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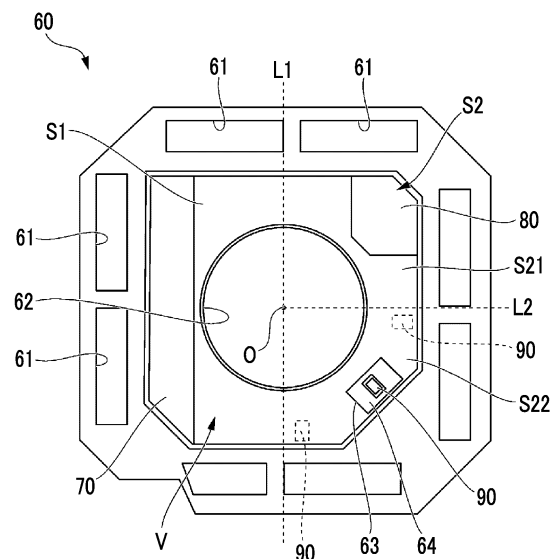
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(54) **CEILING-EMBEDDED AIR CONDITIONER**

(57) This ceiling-embedded air conditioner comprises: a motor having an output shaft that is rotatable about the axis; a turbofan attached to the output shaft; a heat exchanger that surrounds the turbofan and through which air pumped by the turbofan passes; a drain pan provided below the heat exchanger and formed with a suction port opening about the axis; a main electrical box attached to the lower surface of the drain pan; and a refrigerant sensor that is attached to the drain pan and detects refrigerant in the air. The lower surface of the drain pan is formed with a first area where the main electrical box is located on one edge extending along a first dividing line perpendicular to the axis as viewed from the axial direction, and a second area located on the opposite side to the first area; the refrigerant sensor is provided in the second area.

FIG. 2



Description

Technical Field

[0001] The present disclosure relates to a ceiling-embedded air conditioner.

Background Art

[0002] As an air conditioner to be disposed on a ceiling in a room, a ceiling-embedded air conditioner is known. The ceiling-embedded air conditioner mainly includes a turbofan that rotates about an axis extending in an up-down direction, a heat exchanger that surrounds the turbofan from an outer peripheral side, a drain pan that is provided below the heat exchanger, and a casing that covers the drain pan from below. A suction port that is open about an axis is formed in the drain pan and in a central portion of the casing. The indoor air sucked from the suction port is exchanged with heat by flowing to the heat exchanger in the radial outer side by the rotation of the turbofan. The air is temperature-regulated by exchanging heat with the refrigerant when passing through the heat exchanger. The temperature-regulated air is supplied into the room through a drain pan and a discharge port formed in a casing.

[0003] Here, in order to detect a case where the refrigerant leaks from the heat exchanger, a refrigerant sensor is provided in the ceiling-embedded air conditioner (for example, PTL 1 below). In the device according to PTL 1 below, the electrical box that accommodates the electrical component is attached on the side of the suction port on the lower surface of the drain pan. Further, a refrigerant sensor is provided in the vicinity of the electrical box.

Citation List

Patent Literature

[0004] [PTL 1] Japanese Unexamined Patent Application Publication No. 2021-14963

Summary of Invention

Technical Problem

[0005] However, in an area close to the electrical box in the suction port as described above, the flow speed and the flow rate of the air are larger than those in other areas. As a result, the dirt and dust contained in the air are likely to adhere to the refrigerant sensor. As a result, there is a possibility that the accuracy of detecting the refrigerant by the refrigerant sensor may be reduced.

[0006] The present disclosure has been made to solve the above problems, and an object thereof is to provide a ceiling-embedded air conditioner capable of detecting leakage of a refrigerant with higher accuracy.

Solution to Problem

[0007] In order to solve the above problems, according to the present disclosure, there is provided a ceiling-embedded air conditioner including a motor that has an output shaft rotatable about an axis extending in an up-down direction; a turbofan that is attached to the output shaft; a heat exchanger that surrounds the turbofan from an outer peripheral side and through which air pumped by the turbofan passes; a drain pan that is provided below the heat exchanger and is formed with a suction port which is open about the axis; a main electrical box that is attached to a lower surface of the drain pan and accommodates an electrical component; and a refrigerant sensor that is attached to the drain pan and detects a refrigerant in the air, in which a first area in which the main electrical box is disposed in one edge extending along a first dividing line orthogonal to the axis when viewed in a direction of the axis, and a second area located on a side opposite to the first area with the first dividing line interposed therebetween is formed on the lower surface of the drain pan, and the refrigerant sensor is provided in the second area.

[0008] According to the present disclosure, there is provided a ceiling-embedded air conditioner including a motor that has an output shaft rotatable about an axis extending in an up-down direction; a turbofan that is attached to the output shaft; a heat exchanger that surrounds the turbofan from an outer peripheral side and through which air pumped by the turbofan passes; a drain pan that is provided below the heat exchanger and is formed with a suction port which is open about the axis; a main electrical box that is attached to a lower surface of the drain pan and accommodates an electrical component; and a refrigerant sensor that is attached to the drain pan and detects a refrigerant in air, in which a first area in which the main electrical box is disposed in one edge extending along a first dividing line orthogonal to the axis when viewed in a direction of the axis, and a second area located on a side opposite to the first area with the first dividing line interposed therebetween is formed on the lower surface of the drain pan, the second area is partitioned into a first small area and a second small area by a second dividing line that is orthogonal to the first dividing line and that extends in a horizontal direction, a sub electrical box different from the main electrical box is provided in the first small area, a cover detachably attached to an opening hole formed in the second small area is further provided, and the refrigerant sensor is provided on an upper surface side of the cover.

Advantageous Effects of Invention

[0009] According to the present disclosure, it is possible to provide a ceiling-embedded air conditioner capable of detecting leakage of a refrigerant with higher accuracy.

Brief Description of Drawings

[0010]

Fig. 1 is a cross-sectional view of a ceiling-embedded air conditioner according to a first embodiment of the present disclosure.

Fig. 2 is a schematic view of a drain pan according to the first embodiment of the present disclosure as viewed in the direction of the axis.

Fig. 3 is an enlarged cross-sectional view of a main part of the ceiling-embedded air conditioner according to the first embodiment of the present disclosure.

Fig. 4 is a cross-sectional view showing a configuration of a refrigerant sensor according to the first embodiment of the present disclosure.

