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(54) INDOOR UNIT FOR AIR CONDITIONER

(57) An air conditioner includes a drain pan possessing an inner circumferential wall defining a bell-mouth mounting hole and a bell mouth. The coupling fittings are provided in the inner circumferential wall. The coupling fittings include a head at a lower end of a shank, the head possessing a diameter greater than the shank. The fixing parts are provided in the bell mouth. The fixing part includes a through-hole and an engaging hole continuous with the through-hole. In a state where the head is made to penetrate the through-hole, when the bell mouth is rotated, the head moves from the through-hole to the engaging hole to get caught on the engaging hole, and the bell mouth is fixed to the drain pan.

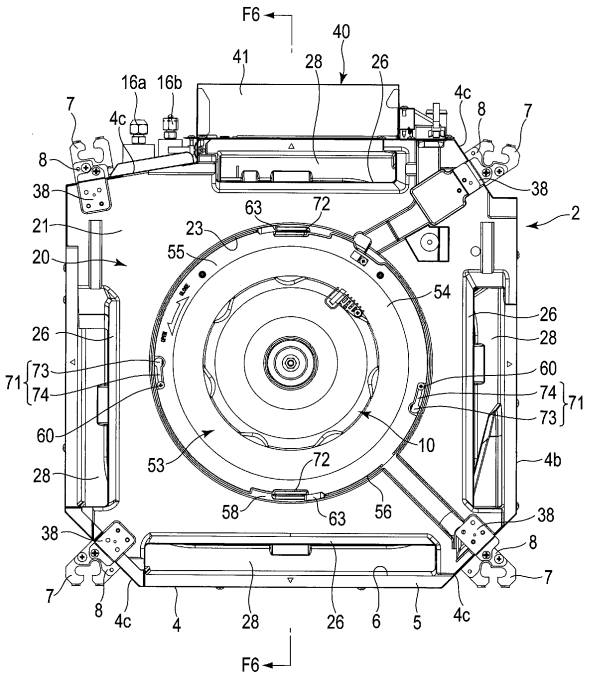

FIG. 4

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Description

Technical Field

[0001] Embodiments described herein relate generally to an indoor unit for an air conditioner.

Background Art

[0002] In a ceiling-embedded air conditioner, an indoor unit is suspended in the ceiling space. The indoor unit has a box-shaped casing containing therein an air blower and heat exchanger, and a lower end of the casing is closed with a drain pan configured to receive dew condensation water dropping from the heat exchanger.

[0003] The drain pan includes a bell-mouth mounting hole positioned directly beneath the air blower, and a bell mouth is attached to the bell-mouth mounting hole. The bell mouth is an element configured to straighten a flow of air sucked by the air blower, and an outer circumferential part thereof is detachably fixed to the drain pan.

Citation List

Patent Literature

[0004] Patent Literature 1: JP 4122396 B

Summary of Invention

Technical Problem

[0005] According to an indoor unit for a conventional air conditioner, at least four positions of an outer circumferential part of the bell mouth are fixed to the drain pan by using screws. Accordingly, it is inevitable that the number of screws is naturally increases, this being a factor causing an increase in cost.

[0006] Furthermore, in order to detach the bell mouth from the drain pan, all the screws need to be completely detached from the drain pan. Accordingly, a worker is forced to carry out troublesome work of loosening many screws one by one by handwork, further a screw is sometimes dropped by mistake at the time of work, and thus there is still room for improvement from the viewpoint of workability.

[0007] An embodiment described herein aims to obtain an indoor unit for an air conditioner capable of reducing the number of components used to fix a bell mouth to a drain pan and improving the workability at the time when the bell mouth is detached from or is attached to the drain pan.

Solution to Problem

[0008] According to an embodiment, an indoor unit for air conditioner includes a unit main body accommodating therein an air blower and heat exchanger, drain pan to be attached to a lower end of the unit main body and configured to receive dew condensation water created in the heat exchanger and including an inner circumferential wall defining a bell-mouth mounting hole continuous with the suction side of the air blower, and bell mouth detachably fitted into the bell-mouth mounting hole of the drain pan.

[0009] A plurality of pieces of coupling fittings are provided in the inner circumferential wall of the drain pan. The coupling fittings are provided in the circumferential direction of the inner circumferential wall with intervals held between the coupling fittings, and each of the coupling fittings includes a head at a lower end of a shank downwardly protruded from a lower end of the inner circumferential wall, the head having a diameter greater than the shank. A plurality of fixing parts are provided in an outer circumferential part of the bell mouth with intervals held between the fixing parts in the circumferential direction. Each of the fixing parts includes a through-hole to be penetrated by the head of the coupling fittings and engaging hole continuous with the through-hole and on which the head gets caught.

[0010] By rotating the bell mouth inside the bell-mouth mounting hole in the circumferential direction in a state where the head of the coupling fittings is made to penetrate the through-hole of the fixing part, the head of the coupling fittings moves from the through-hole of the fixing part to the engaging hole to get caught on the engaging hole, and the bell mouth is fixed to the drain pan.

Brief Description of Drawings

[0011]

FIG. 1 is a perspective view of an indoor unit for a ceiling-embedded air conditioner.

FIG. 2 is a perspective view of the air conditioner showing the state where a unit main body and ceiling panel are separated from each other.

FIG. 3 is a perspective view of the ceiling panel.

FIG. 4 is a plan view showing the state where a drain pan and bell mouth are installed in the casing of the unit main body.

FIG. 5 is a plan view showing the state where the drain pan and bell mouth are detached from the casing of the unit main body.

FIG. 6 is a cross-sectional view along line F6-F6 of FIG. 4.

FIG. 7 is a perspective view of the drain pan.

