin for a heat exchanger according to the present disclosure will be described with reference to the drawings. In the following description, an extending direction of a heat transfer tube is referred to as a Z-axis direction, and among directions orthogonal to the Z-axis direction, air flow direction is referred to as an X-axis direction, and a direction orthogonal to the Z-axis direction and the X-axis direction is referred to as a Y-axis direction. In the following description, a case where the Z-axis direction is an up-down direction will be described. Therefore, the Z-axis direction may be referred to as the up-down direction.

[First Embodiment]

[0013] A first embodiment of a fin for a heat exchanger according to the present disclosure will be described with reference to Figs. 1 to 4.

[0014] A fin 1 according to the present embodiment is a fin for a heat exchanger provided in the heat exchanger. The heat exchanger is, for example, provided in the indoor unit (not shown) of an air conditioner (not shown), and air is sent by a blower (not shown). The heat exchanger includes a plurality of heat transfer tubes (not shown) extending in the Z-axis direction (predetermined direction) and in which a refrigerant flows. A plurality of fins 1 are provided on an outer peripheral surface of the heat transfer tube. The heat exchanger exchanges heat between the refrigerant flowing inside the heat transfer tube and air flowing outside the heat transfer tube in the X-axis direction via the heat transfer tube and the fin 1.

[0015] The plurality of heat transfer tubes are arranged side by side at predetermined intervals in the Y-axis direction. Further, the plurality of heat transfer tubes are arranged side by side in the X-axis direction, however, in the X-axis direction, adjacent heat transfer tubes are arranged to not overlap each other in a case where the adjacent heat transfer tubes are viewed from the X-axis direction. That is, the plurality of heat transfer tubes are

arranged in a so-called staggered arrangement in the X-axis direction.

[0016] Next, the fin 1 according to the present embodiment will be described in detail with reference to Figs. 1 to 4. In the following description, the terms "upstream" and "downstream" mean upstream and downstream in a flow of air.

[0017] As shown in Fig. 3, the plurality of fins 1 are provided. The plurality of fins 1 are arranged side by side at predetermined intervals in the Z-axis direction. In the following description, a gap formed between fins 1 adjacent to each other in the Z-axis direction will be referred to as "fin pitch P". In the present embodiment, a length of the fin pitch P is L1.

[0018] The fin 1 is made of a metallic material (for example, aluminum). As shown in Figs. 1 and 2, the fin 1 integrally includes a plate-shaped substrate portion 10 and a cylindrical portion 30 that protrudes from the substrate portion 10 in the Z-axis direction.

[0019] The substrate portion 10 is a plate-shaped member. The substrate portion 10 is provided along the air flow direction (X-axis direction). Specifically, the substrate portion 10 is provided along a surface (surface formed in X-axis direction and Y-axis direction) intersecting the Z-axis direction. The substrate portion 10 is a plate-shaped member and has a predetermined plate thickness. The substrate portion 10 is, for example, manufactured by press-forming a flat plate-shaped plate material.

[0020] The substrate portion 10 includes a plurality of heat transfer tube passing portions 11 through which the heat transfer tube passes, and a plurality of louver portions 12 in which a first slit 25 or the like is formed by a first louver 21 cut and raised in the Z-axis direction or the like.

[0021] One heat transfer tube passes through each heat transfer tube passing portion 11. Each heat transfer tube passing portion 11 is a circular hole centered on a central axial line C extending in the Z-axis direction. Each heat transfer tube passing portion 11 penetrates the substrate portion 10 in a plate thickness direction (Z-axis direction). As shown in Fig. 2, in the present embodiment, a radius of the heat transfer tube passing portion 11 is R1.

[0022] The plurality of heat transfer tube passing portions 11 are provided at positions corresponding to arrangements of the heat transfer tubes. That is, as shown in Fig. 2, the plurality of heat transfer tube passing portions 11 are arranged side by side at predetermined intervals along the Y-axis direction in the same manner as that of the plurality of heat transfer tubes. In the present embodiment, a distance between central axial lines C of the heat transfer tube passing portions 11 adjacent to each other in the Y-axis direction is defined as D1.

[0023] Further, the plurality of heat transfer tube passing portions 11 are arranged side by side in the X-axis direction, however, in the X-axis direction, adjacent heat transfer tube passing portions 11 are arranged to not overlap each other in a case where the adjacent heat

transfer tube passing portions 11 are viewed from the X-axis direction. That is, the plurality of heat transfer tube passing portions 11 are arranged in the so-called staggered arrangement in the X-axis direction.

[0024] A circularly-shaped annular portion 13 is provided around each heat transfer tube passing portion 11. The annular portion 13 is formed in a flat plate shape. The annular portion 13 is provided concentrically with the heat transfer tube passing portion 11. That is, the annular portion 13 is centered on the central axial line C. A part of an outer peripheral edge of the annular portion 13 is an end portion of the louver portion 12 in the Y-axis direction. In the present embodiment, as shown in Fig. 2, a radius of an outer periphery of the annular portion 13 is R2.

[0025] As shown in Fig. 2, two louver portions 12 are provided between the heat transfer tube passing portions 11 adjacent to each other in the Y-axis direction. The two louver portions 12 are arranged side by side at predetermined intervals in the Y-axis direction. A planar dividing portion 15 is provided between the louver portions 12 adjacent to each other in the Y-axis direction. The dividing portion 15 is formed in a planar shape. The dividing portion 15 is provided at the same height position as that of the annular portion 13. The dividing portion 15 is provided over approximately an entire area of the louver portion 12 in the X-axis direction. In the present embodiment, a length of the dividing portion 15 in the Y-axis direction is defined as L2.

[0026] The louver portions 12 adjacent to each other in the Y-axis direction are symmetrical with reference to the reference surface S2. Therefore, in the following description, one louver portion 12 will be described and the other louver portion 12 will be omitted. The reference surface S2 is a surface that is formed in the X-axis direction and the Z-axis direction, and that includes a center of the dividing portion 15 in the Y-axis direction.

[0027] As shown in Figs. 1 and 2, the louver portion 12 includes an upstream side flat portion (flat portion) 16, an upstream side louver 17 that is connected to a downstream end of the upstream side flat portion 16, the first louver 21 that is provided on a downstream side of the upstream side louver 17, a second louver 22 that is provided on the downstream side of the first louver 21, a third louver 23 that is provided on the downstream side of the second louver 22, a downstream side louver 18 that is provided on a downstream side of the third louver 23, and a downstream side flat portion 19 connected to a downstream end of the downstream side louver 18. An end portion of the louver portion 12 on the heat transfer tube passing portion 11 side has an arc shape concentric with a shape of the heat transfer tube passing portion 11.

[0028] As shown in Figs. 1 and 2, the upstream side flat portion 16 is provided at an end portion (upstream end portion) of the louver portion 12 in the Y-axis direction. In the present embodiment, as shown in Fig. 4, a length of the upstream side flat portion 16 in the X-axis direction is defined as L3. The upstream side flat portion

16 is a flat plate-shaped member provided approximately horizontally. As shown in Figs. 3 and 4, a shape of a cross-section of the upstream side flat portion 16 in a case of cutting on a surface (XZ plane) formed in the Z-axis direction and the X-axis direction is a linear shape. The upstream side flat portion 16 is provided at the same height position as that of the annular portion 13 and the downstream side flat portion 19 or the like.

[0029] As shown in Figs. 3 and 4, the upstream side louver 17 bends obliquely downward from the downstream end of the upstream side flat portion 16 and extends in the downstream side direction. In the present embodiment, as shown in Fig. 4, a length of the upstream side louver 17 in the X-axis direction is defined as L4. A shape of the cross-section of the upstream side louver 17 in a case of cutting on the surface (XZ plane) formed in the Z-axis direction and the X-axis direction is a linear shape that is inclined obliquely downward. The upstream side louver 17 protrudes downward from the upstream side flat portion 16. The upstream side louver 17 is formed by cutting and raising a part of the flat plate-shaped plate material downward.

[0030] As shown in Figs. 3 and 4, a shape of a cross-section of the first louver 21 in a case of cutting on a surface (XZ plane) formed in the Z-axis direction and the X-axis direction is linearly inclined downward from an upstream end toward a downstream end. In the present embodiment, as shown in Fig. 4, a length of the first louver 21 in the X-axis direction is defined as L5. As shown in Fig. 3, the first louver 21 is provided such that the upstream end does not overlap with the heat transfer tube passing portion 11 in a cross-section in a case of cutting on the surface (XZ plane) formed in the Z-axis direction and the X-axis direction. The first louver 21 integrally includes a first louver upstream portion 21a provided on an upstream side with respect to a center point CP in the X-axis direction and a first louver downstream portion 21b provided on a downstream side with respect to the center point CP in the X-axis direction. A downstream end of the first louver upstream portion 21a and an upstream end of the first louver downstream portion 21b are connected to each other. The center point CP of the first louver 21 in the X-axis direction is positioned at the same height as that of the upstream side flat portion 16 or the like.