Fig. 5 is an enlarged cross-sectional view of a main part of the ceiling-embedded air conditioner according to a first modification example of the first embodiment of the present disclosure.

Fig. 6 is an enlarged cross-sectional view of a main part of a ceiling-embedded air conditioner according to a second modification example of the first embodiment of the present disclosure.

Fig. 7 is a view of a drain pan according to a second embodiment of the present disclosure as viewed from below.

Description of Embodiments

<First Embodiment>

(Configuration of Ceiling-Embedded Air Conditioner)

[0011] Hereinafter, a ceiling-embedded air conditioner 1 according to a first embodiment of the present disclosure will be described with reference to Figs. 1 to 4.

[0012] As shown in Fig. 1, the ceiling-embedded air conditioner 1 includes a main body case 10, a motor 20, a turbofan 30, a heat exchanger 40, a bell mouth 50, a drain pan 60, a main electrical box 70, a sub electrical box 80, and a refrigerant sensor 90.

[0013] The main body case 10 is embedded in a ceiling of a building. The main body case 10 has a rectangular shape as viewed from below, and is recessed upward to form a space therein. Specifically, the main body case 10 has a panel 11 that is exposed on a ceiling surface and a boxshaped cabinet 12 that is provided above the panel 11. The panel 11 includes a panel body 13 that is a rectangular frame body, and a grill 14 provided in a lower center. The panel body 13 forms a discharge port 15 around the grill 14. The panel body 13 and the grill 14 are joined to each other in a state where they are removable downward from a drain pan 60 to be described later.

[0014] The motor 20 is provided at a central portion of a bottom surface inside the cabinet 12 facing downward. The motor 20 has a motor body 21 that accommodates a coil, a magnet, and the like, and an output shaft 22 that

protrudes vertically downward from the motor body 21. The output shaft 22 is rotationally driven about an axis O extending in the vertical direction.

[0015] The turbofan 30 is attached to the output shaft 22. The turbofan 30 includes a disk-shaped main panel 31 that extends toward the radial outer side and has the axis O as the center, a plurality of main blades 32 that are arranged at intervals in the circumferential direction, and an annular-shaped shroud 33 that covers the main blades 32 from below. As the output shaft 22 rotates, the turbofan 30 fixed to the output shaft 22 by the main panel 31 rotates, and the air sucked from the grill 14 passes through a bell mouth 50 (to be described later) and is sent to the radial outer side by the turbofan 30.

[0016] The annular-shaped heat exchanger 40 that surrounds the turbofan 30 is provided on radial outer side of the turbofan 30. The heat exchanger 40 is a portion of a refrigerant circuit having a refrigerating cycle.

[0017] The air sent to the heat exchanger 40 by the turbofan 30 is heat-exchanged with a refrigerant when passing through the heat exchanger 40. Accordingly, the air that has flowed out to an outer peripheral side of the heat exchanger 40 becomes cold air or warm air. The air flows downward along a side surface of the cabinet 12, passes through an opening 61 of a drain pan 60 (to be described later), and is supplied to the room from a discharge port 15 of the panel 11.

[0018] The drain pan 60 provided below the heat exchanger 40 is a dish-shaped member for receiving the condensed water generated on the surface of the heat exchanger 40. Details will be described later, but a plurality of openings 61 for guiding the air that has passed through the heat exchanger 40 to the discharge port 15 are formed in the drain pan 60. A portion excluding the openings 61 covers the heat exchanger 40 from below when viewed in a direction of the axis O.

[0019] The bell mouth 50 is disposed below the turbofan 30. The bell mouth 50 is provided to guide the air introduced from the grill 14 and to send the air to the turbofan 30. The bell mouth 50 has a conical shape that gradually contracts in diameter from below to above. An end portion of the bell mouth 50 on one side (upper side) in the direction of the axis O is surrounded by the above-described shroud 33 from an outer peripheral side.

(Configuration of Drain Pan)

[0020] Next, the configuration of the drain pan 60 will be described in detail. As shown in Fig. 2, the drain pan 60 has a rectangular shape when viewed in the direction of the axis O. The four corners of the drain pan 60 are formed with appropriate cutouts in accordance with the shape of the main body case 10. One or a plurality of (for example, two) openings 61 are formed in each of four edges of the drain pan 60.

[0021] A suction port 62 communicating with the bell mouth 50 described above is formed on a lower surface (that is, a surface facing the indoor side) of the drain pan

60. The suction port 62 is a circular opening centered on the axis O. Further, an accommodation space V that is recessed upward is formed around the suction port 62. The accommodation space V has a substantially rectangular shape when viewed in the direction of the axis O. The accommodation space V is partitioned into three areas by a first dividing line L1 and a second dividing line L2 that pass through the axis O.

[0022] The first dividing line L1 extends in a horizontal direction orthogonal to the axis O. The second dividing line L2 passes through the axis O and extends in the horizontal direction orthogonal to the first dividing line L1. Among two areas partitioned by the first dividing line L1, an area on one side (left side in the drawing) is a first area S1, and an area on the other side (right side in the drawing) is a second area S2.

[0023] The second area S2 is further partitioned into two areas by the second dividing line L2. An area on one side (upper side in the drawing) of the second dividing line L2 is a first small area S21, and an area on the other side (lower side in the drawing) of the second dividing line L2 is a second small area S22.

[0024] The main electrical box 70 is provided in the first area S1. The main electrical box 70 accommodates electrical components such as an inverter for supplying power to the motor 20 and the like. As an example, the main electrical box 70 has a rectangular shape disposed along one edge (end edge) in the first area S1 of the accommodation space V or in contact with the edge. That is, the first dividing line L1 extends in the same direction (parallel direction) as a longitudinal direction of the main electrical box 70. The term "same direction or the parallel direction" as used herein means substantially the same and parallel, and slight manufacturing errors or design tolerances are allowed.

[0025] The sub electrical box 80 is provided in the first small area S21 in the second area S2. The sub electrical box 80 accommodates, for example, an actuator or a relay circuit for moving the grill 14 described above in the direction of the axis O. The sub electrical box 80 is disposed to be in contact with two edges forming a corner portion in the first small area S21.