FIG. 8 is a plan view showing a positional relationship between a heat exchanger and drain pan.

FIG. 9 is a cross-sectional view showing the enlarged part F9 of FIG. 6.

FIG. 10 is a plan view showing the state where a plurality of lead wires are drawn out of the casing of the unit main body to the outside of the casing.

FIG. 11 is a cross-sectional view showing the state where a plurality of lead wires are held by the casing

through a seal material.

FIG. 12 is a perspective view of the bell mouth.

FIG. 13 is a perspective view of the bell mouth viewed from the air blower side.

FIG. 14 is a perspective view showing the state where a fixing screw protruded from the drain pan is engaged with a fixing part of the bell mouth.

FIG. 15 is a perspective view showing the state where the fixing screw is screwed into a boss part of the drain pan.

FIG. 16 is a perspective view showing a shape of a claw-receiving part formed in the drain pan.

FIG. 17 is a cross-sectional view of the claw-receiving part formed in the sheet material of the drain pan.

FIG. 18 is a perspective view showing a positional relationship between the claw-receiving part of the drain pan and claw part of the bell mouth.

FIG. 19 is a perspective view showing the state where the claw part of the bell mouth is fitted into a fitting slot of the claw-receiving part.

FIG. 20 is perspective view showing a positional relationship between a temporary latch of the ceiling panel and depressed part of the drain pan.

Mode for Carrying Out the Invention

[0012] An embodiment of the present invention will be described below with reference to the accompanying drawings.

[0013] FIG. 1 is a perspective view of an indoor unit for a ceiling-embedded air conditioner, and FIG. 2 is a perspective view showing the state where a unit main body and ceiling panel are separated from each other.

[0014] As shown in FIG. 1 and FIG. 2, an indoor unit 1 for an air conditioner is provided with a unit main body 2 to be installed in the ceiling space and ceiling panel 3 attached to a lower end of the unit main body 2 as main elements. The unit main body 2 is provided with a casing 4 made of sheet metal. The casing 4 is a downwardly opened box-shaped element, and is suspended from a beam in the ceiling space through, for example, four hanging bolts (not shown).

[0015] The casing 4 includes a top plate part 4a and side part 4b. The side part 4b is continuous in the circumferential direction of the casing 4 and includes four outer circumferential corner parts 4c. As shown in FIG. 6, inner surfaces of the top plate part 4a and side part 4b are covered with a heat insulating material 5 made of, for example, foamed polystyrene. The heat insulating material 5 defines an opening part 6 at a lower end of the casing 4.

[0016] A hanging hook 7 is fixed to each outer circumferential corner part 4c of the casing 4. The hanging hooks 7 are horizontally protruded in four directions from the casing 4, and a lower end of the hanging bolt is coupled to each hanging hook 7.

[0017] Furthermore, four brackets 8 are fixed to the casing 4. The bracket 8 is positioned at a lower end part of each outer circumferential corner part 4c of the casing 4 in such a manner as to be positioned directly under the hanging hook 7. The brackets 8 are horizontally protruded in the four directions from the casing 4.

[0018] As shown in FIG. 2, FIG. 4, FIG. 5, and FIG. 6, an air blower 10 and heat exchanger 11 are accommodated in the casing 4. As the air blower 10, a so-called centrifugal fan configured to suck air from the axial direction and discharge the air in the circumferential direction is employed. The upper end of the air blower 10 is covered with the top plate part 4a of the casing 4, and hence the lower end of the air blower 10 serves as the suction side.

[0019] The heat exchanger 11 is raised inside the casing 4 in such a manner as to surround the discharge side of the air blower 10. The heat exchanger 11 is provided with a plurality of heat radiating fins 12 and a plurality of heat exchanger tubes 13 through which a refrigerant flows. The heat radiating fins 12 are long and thin plates extending in the height direction of the casing 4 and are arranged in the circumferential direction of the casing 4 with intervals held between them. The heat exchanger tubes 13 are arranged in the height direction and lateral direction with intervals held between them in both the directions and are connected in series, thereby forming a plurality of flow paths. Furthermore, the heat exchanger tubes 13 penetrate the heat radiating fins 12 to thereby be thermally connected to the heat radiating fins 12.

[0020] As shown in FIG. 5, refrigerant pipes 14 connected to the heat exchanger 11 are arranged in the space between one outer circumferential corner part 4c and heat exchanger 11 in a concentrated manner. The refrigerant pipes 14 are connected to a pair of connecting ports 16a and 16b. The connecting ports 16a and 16b are configured in such a manner as to be protruded from one outer circumferential corner part 4c of the casing 4 to the outside of the casing 4 and connected to an outdoor unit through a liquid pipe and gas pipe.

[0021] Furthermore, a drain pump 17 is accommodated in the casing 4. The drain pump 17 is an element configured to drain dew condensation water created by the heat exchanging operation of the heat exchanger 11 when the indoor unit 1 is operated in the cooling mode out of the unit main body 2. The drain pump 17 is positioned at the lower end part of the casing 4 in the vicinity of another outer circumferential corner part 4c adjacent to the outer circumferential corner part 4c provided with the connecting ports 16a and 16b. The drain piping 18 connected to the drain pump 17 is upwardly routed from the drain pump 17 through the inside of the casing 4.

[0022] As shown in FIG. 2, FIG. 4, and FIG. 6, the opening part 6 at the lower end of the casing 4 is closed with a drain pan 20. The drain pan 20 is provided with a main body 21 having heat insulating properties, and sheet material 22 formed on the surface of the main body 21 integral with the main body 21. The main body 21 is an element configured to define the shape of the drain pan 20 and is constituted of, for example, foamed polystyrene

which is a kind of foamed plastics. The sheet material 22 is constituted of a synthetic resin material having a thickness of several millimeters, and the stiffness thereof is higher than the main body 21. As the synthetic resin material constituting the sheet material 22, for example, an ABS resin is used.