[0031] The first louver upstream portion 21a is positioned above the upstream side flat portion 16. The first louver downstream portion 21b is positioned below the upstream side flat portion 16. The first louver upstream portion 21a is formed by cutting and raising a part of the flat plate-shaped plate material upward. The first louver downstream portion 21b is formed by cutting and raising a part of the flat plate-shaped plate material downward.

[0032] As shown in Figs. 3 and 4, the second louver 22 includes a linear portion 22b in which the shape of a cross-section in a case of cutting on the surface (XZ plane) formed in the Z-axis direction and the X-axis direction extends in the X-axis direction, a second louver

upstream portion (upstream portion) 22a that bends obliquely upward from the upstream end of the linear portion 22b and extends linearly toward the upstream direction, and a second louver downstream portion (downstream portion) 22c that bends obliquely upward from the downstream end of the linear portion 22b and extends linearly toward the downstream direction.

[0033] As shown in Figs. 3 and 4, the linear portion 22b is disposed such that the center in the X-axis direction is positioned on the central axial line C. In the present embodiment, as shown in Fig. 4, a length of the linear portion 22b in the X-axis direction is defined as L7. The linear portion 22b is a flat plate-shaped member provided approximately horizontally. As shown in Figs. 3 and 4, a shape of a cross-section of the linear portion 22b in a case of cutting on the surface (XZ plane) formed in the Z-axis direction and the X-axis direction is a linear shape. The linear portion 22b is provided at the same height position as that of the annular portion 13 and that of the upstream side flat portion 16 or the like.

[0034] In the present embodiment, as shown in Fig. 4, a length of a second louver upstream portion 22a in the X-axis direction is defined as L6. A shape of a cross-section of the second louver upstream portion 22a in a case of cutting on the surface (XZ plane) formed in the Z-axis direction and the X-axis direction is a linear shape that is inclined obliquely upward. The second louver upstream portion 22a protrudes upward from the linear portion 22b. The second louver upstream portion 22a is formed by cutting and raising a part of the flat plate-shaped plate material upward.

[0035] As shown in Figs. 3 and 4, the second louver downstream portion 22c is symmetrical with the second louver upstream portion 22a with reference to a reference surface S1. In addition, as shown in Figs. 3 and 4, the third louver 23 is symmetrical with the first louver 21 with reference to the reference surface S1. Further, the downstream side louver 18 is symmetrical with the upstream side louver 17 with reference to the reference surface S1. Further, the downstream side flat portion 19 is symmetrical with the upstream side flat portion 16 with reference to the reference surface S1. Therefore, detailed description of the second louver downstream portion 22c, the third louver 23, the downstream side louver 18, and the downstream side flat portion 19 will be omitted. The reference surface S1 is a surface formed in the Y-axis direction and the Z-axis direction, and is a surface including the central axial line C.

[0036] In addition, as shown in Fig. 4, the shape of the cross-section of the louver portion 12 is point-symmetrical with reference to the center point CP in the X-axis direction of the first louver 21 on one side and the other side with respect to the reference surface S1.

[0037] Further, the upstream side louver 17, the first louver 21, and the second louver upstream portion 22a are disposed to be parallel to each other. An angle θ formed by the upstream side louver 17, the first louver 21, the second louver upstream portion 22a, and a hor-

izontal surface is set such that a flow of air flowing between the fins 1 is suitably divided into two.

[0038] The first slit 25 (refer to Figs. 1 and 3) is formed between a downstream end of the upstream side louver 17 and an upstream end of the first louver 21. In addition, a second slit 26 (refer to Figs. 1 and 3) is formed between an upstream end of the second louver 22 and a downstream end of the first louver 21. In addition, as shown in Fig. 1, a length of the first slit 25 in the Y-axis direction is longer than a length of the second slit 26 in the Y-axis direction. The first slit 25 and the second slit 26 are open in the upstream direction.

[0039] A third slit 27 (refer to Fig. 3) is formed between a downstream end of the second louver 22 and an upstream end of the third louver 23. In addition, a fourth slit 28 (refer to Fig. 3) is formed between a downstream end of the third louver 23 and an upstream end of the downstream side louver 18. The third slit 27 and the fourth slit 28 are open to the downstream side.

[0040] The cylindrical portion 30 is a cylindrical member erected along an edge of the heat transfer tube passing portion 11, in which a lower end is connected to the substrate portion 10. In addition, the cylindrical portion 30 is in contact with a lower surface of the substrate portion 10 (specifically, annular portion 13) of which an upper end is positioned above.

[0041] Next, a flow of air passing through the fin 1 will be described with reference to Fig. 3.

[0042] As shown by an arrow F1 in Fig. 3, air that has flowed into the fin pitch P collides with an upstream end portion of the first louver 21. In a case where air collides with the upstream end portion of the first louver 21, a flow of air is divided by the first louver 21. Specifically, the flow of air is divided into a flow (refer to arrow F2a) flowing along an upper surface of the first louver 21 and a flow (refer to arrow F2b) passing through the first slit 25 and flowing along a lower surface of the first louver 21.

[0043] The flow flowing along the upper surface of the first louver 21 passes through the second slit 26 and flows (refer to arrow F3a) along a lower surface of the second louver 22. A flow that has flowed along the lower surface of the second louver 22 flows (refer to arrow F4a) along an upper surface of the third louver 23 and then flows (refer to arrow F5a) along lower surfaces of the downstream side louver 18 and the downstream side flat portion 19.

[0044] On the other hand, the flow flowing along the lower surface of the first louver 21 flows (refer to arrow F3b) along an upper surface of the second louver 22. A flow that has flowed along the upper surface of the second louver 22 flows (refer to arrow F4b) along a lower surface of the third louver 23 and then flows (refer to arrow F5b) along upper surfaces of the downstream side louver 18 and the downstream side flat portion 19.

[0045] In this way, air that has flowed into the fin pitch P flows in two flow paths of a flow path a indicated by arrows F1 and F2a to F5a, and a flow path b indicated by arrows F1 and F2b to F5b. The flow path a and the

flow path b are flow paths in which the fin pitch P is divided into two equal parts.

[0046] In addition, in any of the flow paths, air that has flowed into the fin pitch P first flows downward, changes a flow direction to be upward in a vicinity of the central axial line C, flows while the air is meandering to be upward as it is and is discharged from the fin pitch P. As described above, in the fin 1 of the present embodiment, a change of a direction of air performed from an inflow to a discharge of the fin pitch P is performed once.

[0047] According to the present embodiment, the following actions and effects are achieved.

[0048] In the present embodiment, the louver portion 12 includes a plurality of louvers (first louver 21, second louver 22, or the like). As a result, air flowing along the louver portion 12 meanders along the plurality of louvers. Therefore, as compared with a case where air flows in the linear shape, since it is possible that a distance in which air and the louver portion 12 are contacted increases, it is possible to improve a heat transfer coefficient.

[0049] In addition, in the present embodiment, a flow of air is divided by the first louver 21, so that a plurality of flow paths are formed at the fin pitch P. As described above, since it is possible that the flow of air is suitably divided, it is possible to reduce a pressure loss that occurs in a case where air flows.

[0050] In addition, in the present embodiment, the second louver 22 provided on the downstream side of the first louver 21 includes the linear portion 22b, the second louver upstream portion 22a, and the second louver downstream portion 22c. Accordingly, it is possible that the flow of air is easily divided by the first louver 21. Therefore, since it is possible that the flow of air is more suitably divided, it is possible to further reduce the pressure loss of the flow of air.

[0051] Further, in the present embodiment, all louvers (first louver 21, second louver 22, or the like) are formed in the linear shape. Accordingly, for example, it is possible to reduce a pressure loss of flowing air, as compared with a case where the louver is curved. In addition, it is possible to easily form the louver, as compared with the case where the louver is curved.

[0052] Further, in the present embodiment, the planar dividing portion 15 is provided between the louver portions 12. As a result, it is possible to improve a rigidity of the louver portion 12. Therefore, it is also possible to improve a rigidity of entire fin 1.

[0053] Further, in the present embodiment, the end portion of the louver portion 12 on the heat transfer tube passing portion 11 side has the arc shape concentric with the shape of the heat transfer tube passing portion 11. As a result, it is possible to increase a length of the louver portion 12 toward the heat transfer tube passing portion 11. Therefore, since it is possible to divide more flows of air, it is possible to further improve thermal conductivity.