[0026] In the second area S2, an opening hole 63 for performing the maintenance is formed in the second small area S22. The opening hole 63 is covered by a cover 64. The opening hole 63 and the cover 64 are disposed at a position separated from the suction port 62 in the radial direction, at a central portion of the second small area S22 in the circumferential direction. That is, in the radial direction, the distance from the wall surface of the accommodation space V to the cover 64 is smaller than the distance from the suction port 62 to the cover 64. The opening hole 63 is used to replace an antibacterial agent (not illustrated) mounted on, for example, an upper surface side of the drain pan 60.

[0027] As shown in Fig. 3, a refrigerant sensor 90 for detecting a refrigerant component contained in the air is provided on each of an upper surface and a lower surface

of the cover 64. That is, the refrigerant sensor 90 is provided only in the second area S2 on the side opposite to the main electrical box 70 with the first dividing line L1 as a reference. Further, in the second area S2, the refrigerant sensor 90 is provided only in the second small area S22 on the side opposite to the sub electrical box 80 with reference to the second dividing line L2. In other words, the refrigerant sensor 90 is provided only in an area separated from the main electrical box 70 and the sub electrical box 80, and not in the vicinity of the main electrical box 70 and the sub electrical box 80.

[0028] The position where the refrigerant sensor 90 is provided is not limited to the above-described cover 64, and may be a position indicated by a rectangular broken line in Fig. 2. Specifically, the refrigerant sensor 90 may be disposed at a position slightly separated from the second dividing line L2 in the circumferential direction, or may be disposed at a position slightly separated from the first dividing line L1 in the circumferential direction.

(Configuration of Refrigerant Sensor)

[0029] As shown in Fig. 4, the refrigerant sensor 90 includes a sensor body 91 as a sensor element, and a housing 92 that covers the sensor body 91 from the outer side. The housing 92 has a rectangular parallelepiped shape, and a space for accommodating the sensor body 91 is formed inside the housing 92. In addition, the housing 92 is formed with an inflow port 93 and an outflow port 94 for taking in air toward an internal space. A straight line connecting the inflow port 93 and the outflow port 94 is a direction parallel to the radial direction with respect to the axis O. In addition, it is desirable that the inflow port 93 is located on the radial outer side and the outflow port 94 is located on the radial inner side. The term "parallel" as used herein refers to substantial parallelism, and a manufacturing error is allowed.

(Effects of Action)

[0030] Next, the operation of the ceiling-embedded air conditioner 1 will be described. When the ceiling-embedded air conditioner 1 is operated, power is first supplied to the motor 20. Accordingly, the output shaft 22 of the motor 20 is rotationally driven about the axis O. Then, the turbofan 30 attached to the output shaft 22 also rotates about the axis O. The air in the room is taken into the turbofan 30 through the grill 14 as the turbofan 30 rotates. The air pumped by the turbofan 30 flows toward the radial outer side and comes into contact with the heat exchanger 40. Heat exchange between the refrigerant and the air of the heat exchanger 40 is performed, and the temperature of the air is regulated. The temperature-regulated air is supplied into the room through the discharge port 15.

[0031] Here, the refrigerant sensor 90 is provided in the ceiling-embedded air conditioner 1 for the purpose of detecting a case where the refrigerant leaks from the

heat exchanger 40. The refrigerant sensor 90 detects the concentration of the refrigerant component contained in the air to detect the leakage. For this reason, it is desirable that the refrigerant sensor 90 is disposed at a location where the flow speed and the flow rate of the air are low so that the refrigerant sensor 90 is not contaminated with dust or dirt.

[0032] Therefore, in the present embodiment, as described above, the refrigerant sensor 90 is disposed only in the second small area S22 which is an area separated from the main electrical box 70 and the sub electrical box 80, among the areas of each of the drain pans 60. In the first area S1 where the main electrical box 70 is disposed, the main electrical box 70 is disposed between the grill 14 and the suction port 62. Therefore, the volume of the accommodation space V, which is an air flow path, is small. In other words, a cross-sectional area of the flow path is reduced. Similarly, the cross-sectional area of the flow path is also reduced in the first small area S21 where the sub electrical box 80 is disposed. For this reason, the flow speed of the air increases as compared with that in other areas, and the flow rate also increases with the increase in the flow speed. As a result, in the vicinity of the main electrical box 70 and the sub electrical box 80 (that is, the first area S1 and the first small area S21), the amount of the dirt or the dust contained in the air is larger than that in the second small area S22. Therefore, there is a high possibility that the refrigerant sensor 90 may be contaminated with dust or dirt. However, in the present embodiment, the refrigerant sensor 90 is disposed only in the second small area S22 where the main electrical box 70 and the sub electrical box 80 are not provided. Therefore, the flow speed and the flow rate of the air in contact with the refrigerant sensor 90 can be suppressed to be small. As a result, the amount of the dirt or the dust adhering to the refrigerant sensor 90 is reduced. Therefore, it is possible to improve the accuracy of the leakage detection of the refrigerant by the refrigerant sensor 90.

[0033] Further, according to the above configuration, the refrigerant sensor 90 is attached to the cover 64 that covers the opening hole 63 in the second small area S22. For this reason, when the cover 64 is removed and the maintenance of the inside of the device is performed through the opening hole 63, the maintenance of the refrigerant sensor 90 can be simultaneously performed. As a result, the maintainability of the ceiling-embedded air conditioner 1 can be further improved.

[0034] In addition, according to the above configuration, the refrigerant sensor 90 is attached to the lower surface side of the cover 64. Therefore, the refrigerant sensor 90 is immediately exposed to the outside when the grill 14 is removed. Therefore, the visibility of the refrigerant sensor 90 during work is improved. In this manner, the maintenance of the refrigerant sensor 90 can be more easily and smoothly performed.

[0035] In addition, according to the above configuration, the refrigerant sensor 90 is also attached to the upper surface side of the cover 64. Therefore, the refrigerant

sensor 90 is exposed to the flow of the air having a smaller flow speed and a smaller flow rate than the flow of the air on the lower surface side of the cover 64. In this manner, it is possible to further reduce the possibility that the refrigerant sensor 90 is contaminated with the dirt or the dust. Therefore, the accuracy of detecting the leakage by the refrigerant sensor 90 can be further improved.

[0036] In addition, according to the above configuration, since the inflow port 93 and the outflow port 94 of the housing 92 of the refrigerant sensor 90 are open in the direction parallel to the radial direction, the minimum amount of air required for detecting the refrigerant can be smoothly and continuously sent to the sensor body 91 in the housing 92. Accordingly, it is possible to detect the leakage of the refrigerant with higher accuracy.