[0023] Furthermore, the sheet material 22 is formed by injection molding separately from the main body 21. The sheet material 22 is accommodated in an injection mold when the main body 21 is formed by foam molding, and is integrated with the main body 21 in the process of forming the main body 21 by foam molding. Accordingly, the sheet material 22 is subjected to foam pressure when the main body 21 is formed by foam molding.

[0024] As shown in FIG. 7 and FIG. 8, the drain pan 20 has a square frame-shape corresponding to the heat exchanger 11, and is fitted in the inside of the opening part 6 defined by the heat insulating material 5 of the casing 4. The drain pan 20 includes a circular bell-mouth mounting hole 23 positioned directly beneath the suction side of the air blower 10 and peripheral edge part 24 surrounding the bell-mouth mounting hole 23. The peripheral edge part 24 of the drain pan 20 is fitted in the inside of the opening part 6 of the casing 4.

[0025] In the peripheral edge part 24 of the drain pan 20, four cutout parts 26 and recessed part 27 in which the lower end part of the heat exchanger 11 comes are formed. Each of the cutout parts 26 has a long and thin shape extending along each of the four sides belonging to the peripheral edge part 24 of the drain pan 20. The cutout parts 26 adjacent to each other in the circumferential direction of the drain pan 20 are kept in a positional relationship in which they are perpendicular to each other. Furthermore, the peripheral edge part 24 of the drain pan 20 is fitted in the inside of the opening part 6 defined by the heat insulating material 5, and hence the areas surrounded by the cutout parts 26 and heat insulating material 5 constitute a plurality of communicating ports 28 through which air passing through the heat exchanger 11 is guided.

[0026] The recessed part 27 is a groove-like element continuous in the circumferential direction of the drain pan 20, and is positioned on the inner side of the cutout parts 26 with respect to the drain pan 20. The recessed part 27 is defined by an inner circumferential wall 29a, outer circumferential wall 29b, and bottom wall 29c. The inner circumferential wall 29a is raised from the bottom wall 29c so as to surround the bell-mouth mounting hole 23. That is, the inner circumferential wall 29a can be rephrased as a partition wall intervening between the bell-mouth mounting hole 23 and recessed part 27.

[0027] Furthermore, at a central part of the bottom wall 29c, a swelling part 31 bulging toward the lower end of the heat exchanger 11 is formed. The swelling part 31 is continuously formed in the circumferential direction of the drain pan 20 along the lower end of the heat exchanger 11. On the top face of the swelling part 31, a cushion material 32 configure to receive/catch the lower end of the heat exchanger 11 is laid.

[0028] As shown in FIG. 6, FIG. 7, and FIG. 9, the swelling part 31 partitions the bottom part of the recessed part 27 into a first groove part 33 and second groove part 34. The first groove part 33 is positioned on the inner side of the inner circumferential surface of the heat exchanger 11 with respect to the heat exchanger 11. The inner circumferential surface of the heat exchanger 11 is positioned on the primary side of the heat exchanger 11 receiving the air blowing out of the air blower 10. The second groove part 34 is positioned directly beneath the heat exchanger 11 so as to surround the first groove part 33. Accordingly, the second groove part 34 is positioned on the outer circumferential surface side of the first groove part 33 with respect to the heat exchanger 11. The outer circumferential surface of the heat exchanger 11 is positioned on the secondary side of the heat exchanger 11, the secondary side being the side from which the air passing through the heat exchanger 11 blows out.

[0029] The lower end part of the drain pump 17 comes in the second groove part 34 at a position corresponding to one corner part of the drain pan 20. An inlet port 17a opened at the lower end of the drain pump 17 faces the bottom of the second groove part 34. Furthermore, as shown in FIG. 5, a float switch 35 is arranged at a position adjacent to the drain pump 17. The float switch 35 is an element configured to turn on/off the operation of the drain pump 17 and is positioned at the second groove part 34.

[0030] As shown FIG. 6 through FIG. 9, regarding the inner circumferential wall 29a, outer circumferential wall 29b, and bottom wall 29c including the swelling part 31 all constituting the recessed part 27 of the drain pan 20, a part of these walls exposed to the recessed part 27 is constituted of the sheet material 22 made of the synthetic resin material.

[0031] The sheet material 22 includes a rib 36 positioned inside the recessed part 27. The rib 36 is upwardly protruded from the upper end of the swelling part 31 in the circumferential direction of the heat exchanger 11. The upper end of the rib 36 extends to a higher position than the lower end of the heat exchanger 11 at a position corresponding to the first groove part 33. Furthermore, the rib 36 breaks at a position corresponding to the drain pump 17.

[0032] As shown in FIG. 7, a communicating groove 37 is formed in the swelling part 31 bulging from the bottom wall 29c. The communicating groove 37 is positioned in the vicinity of the drain pump 17. By virtue of the existence of the communicating groove 37, the first groove part 33 and second groove part 34 communicate with each other at a position near the drain pump 17.

[0033] Such a drain pan 20 is detachably supported at the lower end of the casing 4 through four drain-pan fixing brackets 38 shown in FIG. 2 and FIG. 4. The drain-pan fixing brackets 38 are screwed to the undersurfaces of the brackets 8. The drain-pan fixing brackets 38 are horizontally protruded from the outer circumferential corner

parts 4c of the casing 4 toward the four corner parts of the drain pan 20, and the corner parts of the drain pan 20 are placed on the drain-pan fixing brackets 38. Thereby, the drain pan 20 is supported at the lower end of the casing 4 so that the drain pan 20 may not fall off the opening part 6 of the casing 4.