[0054] In addition, in the present embodiment, the first louver 21 is provided such that the upstream end does not overlap with the heat transfer tube passing portion

11 in the cross-section in a case of cutting on the surface (XZ plane) formed in the Z-axis direction and the X-axis direction. As a result, it is difficult for the upstream end of the first louver 21 and the heat transfer tube passing portion 11 to interfere with each other. Therefore, since it is possible to increase a length of an upper end portion of the first louver 21 that divides a flow of air in the Y-axis direction, it is possible to divide more flows of air. Therefore, it is possible to further improve the thermal conductivity.

[0055] Further, in the present embodiment, one side of the louver portion 12 with respect to the central axial line C is point-symmetrical with reference to the center point CP of the first louver 21. Accordingly, it is possible to further reduce the pressure loss that occurs in a case where air flows.

[Second Embodiment]

[0056] A second embodiment of the fin for a heat exchanger according to the present disclosure will be described with reference to Figs. 5 to 8.

[0057] In the present embodiment, the number of first louvers and third louvers is different from that of the first embodiment. The second embodiment is similar to the first embodiment as to the other points, and thus similar configurations will be denoted by the same reference numerals with detailed description thereof omitted.

[0058] As shown in Figs. 5 and 6, a substrate portion 41 of a fin 40 according to the present embodiment includes two first louvers and two third louvers. In the following description, the two first louvers will be referred to as an upstream side first louver 42 and a downstream side first louver 43. Further, the two third louvers are referred to as an upstream side third louver 46 and a downstream side third louver 47.

[0059] As shown in Figs. 7 and 8, a shape of a cross-section of the upstream side first louver 42 in a case of cutting on the surface (XZ plane) formed in the Z-axis direction and the X-axis direction is linearly inclined downward from an upstream end toward a downstream end. In the present embodiment, as shown in Fig. 8, a length of the upstream side first louver 42 in the X-axis direction is defined as L8. As shown in Fig. 7, the upstream side first louver 42 is provided such that the upstream end does not overlap with the heat transfer tube passing portion 11 in the cross-section in a case of cutting on the surface (XZ plane) formed in the Z-axis direction and the X-axis direction. An approximately center point of the upstream side first louver 42 in the X-axis direction is positioned at the same height as that of the upstream side flat portion 16 or the like.

[0060] As shown in Figs. 7 and 8, the downstream side first louver 43 is provided on a downstream side of the upstream side first louver 42. A shape of a cross-section of the downstream side first louver 43 in a case of cutting on the surface (XZ plane) formed in the Z-axis direction and the X-axis direction is linearly inclined downward

from an upstream end toward a downstream end. In the present embodiment, as shown in Fig. 8, a length of the downstream side first louver 43 in the X-axis direction is defined as L9. As shown in Fig. 7, the downstream side first louver 43 is provided such that an entire downstream side first louver 43 overlaps with the heat transfer tube passing portion 11 in the cross-section in a case of cutting on the surface (XZ plane) formed in the Z-axis direction and the X-axis direction. An approximately center point of the downstream side first louver 43 in the X-axis direction is positioned at the same height as that of the upstream side flat portion 16 or the like.

[0061] In each of the upstream side first louver 42 and the downstream side first louver 43, upstream sides with respect to the approximately center point in the X-axis direction are positioned above the upstream side flat portion 16. In each of the upstream side first louver 42 and the downstream side first louver 43, downstream sides with respect to the approximately center point in the X-axis direction are positioned below the upstream side flat portion 16. The upstream sides of the upstream side first louver 42 and the downstream side first louver 43 with respect to the approximately center point in the X-axis direction are formed by cutting and raising a part of the flat plate-shaped plate material upward. The downstream sides of the upstream side first louver 42 and the downstream side first louver 43 with respect to the approximately center point in the X-axis direction are formed by cutting and raising a part of the flat plate-shaped plate material downward.

[0062] As shown in Figs. 7 and 8, the upstream side third louver 46 is symmetrical with the downstream side first louver 43 with reference to the reference surface S1. Further, the downstream side third louver 47 is symmetrical with the upstream side first louver 42 with reference to the reference surface S1. Therefore, detailed description of the upstream side third louver 46 and the downstream side first louver 43 will be omitted.

[0063] Further, as shown in Fig. 8, the upstream side louver 17, the upstream side first louver 42, the downstream side first louver 43, and the second louver upstream portion 22a are disposed to be parallel to each other. An angle θ formed by the upstream side first louver 42, the downstream side first louver 43, and the horizontal surface is set such that the flow of air flowing between the fins 1 is suitably divided into two.

[0064] An upstream side first slit 44 (refer to Figs. 5 and 7) is formed between the downstream end of the upstream side louver 17 and an upstream end of the upstream side first louver 42. In addition, the upstream side first slit 44 is formed between a downstream end of the upstream side first louver 42 and an upstream end of the downstream side first louver 43. Further, the second slit 26 is formed between the upstream end of the second louver 22 and a downstream end of the downstream side first louver 43. Moreover, as shown in Fig. 1, a length of the upstream side first slit 44 in the Y-axis direction is longer than a length of a downstream side first slit 45 in

the Y-axis direction. Additionally, the length of the downstream side first slit 45 in the Y-axis direction is longer than the length of the second slit 26 in the Y-axis direction. The upstream side first slit 44 and the downstream side first slit 45 are open in the upstream direction.

[0065] As shown in Fig. 7, an upstream side third slit 48 is formed between the downstream end of the second louver 22 and an upstream end of the upstream side third louver 46. In addition, a downstream side third slit 49 is formed between a downstream end of the upstream side third louver 46 and an upstream end of the downstream side third louver 47. Further, the fourth slit 28 is formed between a downstream end of the downstream side third louver 47 and the upstream end of the downstream side louver 18. The upstream side third louver 46 and the downstream side third louver 47 are open to the downstream side.

[0066] Next, the flow of air passing through the fin 1 will be described with reference to Fig. 7.

[0067] As shown by the arrow F1 in Fig. 7, air that has flowed into the fin pitch P collides with an upstream end portion of the upstream side first louver 42. In a case where air collides with the upstream end portion of the upstream side first louver 42, a flow of air is divided by the upstream side first louver 42. Specifically, the flow of air is divided into a flow (refer to arrows F2c and F2d) flowing along an upper surface of the upstream side first louver 42 and a flow (refer to arrow F2e) passing through the upstream side first slit 44 and flowing along a lower surface of the upstream side first louver 42. Although the arrows F2c and F2d are indicated by separate arrows for convenience, the arrows F2c and F2d integrally flow at this stage.

[0068] A flow of air flowing along the upper surface of the upstream side first louver 42 collides with an upstream end portion of the downstream side first louver 43. In a case where air collides with the upstream end portion of the downstream side first louver 43, the flow of air is divided by the downstream side first louver 43. Specifically, the flow of air is divided into a flow (refer to arrow F2c) flowing along an upper surface of the downstream side first louver 43 and a flow (refer to arrow F2d) passing through the downstream side first slit 45 and flowing along a lower surface of the downstream side first louver 43.

[0069] The flow (refer to arrow F2c) of air flowing along the upper surface of the downstream side first louver 43 passes through the second slit 26 and flows (refer to arrow F3c) along the lower surface of the second louver 22. The flow that has flowed along the lower surface of the second louver 22 flows along an upper surface of the upstream side third louver 46, flows (refer to arrow F4c) above the downstream side third louver 47, and then flows (refer to arrow F5c) along the lower surfaces of the downstream side louver 18 and the downstream side flat portion 19.

[0070] The flow (refer to arrow F2d) of air flowing along the lower surface of the downstream side first louver 43

flows (refer to arrow F3d) below the second louver 22. A flow of air that has flowed below the second louver 22 flows along a lower surface of the upstream side third louver 46, flows (refer to arrow F4d) an upper surface of the downstream side third louver 47, and then flows (refer to arrow F5d) above the downstream side louver 18 and the downstream side flat portion 19.

[0071] On the other hand, the flow (refer to the arrow F2e) of air flowing along the lower surface of the upstream side first louver 42 flows (refer to the arrow F3e) along the upper surface of the second louver 22 of the fin adjacent in the Z-axis direction. The flow that has flowed along the upper surface of the second louver 22 flows (refer to arrow F4e) below the upstream side third louver 46 and along a lower surface of the downstream side third louver 47, and then flows (refer to arrow F5e) along the upper surfaces of the downstream side louver 18 and the downstream side flat portion 19.

[0072] In this way, air that has flowed into the fin pitch P flows in three flow paths of a flow path c indicated by arrows F2c to F5c, a flow path d indicated by arrows F2d to F5d, and a flow path e indicated by arrows F2e to F5e. The flow path c, the flow path d, and the flow path e are flow paths in which the fin pitch P is divided into three equal parts.

[0073] According to the present embodiment, the following actions and effects are achieved.