[0037] The first embodiment of the present disclosure has been described above. Various changes or improvements can be made to the above configuration without departing from the concept of the present disclosure. For example, in the first embodiment, an example has been described in which one refrigerant sensor 90 is provided on each of the upper surface side and the lower surface side of the cover 64. However, as shown in Figs. 5 and 6, the refrigerant sensor 90 may be provided only on the upper surface side or only on the lower surface side of the cover 64.

<Second Embodiment>

[0038] Subsequently, a ceiling-embedded air conditioner 101 according to a second embodiment of the present disclosure will be described with reference to Fig. 7. The same configurations as those of the first embodiment will be assigned with the same reference numerals, and detailed description thereof will be omitted.

[0039] As shown in Fig. 7, a drain pan 160 of the ceiling-embedded air conditioner 101 has a rectangular shape. Two suction ports 62 arranged at intervals from each other are formed on the lower surface of the drain pan 160. In addition, the main electrical box 170 is disposed on an extension of a straight line connecting the two suction ports 62. Further, one opening 61 is formed on each of both sides of each of the suction ports 62.

[0040] The lower surface of the drain pan 60 is partitioned into two areas by a first dividing line L101 passing through the axis O of the suction port 62 close to the main electrical box 170, among the two suction ports 62. A side where the main electrical box 170 is located with reference to the first dividing line L101 is a first area S101, and an area on a side opposite to the first area S101 is a second area S102. The main electrical box 170 has a rectangular shape disposed to be in contact with one edge (end edge) in the first area S101. That is, the first dividing line L101 extends in the same direction (parallel direction) as the longitudinal direction of the main electrical box 170. The term "same direction or the parallel direction" as used herein means substantially the same

and parallel, and slight manufacturing errors or design tolerances are allowed.

[0041] The refrigerant sensor 90 is disposed in the second area S102. In the example of Fig. 7, the refrigerant sensor 90 is provided between the openings 61. In addition, the refrigerant sensor 90 may be disposed at each position indicated by a rectangular broken line in the drawing. Specifically, the refrigerant sensor 90 may be provided in an area between the end edge farthest from the main electrical box 170 in the second area S102 and the suction port 62.

(Effects of Action)

[0042] According to the above configuration, the refrigerant sensor 90 is disposed only in the second area S102 which is an area separated from the main electrical box 170, among the areas of the drain pan 60. In the first area S101 in which the main electrical box 170 is disposed, the main electrical box 70 is disposed between the grill 14 and the suction port 62. Therefore, the volume of the air flow path is small. In other words, a cross-sectional area of the flow path is reduced. For this reason, the flow speed of the air increases as compared with that in other areas, and the flow rate also increases with the increase in the flow speed. As a result, in the vicinity of the main electrical box 170 (that is, in the first area S101), the amount of the dirt or dust contained in the air is larger than that in the second area S102. Therefore, there is a high possibility that the refrigerant sensor 90 may be contaminated with dust or dirt. However, in the present embodiment, the refrigerant sensor 90 is disposed only in the second area S102 where the main electrical box 170 is not provided. Therefore, the flow speed and the flow rate of the air in contact with the refrigerant sensor 90 can be suppressed to be small. As a result, the amount of the dirt or the dust adhering to the refrigerant sensor 90 is reduced. Therefore, it is possible to improve the accuracy of the leakage detection of the refrigerant by the refrigerant sensor 90.

[0043] The second embodiment of the present disclosure has been described above. Various changes or improvements can be made to the above configuration without departing from the concept of the present disclosure.

<Additional Notes>

[0044] The ceiling-embedded air conditioner 1 in each embodiment is grasped as follows, for example.

(1) The ceiling-embedded air conditioner 1 according to a first aspect includes a motor 20 that has an output shaft 22 rotatable about an axis O extending in an up-down direction; a turbofan 30 that is attached to the output shaft 22; a heat exchanger 40 that surrounds the turbofan 30 from an outer peripheral side and through which air pumped by the turbofan

30 passes; a drain pan 60 that is provided below the heat exchanger 40 and is formed with a suction port 62 which is open about the axis O; a main electrical box 70 that is attached to a lower surface of the drain pan 60 and accommodates an electrical component; and a refrigerant sensor 90 that is attached to the drain pan 60 and detects a refrigerant in the air, in which a first area S1 in which the main electrical box 70 is disposed in one edge extending along a first dividing line L1 orthogonal to the axis O when viewed in a direction of the axis O, and a second area S2 located on a side opposite to the first area S1 with the first dividing line L1 interposed therebetween is formed on the lower surface of the drain pan 60, and the refrigerant sensor 90 is provided in the second area S2.

According to the above configuration, the refrigerant sensor 90 is disposed in the second area S2 on the side opposite to the main electrical box 70. In the first area S1 where the main electrical box 70 is installed, the flow speed and the flow rate of the air flowing toward the suction port 62 are large, while in the second area S2, the flow speed and the flow rate are relatively small. For this reason, it is possible to reduce the possibility that the dirt or the dust contained in the air adheres to the refrigerant sensor 90.

(2) The ceiling-embedded air conditioner 1 according to a second aspect is the ceiling-embedded air conditioner 1 of (1), in which the second area S2 is partitioned into a first small area S21 and a second small area S22 by a second dividing line L2 that is orthogonal to the first dividing line L1 and that extends in a horizontal direction, a sub electrical box 80 different from the main electrical box 70 is provided in the first small area S21, and the refrigerant sensor 90 is provided in the second small area S22.

According to the above configuration, the refrigerant sensor 90 is disposed in the second small area S22 in the second area S2. Since the sub electrical box 80 is disposed in the first small area S21, the flow speed and the flow rate of the air flowing toward the suction port 62 are large, while the flow speed and the flow rate are relatively small in the second small area S22. For this reason, it is possible to further reduce the possibility that the dirt or dust contained in the air adheres to the refrigerant sensor 90.

(3) The ceiling-embedded air conditioner 1 according to a third aspect is the ceiling-embedded air conditioner 1 of (2), and further includes a cover 64 detachably attached to an opening hole 63 formed in the second small area S22, in which the refrigerant sensor 90 is provided in the cover 64.