[0034] In this embodiment, when the indoor unit 1 starts a cooling operation, dew condensation water created by the heat exchanging operation of the heat exchanger 11 drops along the heat radiating fins 12. Part of the dropping dew condensation water directly flows into the second groove part 34 of the recessed part 27. The other part of the dew condensation water reaches the top face of the swelling part 31 of the recessed part 27.

[0035] At this time, the rib 36 upwardly protruded from the upper end of the swelling part 31 extends to a higher position than the lower end of the heat exchanger 11 on the primary side of the heat exchanger 11. Accordingly, the dew condensation water reaching the top face of the swelling part 31 cannot flow in the direction to the first groove part 33 due to the existence of the rib 36, and the most part thereof flows into the second groove part 34 through the portions between the lower ends of the heat radiating fins 12.

[0036] As a result of this, the most part of the cool dew condensation water dropping from the heat exchanger 11 at the time of cooling operation is guided to the second groove part 34, and the dew condensation water never collects in the first groove part 33.

[0037] When the water level of the dew condensation water flowing into the second groove part 34 reaches the upper limit, the drain pump 17 is operated through the float switch 35. Thereby, the dew condensation water collecting in the second groove part 34 is forcibly drained to the outside of the indoor unit 1 by the drain pump 17.

[0038] On the other hand, when the indoor unit 1 stops the cooling operation, the water inside the drain piping 18 returns from the inlet port 17a of the drain pump 17 to the second groove part 34 of the drain pan 20. When the bulk of the backwater returning to the second groove part 34 reaches a certain fixed amount, the backwater flows into the first groove part 33 through the communicating groove 37. Accordingly, the backwater from the drain piping 18 is separated into both the first groove part 33 and second groove part 34.

[0039] Thereby, it is possible to sufficiently secure the water retention capacity of the drain pan 20 at the time when the indoor unit 1 stops the cooling operation, and hold down the water-surface level of the backwater collecting in the recessed part 27 of the drain pan 20 to a lower level. As a result of this, the lower end part of the heat exchanger 11 can be prevented from being submerged in the backwater, and thus the heat exchanger 11 becomes hardly corroded.

[0040] Furthermore, the backwater returning to the drain pan 20 is dispersed to the wide range of the recessed part 27, and hence it is possible to make the drain pan 20 thin while securing the water retention capacity thereof. Accordingly, it is possible to prevent the height dimension of the casing 4 containing therein the drain pan 20 from increasing, and form the indoor unit 1 thin and compact.

[0041] Besides, the backwater flowing into the first groove part 33 is never cooled by the dew condensation water created at the time of cooling operation. Thereby, around the first groove part 33 positioned on the primary side of the heat exchanger 11, it is possible to make the thickness of the main body 21 less than the thickness of the part of the main body 21 positioned on the secondary side of the heat exchanger 11. Accordingly, it is possible to reduce the wall thickness of the inner circumferential wall 29a serving as a partition between the recessed part 27 and bell-mouth mounting hole 23, and expand the bore diameter of the bell-mouth mounting hole 23 correspondingly.

[0042] As shown in FIG. 1 and FIG. 2, an electrical unit 40 is supported on the front face of the side part 4b of the casing 4. The electrical unit 40 is provided with an electrical-component box 41 exposed to the outside of the casing 4, and control circuit 42 accommodated in the electrical-component box 41. The control circuit 42 includes, various electrical components 43 such as a wiring board on which a plurality of IC chips are mounted, reactor, terminal block, and the like. The control circuit 42 is electrically connected to the air blower 10, heat exchanger 11, drain pump 17, and float switch 35 through a plurality of lead wires 44.

[0043] In this embodiment, the electrical unit 40 is positioned outside the casing 4, and hence, as shown in FIG. 10, the lead wires 44 penetrate the heat insulating material 5 of the casing 4 to be drawn out of the casing 4 to the outside of the casing 4. At this time, if a gap exists at the part at which the lead wires 44 penetrate the heat insulating material 5, there is a possibility of cold air passing through the heat exchanger 11 leaking out of the casing 4 through the gap to thereby cause dew condensation on the casing 4.

[0044] Thus, in this embodiment, a seal structure configured to air-tightly seal the part at which the lead wires 44 penetrate the heat insulating material 5 is additionally provided. More specifically, FIG. 10 is a plan view showing the state where the drain pan 20 is detached from the casing 4, and FIG. 11 is a cross-sectional view schematically showing the part at which the lead wires 44 penetrate the heat insulating material 5.

[0045] As shown in FIG. 10, a plurality of lead wires 44 positioned inside the casing 4 are drawn out of the casing 4 toward the electrical-component box 41 from two portions at the lower end of the heat insulating material 5 defining the opening part 6. Each of the portions at which the lead wires 44 are drawn out has a configuration common to the portions, and hence one of the portions at which the lead wires 44 are drawn out will be described below as a representative.

[0046] As shown in FIG. 11, a wiring groove 46 is formed at a lower end part of the heat insulating material

5. The wiring groove 46 penetrates the heat insulating material 5 in the thickness direction, and is opened at the lower end face of the heat insulating material 5. The wiring groove 46 includes a pair of side faces 46a and 46b facing each other, and end face 46c connecting the side faces 46a and 46b to each other. The end face 46c is curved into a form of a circular arc.

[0047] The lead wires 44 are inserted into the wiring groove 46, and are air-tightly held by the wiring groove 46 through a seal material 47. The seal material 47 of this embodiment is formed by combining first to third seal elements 48, 49, and 50 with each other.

[0048] The first seal element 48 is constituted of, for example, flexible urethane foam. The first seal element 48 is stuck to the side faces 46a and 46b and end face 46c in such a manner as to continuously cover the side faces 46a and 46b and end face 46c of the wiring groove 46.