[0074] In the present embodiment, a plurality of first louvers (upstream side first louver 42 and downstream side first louver 43) are provided (in the present embodiment, two as example). Accordingly, it is possible to increase a total length of upstream ends of the first louvers in the Y-axis direction (total length of upstream ends of first louvers in Y-axis direction), as compared with a case where one first louver is used. Therefore, it is possible to divide more flows of air. Therefore, it is possible to further reduce the pressure loss that occurs in a case where air flows.

[0075] Further, in the present embodiment, the plurality of first louvers (upstream side first louver 42 and downstream side first louver 43) are arranged along the X-axis direction. Accordingly, it is possible to decrease a length of each first louver in the X-axis direction, as compared with a case where only one first louver is used. Therefore, since the first louver has an angle θ with respect to the horizontal surface, it is possible to decrease a length (in other words, length of first louver protruding in Z-axis direction) of each first louver in the Z-axis direction (extending direction of heat transfer tube). Therefore, since it is possible to decrease a length of the fin for a heat exchanger itself in the Z-axis direction, in a case where a plurality of fins 40 are provided side by side in the Z-axis direction, it is possible to densely dispose the fins 40. Alternatively, in a case where the same number of fins 40 is provided, it is possible to miniaturize the heat exchanger provided with the fins 40.

[0076] In the present embodiment, a separation distance between the fins 40 adjacent to each other in the

Z-axis direction is defined as the same L1 as in the first embodiment, however, the distance may be shorter than L1.

[0077] The present disclosure is not limited to each of the embodiments described above, and can be appropriately modified within a scope which does not depart from the gist of the present disclosure.

[0078] For example, dimensions of each portion of the fin 1 described in the above-described embodiment are examples and are not limited to the above-described dimensions.

[0079] In addition, in the first embodiment, an example in which the number of the first louver and the number of the third louver is one is described, and in the second embodiment, an example in which the number of the first louvers and the number of the third louvers is two is described, however, the number of first louvers and third louvers is not limited thereto. For example, the number of each of the first louver and the third louver may be three or more. However, in a case where the number of first louvers and third louvers is too large, air resistance is increased, and there is a possibility that a pressure loss of air passing through the fin for a heat exchanger is increased. Therefore, the optimum number of first louvers and third louvers may be determined from a viewpoint of air resistance.

[0080] The fin for a heat exchanger in the embodiment described above is understood as follows, for example.

[0081] According to an embodiment of the present disclosure, there is provided a fin (1) for a heat exchanger that is provided in the heat exchanger exchanging heat between a refrigerant flowing inside a heat transfer tube that extends in a predetermined direction (Z-axis direction) and air flowing outside the heat transfer tube in a direction (X-axis direction) that intersects with the predetermined direction, and that is attached to the heat transfer tube including a plate-shaped substrate portion (10) that includes a heat transfer tube passing portion (11) having a circular shape centered on a central axial line (C) extending in the predetermined direction and through which the heat transfer tube passes, a louver portion (12) in which a slit (25) is formed by louvers (21, 22) cut and raised in the predetermined direction, and that is provided along a direction in which the air flows, in which the slit communicates one surface side and the other surface side of the substrate portion with each other, the louver portion includes a flat portion (16), a first louver (21) that is provided on a downstream side of the flat portion and that protrudes with respect to the flat portion in the predetermined direction, and a second louver (22) that is provided on a downstream side of the first louver, the second louver includes a linear portion (22b) at which a shape of a cross-section in a case of cutting on a surface (XZ plane) that is formed in the predetermined direction and in the direction in which the air flows, extending in the direction in which the air flows, an upstream portion (22a) at which the shape of the cross-section is obliquely bent in an upstream direction from an upstream end of

the linear portion and extends linearly, and a downstream portion (22c) at which the shape of the cross-section is obliquely bent in a downstream direction from a downstream end of the linear portion and extends linearly, and the linear portion is disposed to overlap with the heat transfer tube passing portion in a case where the cross-section is viewed.

[0082] In the above configuration, the louver portion includes the first louver and the second louver. As a result, air flowing along the louver portion meanders along the first louver and the second louver. Therefore, as compared with the case where air flows in the linear shape, since it is possible that the distance in which air and the louver portion are contacted increases, it is possible to improve the heat transfer coefficient.

[0083] In addition, in the above configuration, air flowing along the louver portion flows along the flat portion and then collides with the upstream end portion of the first louver. In a case where air collides with the upstream end portion of the first louver, the flow of air is divided by the first louver. Specifically, the flow of air is divided into a flow that flows along one surface of the louver portion, and a flow that passes through the slit and flows along the other surface of the louver portion. In this manner, since the flow of air is divided by the first louver, for example, in a case where the plurality of fins (hereinafter, fins adjacent to each other in predetermined direction are referred to as "first fin" and "second fin") are arranged side by side at predetermined intervals in the predetermined direction, a plurality of flows are formed in a gap formed between the first fin and the second fin. In detail, a flow of air flowing along the other surface of the first fin and a flow of air flowing along one surface of the second fin are formed. As described above, since it is possible that the flow of air is suitably divided by the first louver, it is possible to reduce the pressure loss that occurs in a case where air flows.

[0084] In addition, in the above configuration, the second louver provided on the downstream side of the first louver includes a linear portion, an upstream portion, and a downstream portion. The linear portion, the upstream portion, and the downstream portion are all formed in the linear shape. Accordingly, for example, it is possible to easily perform a processing, as compared with a case where the linear portion, the upstream portion, and the downstream portion are formed in a curved shape.

[0085] In addition, according to the embodiment of the present disclosure, there is provided a fin for a heat exchanger, in which the first louver is formed in a linear shape in the cross-section.

[0086] In the above configuration, the first louver is formed in the linear shape. Accordingly, for example, it is possible to reduce the pressure loss of flowing air, as compared with a case where the first louver is curved. In addition, it is possible to easily form the first louver, as compared with the case where the first louver is curved.

[0087] In addition, according to the embodiment of the present disclosure, there is provided the fin for a heat

exchanger, in which a plurality of louver portions are provided, the plurality of louver portions are arranged side by side in a direction that intersects the direction in which the air flows, and a planar dividing portion (15) is provided between the louver portions.

[0088] In the above configuration, a planar dividing portion is provided between the louver portions. As a result, it is possible to improve a rigidity of the louver portion. Therefore, it is also possible to improve a rigidity of entire fin.

[0089] In addition, according to the embodiment of the present disclosure, there is provided the fin for a heat exchanger, in which an end portion of the louver portion on a heat transfer tube passing portion side has an arc shape concentric with a shape of the heat transfer tube passing portion.

[0090] In the above configuration, the end portion of the louver portion on the heat transfer tube passing portion side has the arc shape concentric with the shape of the heat transfer tube passing portion. As a result, it is possible to increase a length of the louver portion toward the heat transfer tube passing portion side. Therefore, since it is possible to divide more flows of air, it is possible to further reduce the pressure loss that occurs in a case where air flows.

[0091] In addition, according to the embodiment of the present disclosure, there is provided the fin for a heat exchanger, in which the first louver is provided such that an upstream end does not overlap with the heat transfer tube passing portion in the cross-section.

[0092] In the above configuration, the first louver is provided such that the upstream end does not overlap with the heat transfer tube passing portion in the cross-section. As a result, it is difficult for the upstream end of the first louver and the heat transfer tube passing portion to interfere with each other. Therefore, since it is possible to increase a length of the upstream end of the first louver that divides the flow of air, it is possible to divide more flows of air. Therefore, it is possible to further reduce the pressure loss that occurs in a case where air flows.

[0093] In addition, according to the embodiment of the present disclosure, there is provided the fin for a heat exchanger, in which the shape of the cross-section of the louver portion is line-symmetrical with reference to the central axial line, and one side with respect to the central axial line is point-symmetrical with reference to a center point (CP) of the first louver.

[0094] In the above configuration, the one side with respect to the central axial line of the louver portion is point-symmetrical with reference to the center point of the first louver. Accordingly, it is possible to reduce the pressure loss that occurs in a case where air flows.

[0095] In addition, according to the embodiment of the present disclosure, there is provided the fin for a heat exchanger, in which a plurality of first louvers (42, 43) are provided, and the plurality of first louvers are arranged side by side in the direction in which the air flows.

[0096] In the above configuration, the plurality of first

louvers are provided. Accordingly, it is possible to increase a total length of the upstream ends of the first louvers (total length of upstream ends of first louvers), as compared with the case where one first louver is used. Therefore, it is possible to divide more flows of air. Therefore, it is possible to further reduce the pressure loss that occurs in a case where air flows.

[0097] In addition, in the above configuration, the plurality of first louvers are arranged along the air flow direction. Accordingly, it is possible to decrease a size of each first louver, as compared with the case where only one first louver is used. Therefore, it is possible to decrease a length (in other words, length of first louver protruding in predetermined direction) of each first louver in the predetermined direction (extending direction of heat transfer tube). Therefore, since it is possible to decrease a length of the fin for a heat exchanger itself in the predetermined direction, in a case where a plurality of fins for a heat exchanger are provided side by side in the predetermined direction, it is possible to densely dispose the plurality of fins for a heat exchanger. Alternatively, in a case where the same number of fins for a heat exchanger is provided, it is possible to miniaturize the heat exchanger provided with the fins for a heat exchanger in the above-configuration.