According to the above configuration, the refrigerant sensor 90 is attached to the cover 64 covering the opening hole 63. Therefore, when maintenance is performed through the opening hole 63, the maintenance of the refrigerant sensor 90 can be simultaneously performed.

(4) The ceiling-embedded air conditioner 1 according to a fourth aspect is the ceiling-embedded air conditioner 1 of (3), in which the refrigerant sensor 90 is provided on a lower surface side of the cover 64. According to the above configuration, the refrigerant sensor 90 is attached to the lower surface side of the cover 64. Therefore, the visibility of the refrigerant sensor 90 is improved. In this manner, the maintenance of the refrigerant sensor 90 can be more easily and smoothly performed.

(5) The ceiling-embedded air conditioner 1 according to a fifth aspect is the ceiling-embedded air conditioner 1 of (3) or (4), in which the refrigerant sensor 90 is provided on an upper surface side of the cover 64.

According to the above configuration, the refrigerant sensor 90 is attached to the upper surface side of the cover 64. Therefore, the refrigerant sensor 90 is exposed to the flow of the air having a smaller flow speed and a smaller flow rate than the air on the lower surface side of the cover 64. In this manner, it is possible to further reduce the possibility that the refrigerant sensor 90 is contaminated with the dirt or the dust.

(6) The ceiling-embedded air conditioner 1 according to a sixth aspect is the ceiling-embedded air conditioner 1 according to any one of (1) to (5), in which the refrigerant sensor 90 includes a sensor body 91 that detects a refrigerant component in the air, and a housing 92 that covers the sensor body 91 from an outer side and in which an inflow port 93 through which the air is taken in and an outflow port 94 through which the air flows out are formed, and the inflow port 93 and the outflow port 94 are open in a direction parallel to a radial direction with respect to the axis O.

According to the above configuration, since the inflow port 93 and the outflow port 94 of the housing 92 of the refrigerant sensor 90 are open in the direction parallel to the radial direction, air can be smoothly sent to the sensor body 91.

(7) The ceiling-embedded air conditioner 1 according to a seventh aspect includes a motor 20 that has an output shaft 22 rotatable about an axis O extending in an up-down direction; a turbofan 30 that is attached to the output shaft 22; a heat exchanger 40 that surrounds the turbofan 30 from an outer peripheral side and through which air pumped by the turbofan 30 passes; a drain pan 60 that is provided below the heat exchanger 40 and is formed with a suction port 62 which is open about the axis O; a main electrical box 70 that is attached to a lower surface of the drain pan 60 and accommodates an electrical component; and a refrigerant sensor 90 that is attached to the drain pan 60 and detects a refrigerant in air, in which a first area S1 in which the main electrical box 70 is disposed in one edge extending along a first dividing line L1 orthogonal to the axis O when viewed

in a direction of the axis O, and a second area S2 located on a side opposite to the first area S1 with the first dividing line L1 interposed therebetween is formed on the lower surface of the drain pan 60, the second area S2 is partitioned into a first small area S21 and a second small area S22 by a second dividing line L2 that is orthogonal to the first dividing line L1 and that extends in a horizontal direction, a sub electrical box 80 different from the main electrical box 70 is provided in the first small area S21, a cover 64 detachably attached to an opening hole 63 formed in the second small area S22 is further provided, and the refrigerant sensor 90 is provided on an upper surface side of the cover 64.

[0045] According to the above configuration, the refrigerant sensor 90 is attached to the upper surface side of the cover 64. Therefore, the refrigerant sensor 90 is exposed to the flow of the air having a smaller flow speed and a smaller flow rate than the air on the lower surface side of the cover 64. In this manner, it is possible to further reduce the possibility that the refrigerant sensor 90 is contaminated with the dirt or the dust.

Industrial Applicability

[0046] In the ceiling-embedded air conditioner 1, it is possible to detect the leakage of the refrigerant with higher accuracy.

Reference Signs List

[0047]

1: ceiling-embedded air conditioner
 10: main body case
 11: panel
 12: cabinet
 13: panel body
 14: grill
 15: discharge port
 20: motor
 21: motor body
 22: output shaft
 30: turbofan
 31: main panel
 32: main blade
 33: shroud
 40: heat exchanger
 50: bell mouth
 60: drain pan
 61: opening
 62: suction port
 63: opening hole
 64: cover
 70: main electrical box
 80: sub electrical box
 90: refrigerant sensor

91: sensor body
 92: housing
 93: inflow port
 94: outflow port
 101: ceiling-embedded air conditioner
 160: drain pan
 170: main electrical box
 L1: first dividing line
 L101: first dividing line
 L2: second dividing line
 O: axis
 S1: first area
 S101: first area
 S102: second area
 S2: second area
 S21: first small area
 S22: second small area
 V: accommodation space

Claims

1. A ceiling-embedded air conditioner comprising:

a motor that has an output shaft rotatable about an axis extending in an up-down direction;
 a turbofan that is attached to the output shaft;
 a heat exchanger that surrounds the turbofan from an outer peripheral side and through which air pumped by the turbofan passes;
 a drain pan that is provided below the heat exchanger and is formed with a suction port which is open about the axis;
 a main electrical box that is attached to a lower surface of the drain pan and accommodates an electrical component; and
 a refrigerant sensor that is attached to the drain pan and detects a refrigerant in the air, wherein a first area in which the main electrical box is disposed in one edge extending along a first dividing line orthogonal to the axis when viewed in a direction of the axis, and a second area located on a side opposite to the first area with the first dividing line interposed therebetween is formed on the lower surface of the drain pan, and

the refrigerant sensor is provided in the second area.

2. The ceiling-embedded air conditioner according to Claim 1,

wherein the second area is partitioned into a first small area and a second small area by a second dividing line that is orthogonal to the first dividing line and that extends in a horizontal direction, a sub electrical box different from the main electrical box is provided in the first small area, and

the refrigerant sensor is provided in the second small area.

3. The ceiling-embedded air conditioner according to Claim 2, further comprising:

a cover detachably attached to an opening hole formed in the second small area, wherein the refrigerant sensor is provided in the cover.

4. The ceiling-embedded air conditioner according to Claim 3, wherein the refrigerant sensor is provided on a lower surface side of the cover.

5. The ceiling-embedded air conditioner according to Claim 3 or 4, wherein the refrigerant sensor is provided on an upper surface side of the cover.