[0049] In this embodiment, the first seal element 48 is divided into a first part 48a and second part 48b in order that the first seal element 48 can easily be stuck to the inner surface of the wiring groove 46 by handwork. The first part 48a continuously covers an area from the one side face 46a of the wiring groove 46 to the end face 46c. The second part 48b covers the other side face 46b of the wiring groove 46 and is butted against the first part 48a inside the wiring groove 46.

[0050] The second seal element 49 is constituted of, for example, polyethylene harder than the first seal element 48. The second seal element 49 is interposed between the end part of the first part 48a of the first seal element 48 and end part of the second part 48b, and air-tightly seals the gap between the end part of the first part 48a and end part of the second part 48b. The second seal element 49 is stuck to the end part of the second part 48b of the first seal element 48.

[0051] Accordingly, the first seal element 48 and second seal element 49 cooperate with each other to air-tightly surround the plurality of lead wires 44 inserted into the wiring groove 46. The lead wires 44 elastically cut into the first part 48a and second part 48b of the first seal element 48, whereby the lead wires 44 are retained inside the wiring groove 46.

[0052] The third seal element 50 is constituted of, for example, ethylene-propylene-diene rubber (EPDM). The third seal element 50 is divided into a first part 50a and second part 50b. The first part 50a is stuck to the end face of the first part 48a of the first seal element 48 and lower end face of the heat insulating material 5 astride these end faces. The second part 50b is continuously stuck to the end face of the second part 48b of the first seal element 48, end face of the second seal element 49, and lower end face of the heat insulating material 5. Furthermore, the first part 50a and second part 50b of the third seal element 50 are butted against each other on the opening end of the wiring groove 46 so as to close the opening end positioned at the lower end face of the heat insulating material 5.

[0053] Accordingly, the third seal element 50 holds the first seal element 48 and second seal element 49 from the direction of the opening end of the wiring groove 46 in order that the first seal element 48 and second seal element 49 may not fall off the wiring groove 46.

[0054] In the state where the opening part 6 of the lower end of the casing 4 is closed with the drain pan 20, the third seal element 50 is pressed by the peripheral edge part 24 of the drain pan 20. By this pressing, the crushed third seal element 50 air-tightly closes the opening end of the wiring groove 46 positioned at the lower end face of the heat insulating material 5, and the first seal element 48 and second seal element 49 are forced into the wiring groove 46 through the third seal element 50.

[0055] As a result of this, the first seal element 48 and second seal element 49 are compressed inside the wiring groove 46 and tuck the lead wires 44 into them.

[0056] According to such a seal structure, the first seal element 48 and second seal element 49 positioned inside the wiring groove 46 tuck the lead wires 44 into them, and third seal element 50 tightly seals the opening end of the wiring groove 46 positioned at the lower end face of the heat insulating material 5. Accordingly, it is possible to prevent cold air from leaking out of the wiring groove 46 while air-tightly holding the lead wires 44 in the wiring groove 46.

[0057] Moreover, the seal material 47 retains the lead wires 44, and hence a dedicated clamp configured to suppress a lift of the lead wires 44 or define the insertion position of the lead wires 44 becomes unnecessary. Accordingly, the number of components can be held down to a small number, this contributing to reduction in the cost of the indoor unit 1.

[0058] Besides, the work of drawing the lead wires 44 from inside the casing 4 to the outside of the casing 4 can easily be carried out, and the workability at the time of assembly of the indoor unit 1 and at the time of disassembly thereof is improved.

[0059] As shown in FIG. 2, FIG. 4, and FIG. 6, a bell mouth 53 is detachably fitted into the bell-mouth mounting hole 23 of the drain pan 20. The bell mouth 53 is an element configured to straighten a flow of air sucked by the air blower 10 and is constituted of a synthetic resin material such as an ABS resin.

[0060] As shown in FIG. 12 and FIG. 13, the bell mouth 53 includes a bell mouth main body 54 having a shape downwardly diameter-expanded into a horn-like form, and flange part 55 horizontally extending outwardly in the radial direction from the lower end part of the bell mouth main body 54 defining the maximum diameter of the bell mouth main body 54. The flange part 55 is formed continuously in the circumferential direction of the bell mouth main body 54. Furthermore, at the tip of the flange part 55, an outer circumferential wall 56 downwardly bent at right angles is formed.

[0061] The drain pan 20 is provided with a flat seat part 58 configured to receive/catch the flange part 55 of the bell mouth 53. The seat part 58 is positioned at a lower

end of the inner circumferential wall 29a interposed between the bell-mouth mounting hole 23 and recessed part 27. The seat part 58 is formed into an annular shape continuous in the circumferential direction of the bell-mouth mounting hole 23.

[0062] As shown in FIG. 4 and FIG. 15, a pair of fixing screws 60 is provided in the seat part 58. The fixing screw 60 is an example of coupling fittings, and is provided with a shank 60a including a thread, and head 60b coaxially positioned at one end of the shank 60a. The head 60b has an outer diameter greater than the shank 60a. The fixing screws 60 are shifted from each other by about 180° in the circumferential direction of the seat part 58 in opposition to each other in the radial direction of the bell-mouth mounting hole 23.

[0063] In this embodiment, a boss part 61 configured to receive and catch the fixing screw 60 is formed integral with the sheet material 22 of the drain pan 20. As shown in FIG. 15, the boss part 61 is downwardly protruded from the sheet material 22 in such a manner as to penetrate the main body 21 of the drain pan 20, and a lower end face thereof reaches the seat part 58. The shank 60a of the fixing screw 60 is screwed into the boss part 61. Between the head 60b of the fixing screw 60 and seat part 58, a gap in which the flange part 55 of the bell mouth 53 comes is formed.