Reference Signs List

[0098]

1:	fin	
10:	substrate portion	
11:	heat transfer tube passing portion	
12:	louver portion	
13:	annular portion	
15:	dividing portion	
16:	upstream side flat portion (flat portion)	
17:	upstream side louver	
18:	downstream side louver	
19:	downstream side flat portion	
21:	first louver	
21a:	first louver upstream portion	
21b:	first louver downstream portion	
22:	second louver	
22a:	second louver upstream portion (upstream portion)	
22b:	linear portion	
22c:	second louver downstream portion (downstream portion)	
23:	third louver	
25:	first slit	
26:	second slit	
27:	third slit	
28:	fourth slit	
30:	cylindrical portion	
40:	fin	
41:	substrate portion	
42:	upstream side first louver	

43:	downstream side first louver
44:	upstream side first slit
45:	downstream side first slit
46:	upstream side third louver
5	47: downstream side third louver
	48: upstream side third slit
	49: downstream side third slit

10 Claims

1. A fin for a heat exchanger that is provided in the heat exchanger exchanging heat between a refrigerant flowing inside a heat transfer tube that extends in a predetermined direction and air flowing outside the heat transfer tube in a direction that intersects with the predetermined direction, and that is attached to the heat transfer tube comprising:

a plate-shaped substrate portion that includes a heat transfer tube passing portion having a circular shape centered on a central axial line extending in the predetermined direction and through which the heat transfer tube passes, a louver portion in which a slit is formed by louvers cut and raised in the predetermined direction, and that is provided along a direction in which the air flows, wherein the slit communicates one surface side and the other surface side of the substrate portion with each other, the louver portion includes a flat portion, a first louver that is provided on a downstream side of the flat portion and that protrudes with respect to the flat portion in the predetermined direction, and a second louver that is provided on a downstream side of the first louver, the second louver includes a linear portion at which a shape of a cross-section in a case of cutting on a surface that is formed in the predetermined direction and in the direction in which the air flows, extending in the direction in which the air flows, an upstream portion at which the shape of the cross-section is obliquely bent in an upstream direction from an upstream end of the linear portion and extends linearly, and a downstream portion at which the shape of the cross-section is obliquely bent in a downstream direction from a downstream end of the linear portion and extends linearly, and the linear portion is disposed to overlap with the heat transfer tube passing portion in a case where the cross-section is viewed.

- 55 2. The fin for a heat exchanger according to Claim 1, wherein the first louver is formed in a linear shape in the cross-section.

3. The fin for a heat exchanger according to Claim 1 or 2,
wherein a plurality of louver portions are provided,
the plurality of louver portions are arranged side by side in a direction that intersects with the direction in which the air flows, and a planar dividing portion is provided between the louver portions. 5
4. The fin for a heat exchanger according to any one of Claims 1 to 3, 10
wherein an end portion of the louver portion on a heat transfer tube passing portion side has an arc shape concentric with a shape of the heat transfer tube passing portion. 15
5. The fin for a heat exchanger according to Claim 4,
wherein the first louver is provided such that an upstream end does not overlap with the heat transfer tube passing portion in the cross-section. 20
6. The fin for a heat exchanger according to any one of Claims 1 to 5,
wherein the shape of the cross-section of the louver portion is line-symmetrical with reference to the central axial line, and one side with respect to the central axial line is point-symmetrical with reference to a center point of the first louver. 25
7. The fin for a heat exchanger according to any one of Claims 1 to 5, 30
wherein a plurality of first louvers are provided, and the plurality of first louvers are arranged side by side in the direction in which the air flows.