6. The ceiling-embedded air conditioner according to any one of Claims 1 to 5,

wherein the refrigerant sensor includes

a sensor body that detects a refrigerant component in the air, and
 a housing that covers the sensor body from an outer side and in which an inflow port through which the air is taken in and an outflow port through which the air flows out are formed, and

the inflow port and the outflow port are open in a direction parallel to a radial direction with respect to the axis.

7. A ceiling-embedded air conditioner comprising:

a motor that has an output shaft rotatable about an axis extending in an up-down direction;
 a turbofan that is attached to the output shaft;
 a heat exchanger that surrounds the turbofan from an outer peripheral side and through which air pumped by the turbofan passes;
 a drain pan that is provided below the heat exchanger and is formed with a suction port which is open about the axis;
 a main electrical box that is attached to a lower surface of the drain pan and accommodates an electrical component; and
 a refrigerant sensor that is attached to the drain pan and detects a refrigerant in air, wherein a first area in which the main electrical box is disposed in one edge extending along a first dividing line orthogonal to the axis when viewed in a direction of the axis, and a second

area located on a side opposite to the first area with the first dividing line interposed therebetween is formed on the lower surface of the drain pan,

the second area is partitioned into a first small area and a second small area by a second dividing line that is orthogonal to the first dividing line and that extends in a horizontal direction, a sub electrical box different from the main electrical box is provided in the first small area, a cover detachably attached to an opening hole formed in the second small area is further provided, and the refrigerant sensor is provided on an upper surface side of the cover.