[0064] Furthermore, a pair of claw-receiving parts 63 is provided in the seat part 58 of the drain pan 20. As shown in FIG. 16 and FIG. 17, the claw-receiving part 63 is formed integral with the sheet material 22 of the drain pan 20. The claw-receiving part 63 is downwardly protruded from the sheet material 22 so as to penetrate the main body 21 of the drain pan 20. The protrusion end of the claw-receiving part 63 is exposed at the face of the seat part 58, and a fitting slot 64 is formed at the protrusion end. The fitting slot 64 has a shape opened toward the one side in the circumferential direction of the seat part 58. The inner face of the fitting slot 64 is positioned flush with the seat part 58.

[0065] The claw-receiving part 63 formed in the sheet material 22 is integrated with the main body 21 in the process of forming the main body 21 by foam molding, and hence the claw-receiving part 63 is subjected to foam pressure when the main body 21 is formed by foam molding. In this embodiment, in order to prevent the fitting slot 64 from being deformed by the foam pressure, a cavity part 65 is provided inside the claw-receiving part 63.

[0066] The cavity part 65 is simple space not filled with foamed polystyrene, and has a flat shape in the circumferential direction of the seat part 58. The cavity part 65 is adjacent to the fitting slot 64 and is partitioned off the fitting slot 64 by a first partition wall 66. Furthermore, between the cavity part 65 and main body 21 made of foamed polystyrene, a second partition wall 67 parallel to the first partition wall 66 exists.

[0067] By this configuration, the second partition wall 67 receives/catches the most part of the foam pressure occurring when the main body 21 is formed by foam molding, and is deformed in such a manner that the second partition wall 67 enters the space of the cavity part 65 according to the magnitude of the foam pressure. Accordingly, it is possible to absorb the foam pressure by the cavity part 65 before the foam pressure is transmitted to the fitting slot 64, and prevent the fitting slot 64 from being deformed.

[0068] As shown in FIG. 4, the claw-receiving parts 63 are shifted from each other by about 180° in the circumferential direction of the seat part 58 so as to be opposed to each other in the radial direction of the bell-mouth mounting hole 23 at positions away from the fixing screws 60. Accordingly, the pair of fixing screws 60 and pair of claw-receiving parts 63 are alternately arranged in the circumferential direction of the seat part 58, and the fixing screw 60 and claw-receiving part 63 adjacent to each other are shifted from each other by about 90° in the circumferential direction of the seat part 58.

[0069] As shown in FIG. 12 and FIG. 13, in the flange part 55 positioned at the outer circumferential part of the bell mouth 53, a pair of fixing parts 71 and pair of depressed parts 72 are formed. The fixing parts 71 are elements to which the fixing screws 60 protruded from the seat part 58 of the drain pan 20 are detachably coupled, and are provided at positions shifted from each other by about 180° in the circumferential direction of the bell mouth 53 so as to be correspondent to the fixing screws 60.

[0070] The fixing part 71 is provided with a circular through-hole 73 and slit-like engaging hole 74. The through-hole 73 has such a size that the head 60b of the fixing screw 60 can penetrate. The engaging hole 74 is curved into an arc-like shape in the circumferential direction of the bell mouth 53, and one end thereof in the longitudinal direction communicates with the through-hole 73. Furthermore, the width dimension of the engaging hole 74 in the direction perpendicular to the longitudinal direction thereof has such a size that the shank 60a of the fixing screw 60 can slidably be inserted therein, and is less than the diameter of the head 60b of the fixing screw 60.

[0071] The depressed parts 72 are shifted from each other by about 180° in the circumferential direction of the bell mouth 53 so as to be opposed to each other in the radial direction of the bell mouth 53 at positions away from the fixing parts 71. Accordingly, as shown in FIG. 12 and FIG. 13, the pair of fixing parts 71 and pair of depressed parts 72 are alternately arranged in the circumferential direction of the bell mouth 53, and the fixing part 71 and depressed part 72 adjacent to each other are shifted from each other by about 90° in the circumferential direction of the bell mouth 53.

[0072] The depressed part 72 is inwardly depressed in the radial direction of the bell mouth 53 from the outer peripheral edge of the flange part 55, and has a shape curved into an arc-like shape in the circumferential direction of the flange part 55. Furthermore, a corner part defined by one end of the depressed part 72 and flange

part 55 defines a claw part 76. The claw parts 76 are opposed to each other in the radial direction of the bell mouth 53 between the fixing parts 71.

[0073] In order to attach the bell mouth 53 to the bell-mouth mounting hole 23 of the drain pan 20, first the through-hole 73 of the fixing part 71 of the bell mouth 53 is made to coincide with the head 60b of the fixing screw 60 downwardly protruded from the seat part 58 of the drain pan 20. In this state, the bell mouth 53 is pushed up toward the bell-mouth mounting hole 23.

[0074] Thereby, the head 60b of the fixing screw 60 penetrates the through-hole 73 of the fixing part 71. At the same time, as shown in FIG. 18, the claw-receiving part 63 of the drain pan 20 enters the depressed part 72 of the bell mouth 53. In the state where the claw-receiving part 63 has entered the depressed part 72, the opening end of the fitting slot 64 of the claw-receiving part 63 is opposed to the claw part 76 of the bell mouth 53.

[0075] In this state, when the bell mouth 53 fitted into the bell-mouth mounting hole 23 is rotated in the circumferential direction, the shank 60a of the fixing screw 60 moves from the through-hole 73 to the engaging hole 74. At the same time, as shown in FIG. 14, the head 60b of the fixing screw 60 moves from the through-hole 73 to the engaging hole 74, whereby the head 60b gets caught on the opening peripheral edge part of the engaging hole 74. Furthermore, as shown in FIG. 19, the claw part 76 is slidably fitted into the fitting slot 64, and the tip of the claw part 76 butts against the end of the fitting slot 64.