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FIG. 1

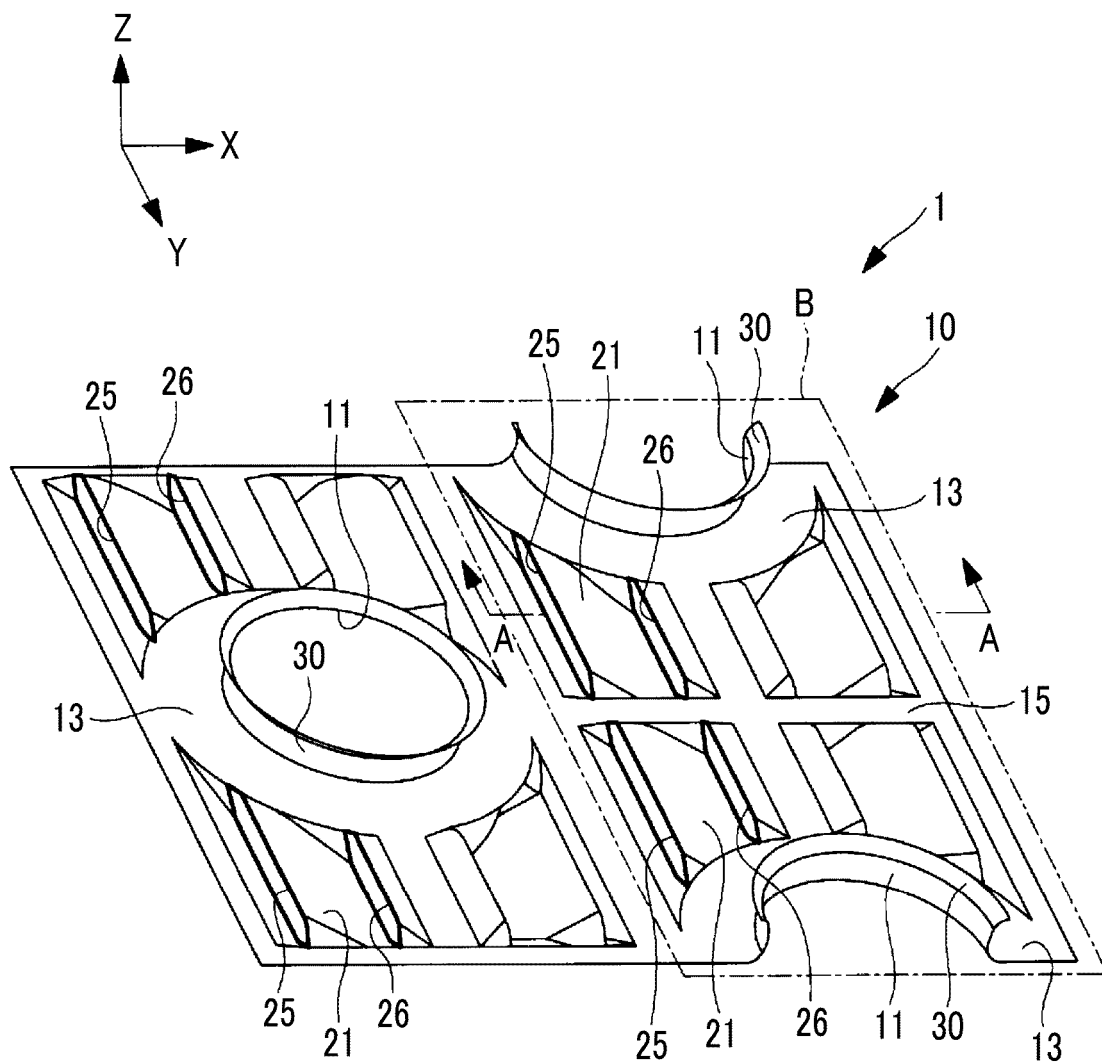


FIG. 2

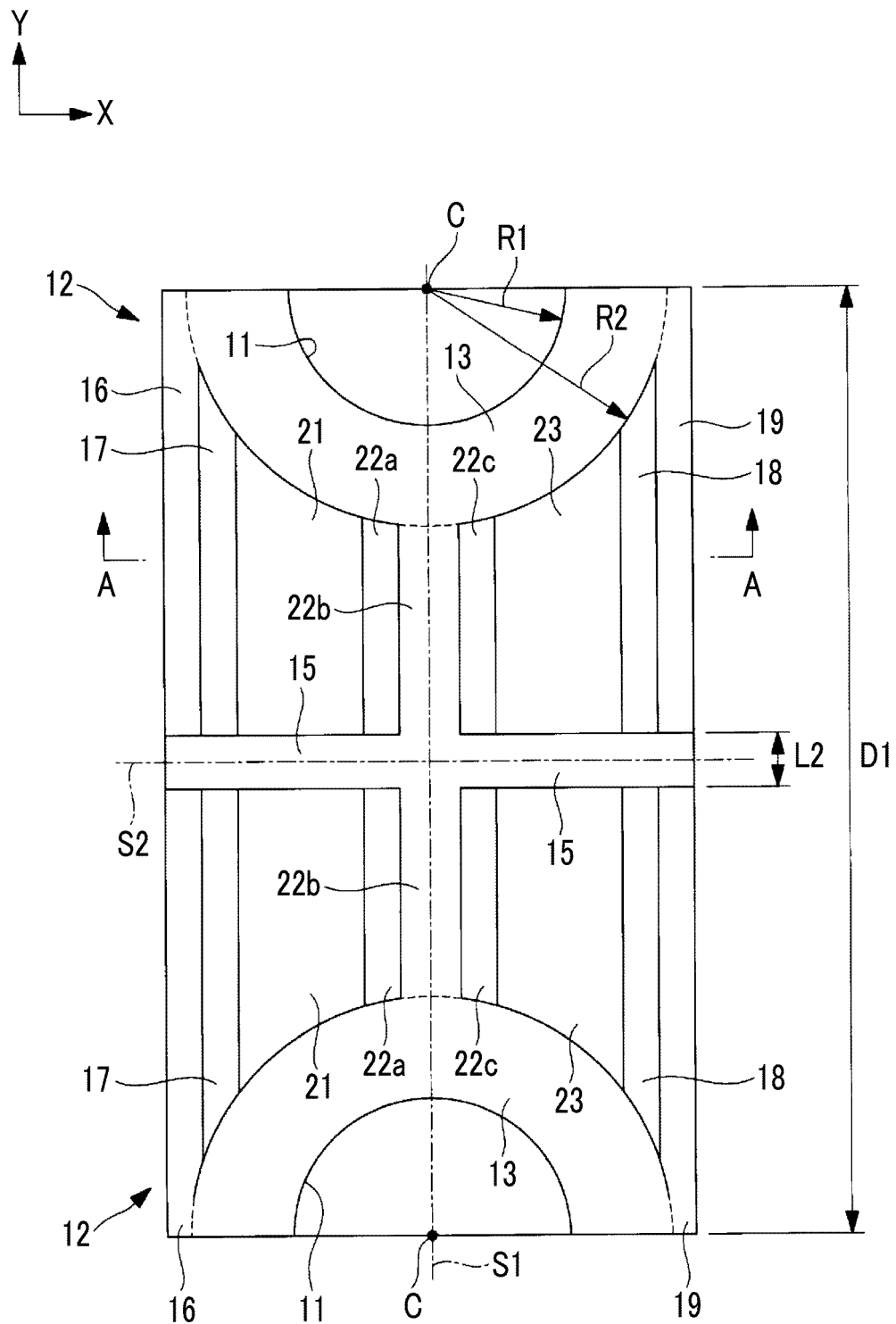


FIG. 3

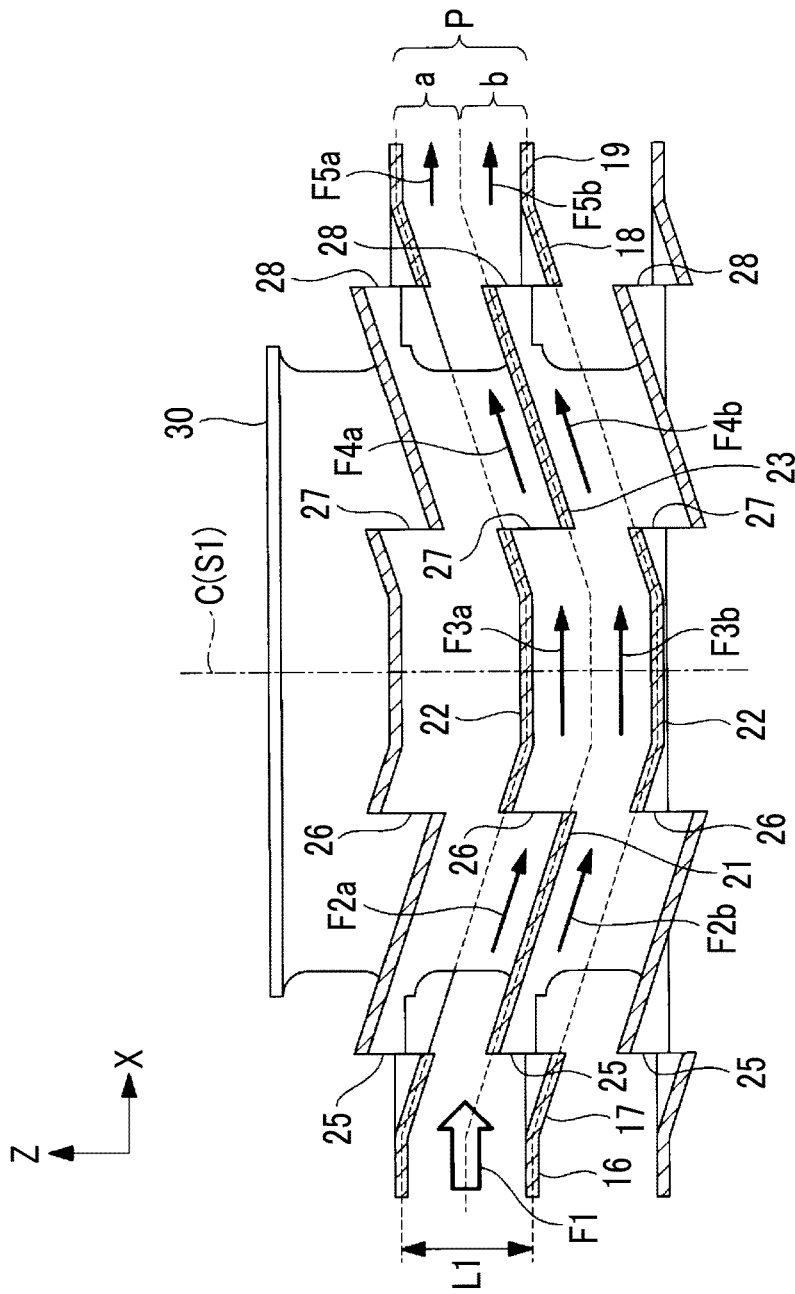


FIG. 4

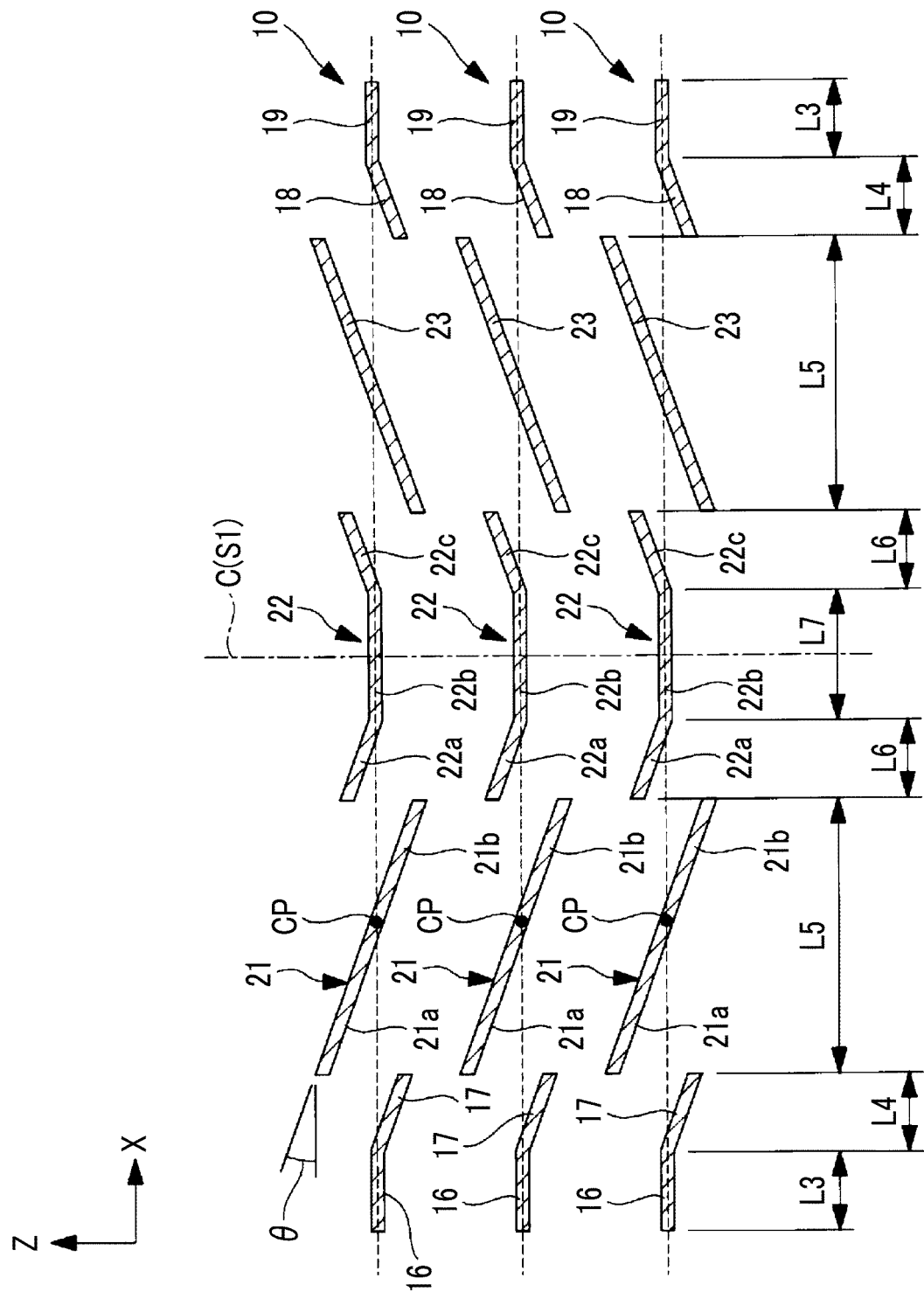


FIG. 5

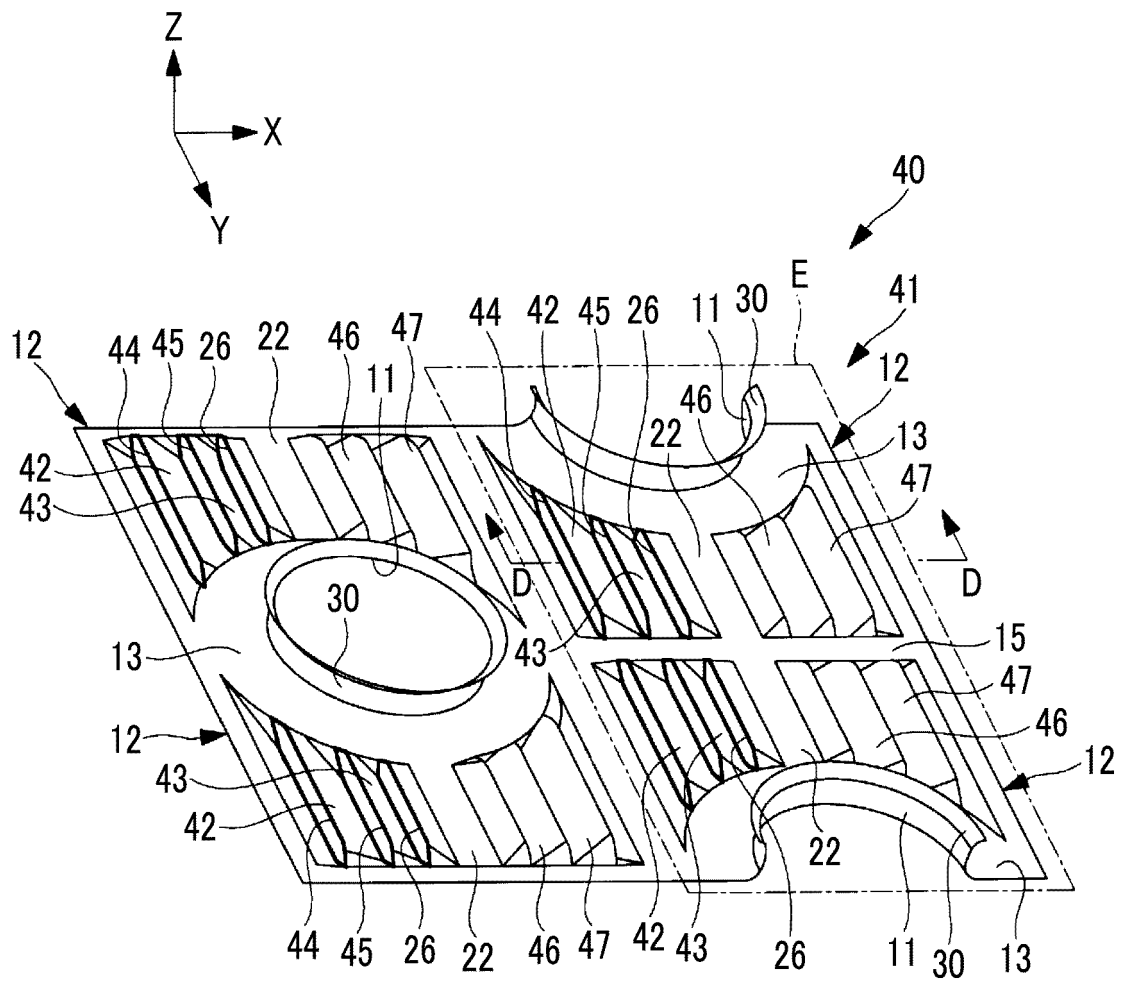


FIG. 6

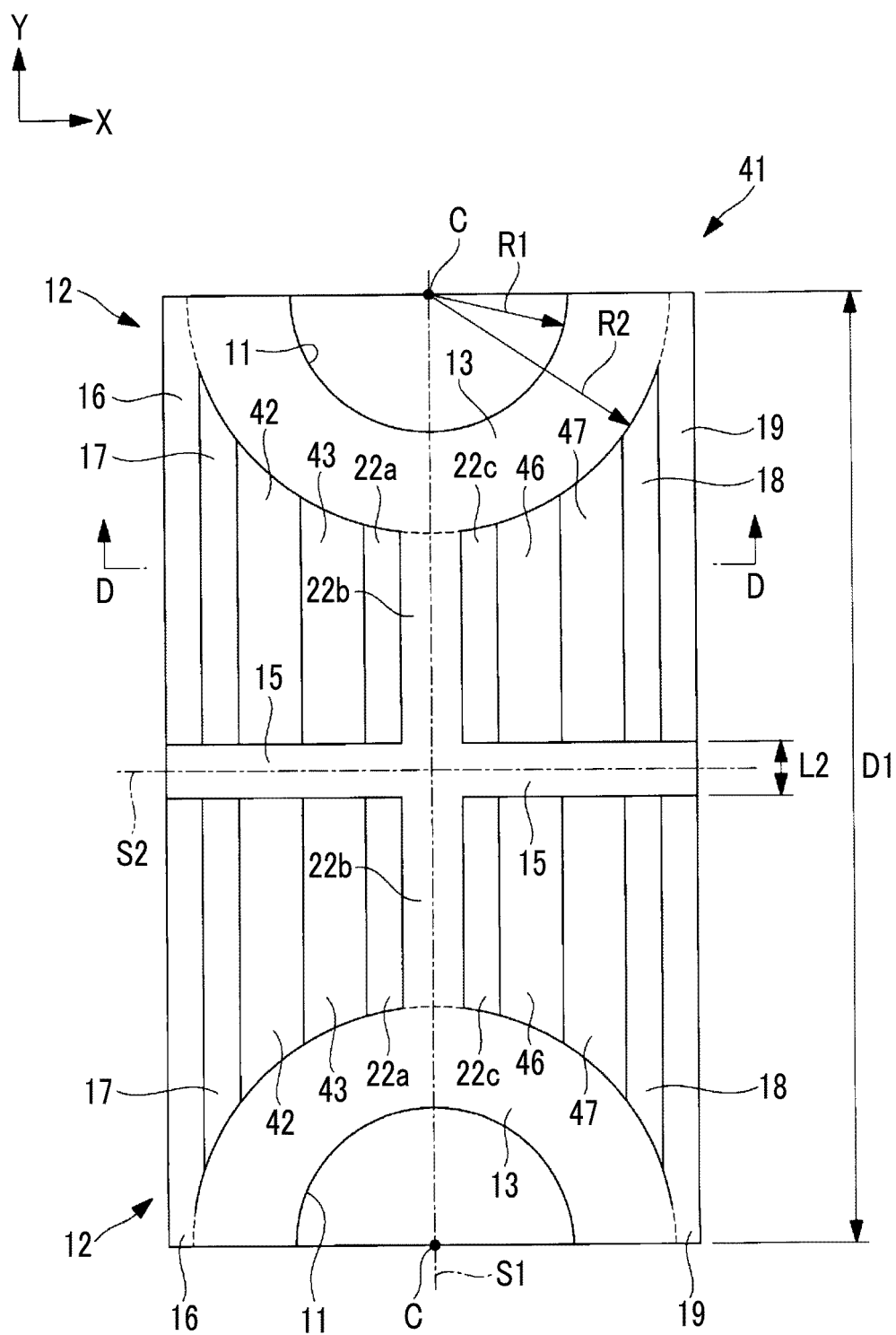


FIG. 7

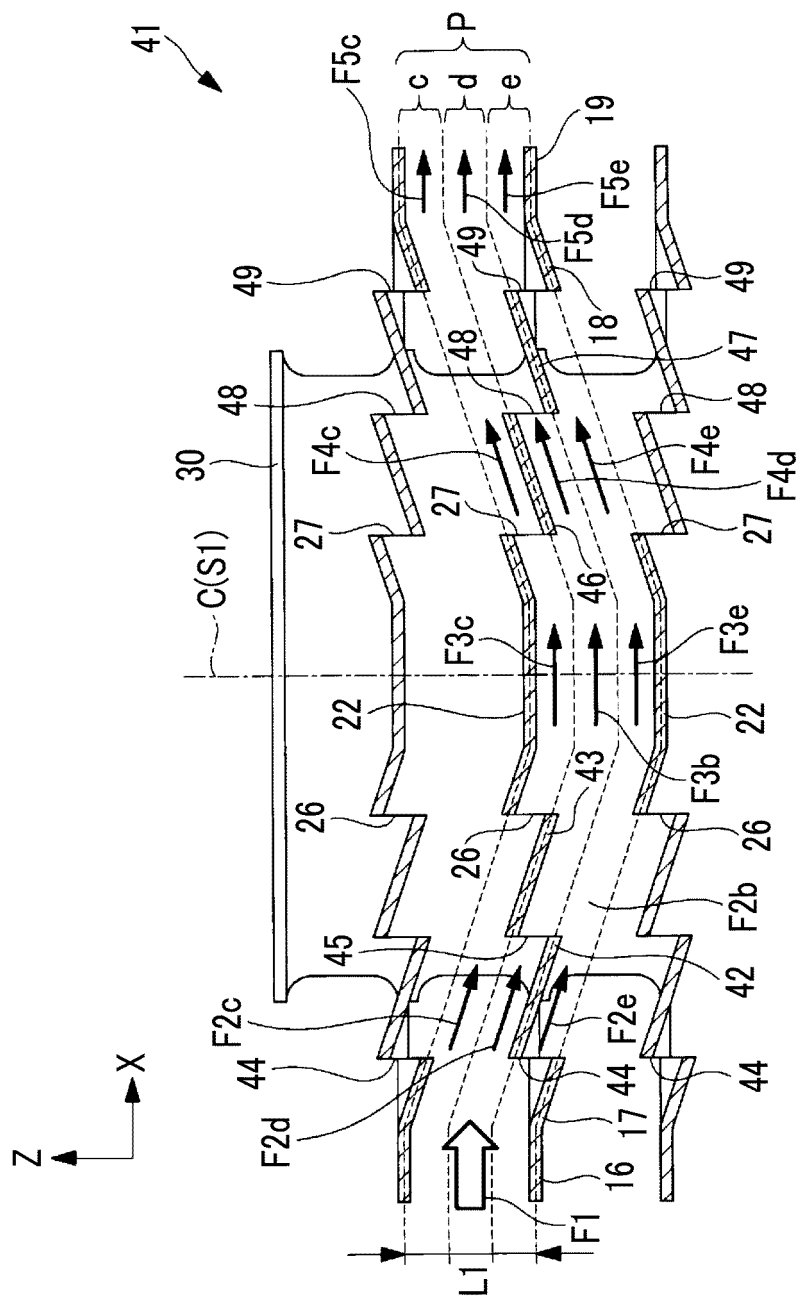
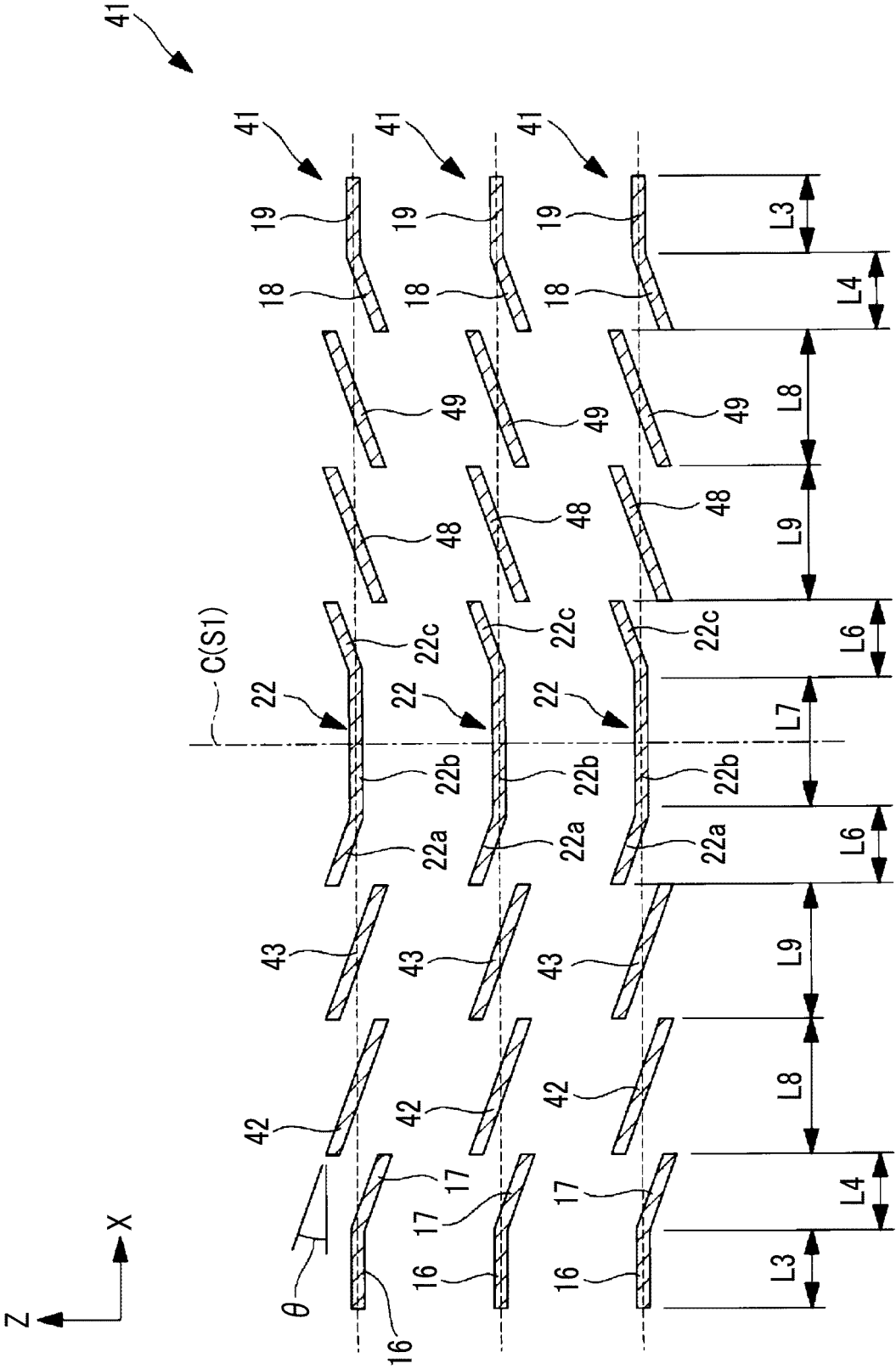


FIG. 8



INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2022/022801

A. CLASSIFICATION OF SUBJECT MATTER		
<i>F28F 1/32</i> (2006.01)i		
FI: F28F1/32 S; F28F1/32 D		
According to International Patent Classification (IPC) or to both national classification and IPC		
B. FIELDS SEARCHED		
Minimum documentation searched (classification system followed by classification symbols)		
F28F1/32		
Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched		
Published examined utility model applications of Japan 1922-1996		
Published unexamined utility model applications of Japan 1971-2022		
Registered utility model specifications of Japan 1996-2022		
Published registered utility model applications of Japan 1994-2022		
Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)		
C. DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	JP 2019-52830 A (SAMSUNG ELECTRONICS CO., LTD.) 04 April 2019 (2019-04-04)	1-2, 4-7
Y	paragraphs [0018]-[0028], [0041]-[0043], fig. 2-4, 9	3-7
Y	US 2014/0034272 A1 (LG ELECTRONICS INC.) 06 February 2014 (2014-02-06)	3-7
	paragraphs [0027]-[0053], fig. 1-3	
☐ Further documents are listed in the continuation of Box C. ☒ See patent family annex.		
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"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	Date of mailing of the international search report	
28 June 2022	12 July 2022	
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.	

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INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/JP2022/022801

Patent document cited in search report	Publication date (day/month/year)	Patent family member(s)	Publication date (day/month/year)
JP 2019-52830 A	04 April 2019	(Family: none)	
US 2014/0034272 A1	06 February 2014	EP 2693151 A1	
		KR 10-2014-0017835 A	
		CN 103574995 A	

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

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- JP H9166392 A [0004]