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FIG. 1

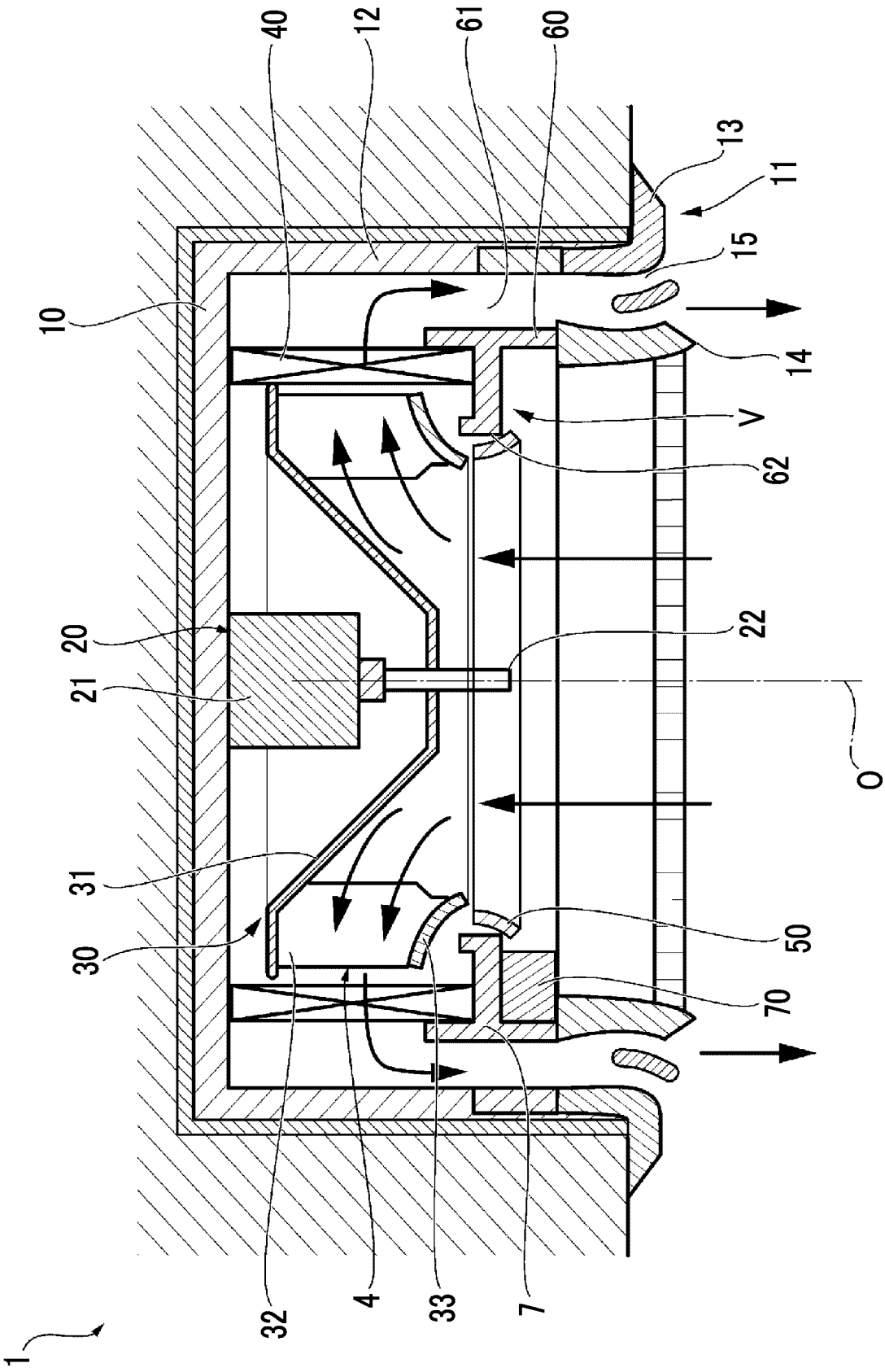


FIG. 2

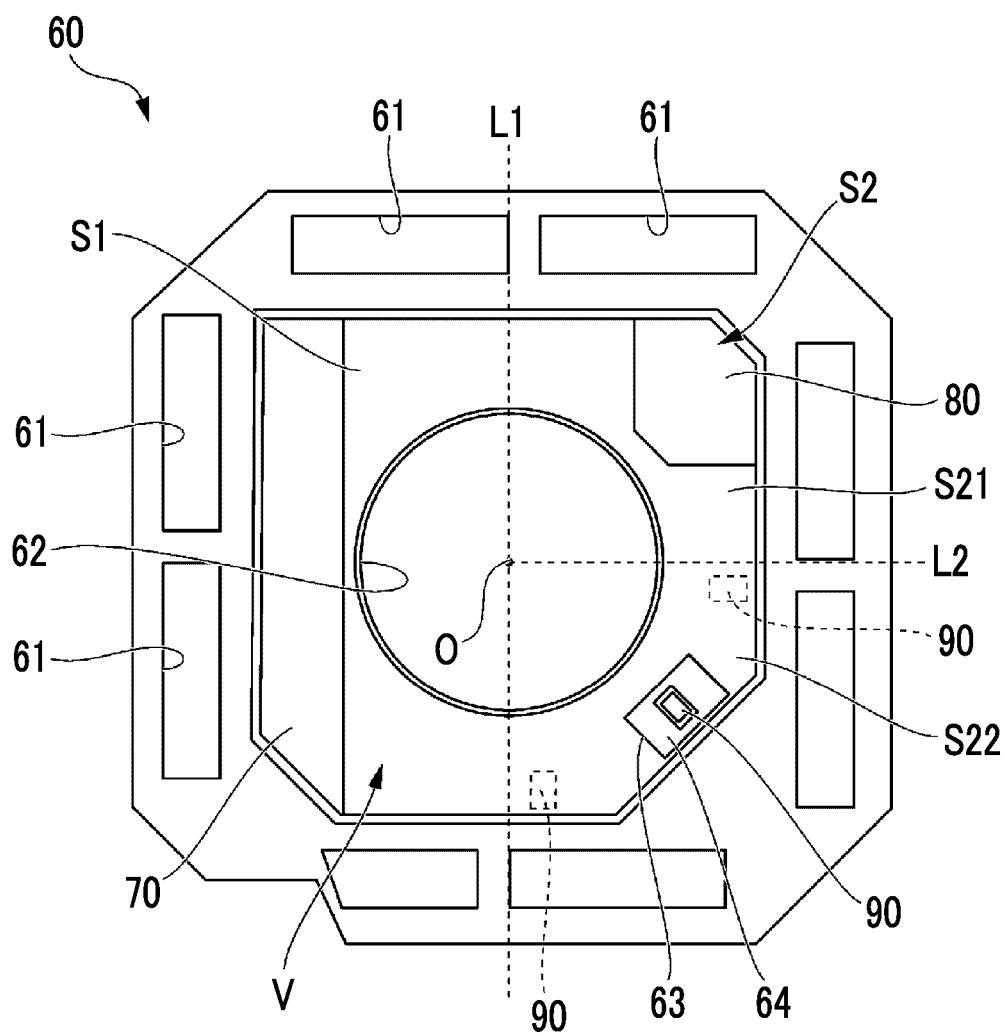


FIG. 3

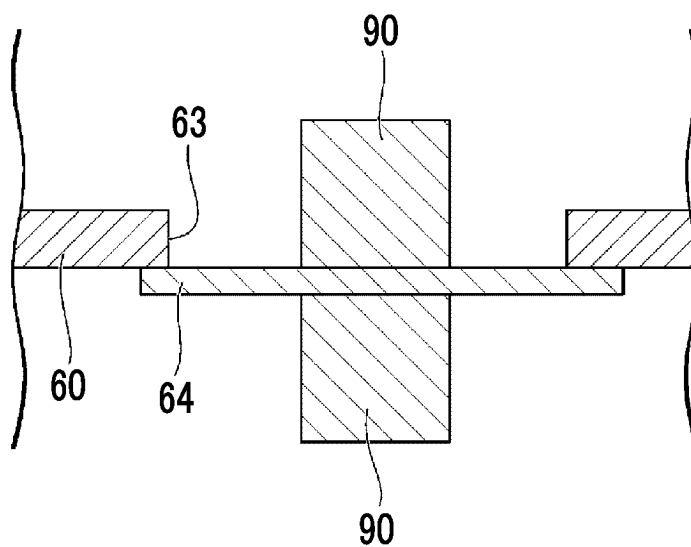


FIG. 4

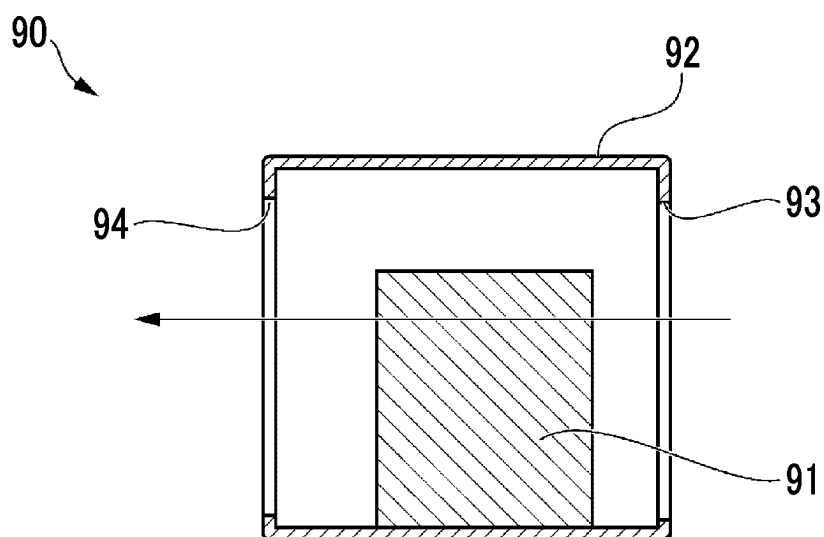


FIG. 5

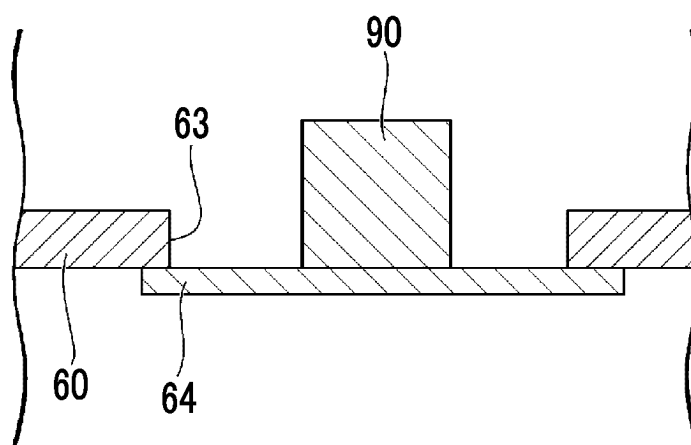


FIG. 6

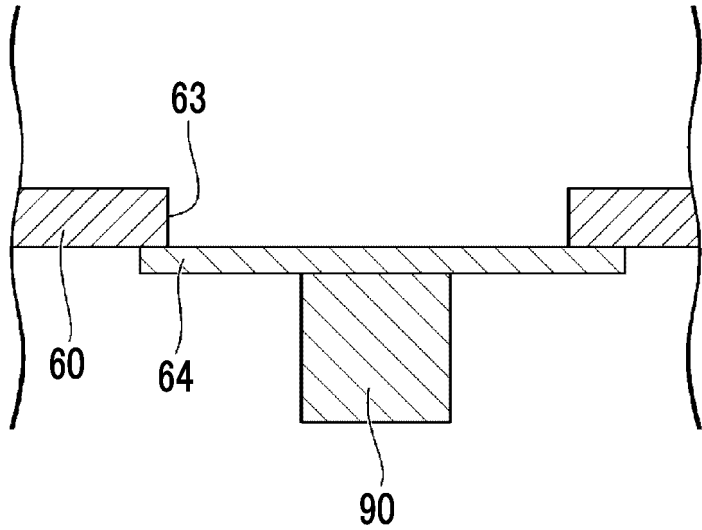
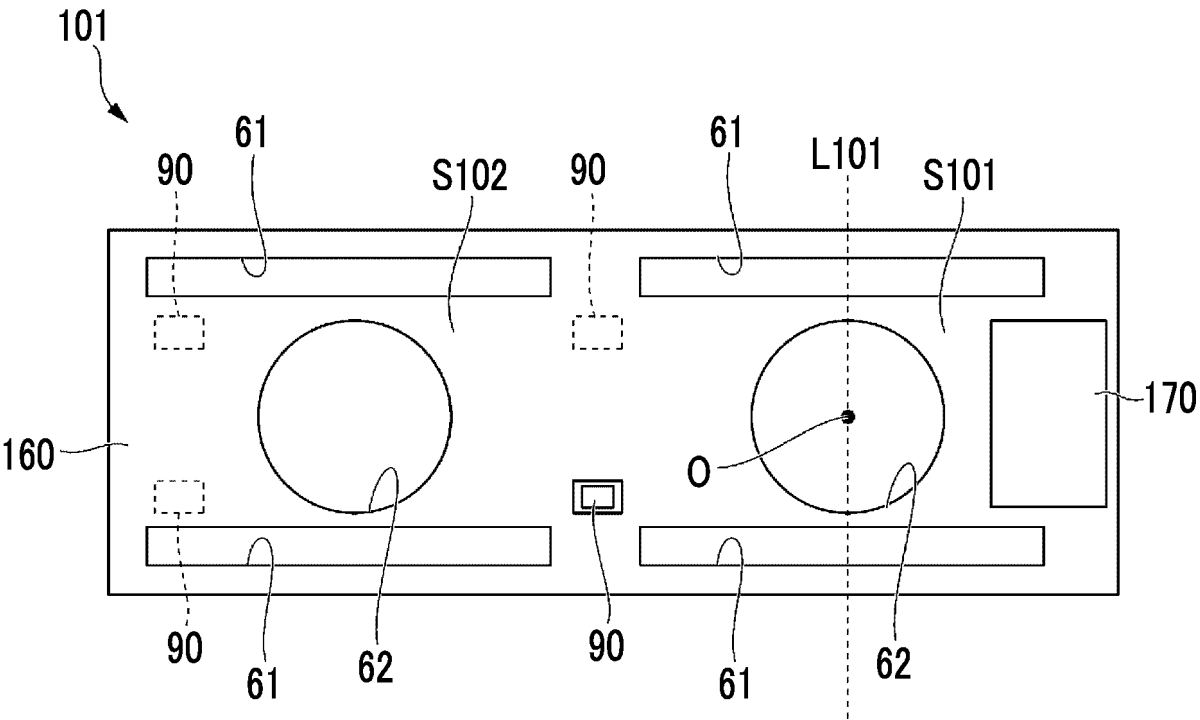


FIG. 7



INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2022/009745

A. CLASSIFICATION OF SUBJECT MATTER

F24F 11/89(2018.01)i; *F24F 13/20*(2006.01)i

FI: F24F11/89; F24F1/0007 401E

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)

F24F11/89; F24F13/20

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.
Y	JP 2010-071502 A (SANYO ELECTRIC CO LTD) 02 April 2010 (2010-04-02) paragraphs [0010]-[0043], fig. 1-12	1, 6
A		2-5, 7
Y	WO 2021/090810 A1 (DAIKIN IND LTD) 14 May 2021 (2021-05-14) paragraphs [0066], [0083]-[0086], fig. 3	1, 6
A		2-5, 7
Y	JP 2003-074900 A (HITACHI LTD) 12 March 2003 (2003-03-12) paragraph [0003]	1, 6
A		2-5, 7
Y	WO 2019/156107 A1 (MITSUBISHI HEAVY IND THERMAL SYSTEMS LTD) 15 August 2019 (2019-08-15) paragraphs [0027]-[0054], fig. 1-6	6
A		2-5, 7

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

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"A" document defining the general state of the art which is not considered to be of particular relevance	"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