[0076] Thereby, the bell mouth 53 is held by the drain pan 20 at four parts in the circumferential direction. Finally, the fixing screws 60 are tightened. As a result of this, the flange part 55 of the bell mouth 53 is held between the heads 60b of the fixing screws 60 and seat part 58 of the drain pan 20, and the bell mouth 53 is fixed to the drain pan 20.

[0077] On the other hand, in order to detach the bell mouth 53 from the drain pan 20, for example, when maintenance of the air blower is carried out, the fixing screws 60 are loosened, whereby tightening of the flange part 55 of the bell mouth 53 by the fixing screws 60 is released.

[0078] In this state, the bell mouth 53 is rotated in the direction opposite to the direction at the time of attaching the bell mouth 53. Thereby, the head 60b of the fixing screw 60 moves from the engaging hole 74 to the through-hole 73, and the claw part 76 withdraws from the fitting slot 64. Accordingly, fixing of the bell mouth 53 to the bell-mouth mounting hole 23 is released, and the bell mouth 53 can downwardly be drawn out of the bell-mouth mounting hole 23.

[0079] According to this embodiment, the bell mouth 53 includes rib-like hooking parts 77 at positions corresponding to the depressed parts 72. As shown in FIG. 6, FIG. 9, and FIG. 13, the hooking part 77 upwardly extends from the upper edge of the depressed part 72, and is provided in a predetermined range in the circumferential direction of the bell mouth 53. The hooking parts 77 are shifted from each other by about 180° in the circumferential direction of the bell mouth 53 so as to be opposed to each other in the radial direction of the bell mouth 53.

[0080] Furthermore, the seat part 58 of the drain pan 20 against which the top face of the flange part 55 of the bell mouth 53 butts includes a pair of depressed parts 78. The depressed parts 78 are provided at positions corresponding to the hooking parts 77. The depressed part 78 has a shape formed by partially hollowing out the seat part 58 of the drain pan 20 so as to avoid the hooking part 77. Between the inner face of the depressed part 78 and hooking part 77, ample insertion space S is secured.

[0081] The ceiling panel 3 of the indoor unit 1 is arranged in an attitude along the ceiling not shown. As shown in FIG. 1 through FIG. 3, the ceiling panel 3 is provided with an inlet grille 80 and frame body 81. The inlet grille 80 is positioned at the central part of the ceiling panel 3.

[0082] The inlet grille 80 is provided with a square outer frame part 82 and grille part 83 surrounded by the outer frame part 82. The grille part 83 is positioned directly beneath the bell mouth 53 and includes a detachable filter 84.

[0083] The frame body 81 of the ceiling panel 3 is a square element surrounding the inlet grille 80, and includes first to fourth side parts 85a, 85b, 85c, and 85d, and four corner parts 86a, 86b, 86c, and 86d.

[0084] Each of the first to fourth side parts 85a, 85b, 85c, and 85d extends along the outer peripheral edge of the outer frame part 82 of the inlet grille 80. The corner parts 86a, 86b, 86c, and 86d are positioned at four corners of the ceiling panel 3, and integrally connect the first to fourth side parts 85a, 85b, 85c, and 85d adjacent to each other in the circumferential direction of the frame body 81 to each other. The square area surrounded by the inner peripheral edges of the first to fourth side parts 85a, 85b, 85c, and 85d defines a work opening 87.

[0085] Furthermore, the ceiling panel 3 is detachably coupled to the brackets 8 of the casing 4 at the portions of the four corner parts 86a, 86b, 86c, and 86d included in the frame body 81. Thereby, the lower end of the unit main body 2 including the drain pan 20 and bell mouth 53 is covered with the ceiling panel 3.

[0086] As shown in FIG. 1, the ceiling panel 3 includes four air outlets 88 from which air passing through the heat exchanger 11 is discharged into the room. The air outlets 88 are formed in the first to fourth side parts 85a, 85b, 85c, and 85d of the frame body 81 in opposition to the four cutout parts 26 included in the drain pan 20.

[0087] Four louvers 89 are supported on the frame body 81 of the ceiling panel 3. The louver 89 is an element configured to change the direction in which the air is discharged from the air outlet 88 into the room, and is formed into a flat, long and thin plate-like shape. The louver 89 is rotatable between a closing position at which the louver 89 closes the air outlet 88 and opening position at which the louver 89 inclines to open the air outlet 88. In the state where the louvers 89 are rotated to the closing position, the louvers 89 are configured to become horizontal

to thereby entirely cover the first to fourth side parts 85a, 85b, 85c, and 85d of the frame body 81.

[0088] According to this embodiment, regarding the inlet grille 80 of the ceiling panel 3, one side of the outer frame part 82 is selectively coupled to one of the first to fourth side parts 85a, 85b, 85c, and 85d of the frame body 81 so as to be rotatable. Accordingly, the inlet grille 80 is configured to be rotatable between a first position at which the work opening 87 is closed and second position at which the work opening 87 is opened. Furthermore, the inlet grille 80 is configured in such a manner that in the state where the inlet grille 80 is rotated to the second position, the inlet grille 80 can be detached from the frame body 81.

[0089] As shown in FIG. 3, a temporary latch 91 (only one of them is shown) is fixed to each of the inner peripheral edges of the first side part 85a and third side part 85c, the inner peripheral edges facing the work opening 87. The temporary latch 91 is an element to be used when the ceiling panel 3 is to be temporarily fixed to the unit main body 2, and is constituted of a sheet-metal material bent into a desired shape.