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"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	"&" document member of the same patent family
"O" document referring to an oral disclosure, use, exhibition or other means	
"P" document published prior to the international filing date but later than the priority date claimed	

Date of the actual completion of the international search 10 May 2022	Date of mailing of the international search report 17 May 2022
Name and mailing address of the ISA/JP Japan Patent Office (ISA/JP) 3-4-3 Kasumigaseki, Chiyoda-ku, Tokyo 100-8915 Japan	Authorized officer Telephone No.

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INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2022/009745

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	CN 212511464 U (GUANGDONG MIDEA REFRIGERATION EQUIPMENT CO., LTD.) 09 February 2021 (2021-02-09) entire text, all drawings	1-7

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.

PCT/JP2022/009745

Patent document cited in search report	Publication date (day/month/year)	Patent family member(s)	Publication date (day/month/year)
JP 2010-071502 A	02 April 2010	CN 101676640 A	
		KR 10-2010-0032292 A	
WO 2021/090810 A1	14 May 2021	JP 2021-76263 A	
		JP 2021-85642 A	
		JP 2021-85643 A	
JP 2003-074900 A	12 March 2003	(Family: none)	
WO 2019/156107 A1	15 August 2019	JP 2019-138556 A	
CN 212511464 U	09 February 2021	(Family: none)	

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 2021014963 A [0004]