[0090] The temporary latch 91 is protruded from an intermediate part of each of the first side part 85a and third side part 85c in the longitudinal direction thereof toward a part above the frame body 81. As shown in FIG. 9 and FIG. 20, a hook part 92 downwardly turned down is formed at the top edge of the temporary latch 91. The hook part 92 is inserted in the insertion space S between the hooking part 77 and depressed part 78 from below the bell mouth 53 and is detachably hooked to the hooking part 77 of the bell mouth 53. Thereby, the ceiling panel 3 is temporarily fixed to the main body 2 in the form in which the ceiling panel 3 is suspended from the bell mouth 53.

[0091] It should be noted that in the state where the corner parts 86a, 86b, 86c, and 86d of the ceiling panel 3 are fixed to the brackets 8 of the unit main body 2, the hook part 92 of the temporary latch 91 is pulled up so as to withdraw from the hooking part 77 of the bell mouth 53.

[0092] According to the first embodiment, when the bell mouth 53 fitted into the bell-mouth mounting hole 23 of the drain pan 20 is rotated in the circumferential direction, the head 60b of the fixing screw 60 gets caught on the engaging hole 74 of the bell mouth 53, and the claw part 76 of the bell mouth 53 is fitted into the fitting slot 64 of the drain pan 20. Accordingly, the bell mouth 53 is held by the bell-mouth mounting hole 23 of the drain pan 20 at four parts in the circumferential direction.

[0093] Accordingly, the number of the fixing screws 60 can be reduced as compared with the conventional case, the number of components is held down correspondingly and the cost of the indoor unit 1 can be reduced.

[0094] Moreover, both when the bell mouth 53 is attached to the drain pan 20 and when the bell mouth 53 is detached from the drain pan 20, the fixing screw 60 is maintained in the state where the fixing screw 60 is left screwed into the boss part 61 of the drain pan 20 as it is. Accordingly, when the bell mouth 53 is detached from the drain pan 20, the worker is released from the troublesome work of loosening all the fixing screws 60 one by one by handwork, and the fixing screw 60 is never dropped by mistake.

[0095] In other words, it becomes possible to attach or detach the bell mouth 53 by only simply loosening the fixing screws 60, and the serviceability at the time of maintenance of the indoor unit 1 is improved.

[0096] Furthermore, according to this embodiment, it is possible to absorb the foam pressure by the cavity part 65 before the foam pressure occurring when the main body 21 is formed by foam molding is transmitted to the fitting slot 64, and prevent the fitting slot 64 from being deformed at the time of formation of the drain pan 20.

[0097] Accordingly, when the bell mouth 53 is rotated in the circumferential direction, the claw part 76 of the bell mouth 53 is smoothly fitted into the fitting slot 64 or is smoothly withdrawn from the fitting slot 64. Therefore, the rotation of the bell mouth 53 is never disturbed, and the workability at the time of attachment/detachment of the bell mouth 53 can be maintained satisfactory.

[0098] Moreover, according to this embodiment, it is possible to hook the temporary latch 91 of the ceiling panel 3 directly to the hooking part 77 of the bell mouth 53. Accordingly, it is not necessary to provide the main body 21 made of foamed polystyrene constituting the drain pan 20 with dedicated metal fittings configured to catch the temporary latch 91 by insert molding. Accordingly, it is possible to simplify the configuration of the drain pan 20, this being advantageous from the viewpoint of cost reduction of the indoor unit 1.

[0099] While certain embodiments have been described, these embodiments have been presented by way of example only, and are not intended to limit the scope of the inventions. Indeed, the novel embodiments described herein may be embodied in a variety of other forms; furthermore, various omissions, substitutions and changes in the form of the embodiments described herein may be made without departing from the spirit of the inventions. The accompanying claims and their equivalents are intended to cover such forms or modifications as would fall within the scope and spirit of the inventions.

[0100] For example, in the embodiment described above, although a pair of fixing screws and pair of claw-receiving parts are used to fix the bell mouth to the drain pan, the configuration is not limited to this, and the fitting part may be omitted.

[0101] Furthermore, the number of fixing screws and number of claw-receiving parts are not particularly limited and, the numbers can appropriately be changed according to, for example, the size of the bell mouth.

Reference Signs List

[0102] 1 ··· indoor unit, 2 ··· unit main body, 10 ··· air blower, 11 ··· heat exchanger, 20 ··· drain pan, 23 ··· bell-mouth mounting hole, 29a ··· inner circumferential wall,

53 ··· bell mouth, 60 ··· coupling fittings (fixing screw), 60a ··· shank, 60b ··· head, 71 ··· fixing part, 73 ··· through-hole, and 74 ··· engaging hole.

Claims

1. An indoor unit for air conditioner comprising:

a unit main body accommodating therein an air blower and a heat exchanger;
a drain pan to be attached to a lower end of the unit main body and configured to receive dew condensation water created in the heat exchanger and including an inner circumferential wall defining a bell-mouth mounting hole continuous with the suction side of the air blower;
a bell mouth detachably fitted into the bell-mouth mounting hole of the drain pan;
a plurality of pieces of coupling fittings provided in the inner circumferential wall of the drain pan with intervals held between the fittings in the circumferential direction and each of which includes a head at a lower end of a shank downwardly protruded from a lower end of the inner circumferential wall, the head possessing a diameter greater than the shank; and
a plurality of fixing parts provided in an outer circumferential part of the bell mouth with intervals held between the fixing parts in the circumferential direction and each of which includes a through-hole to be penetrated by the head of the coupling fittings and an engaging hole continuous with the through-hole and on which the head gets caught, wherein
by rotating the bell mouth inside the bell-mouth mounting hole in the circumferential direction in a state where the head of the coupling fittings is made to penetrate the through-hole of the fixing part, the head of the coupling fittings moves from the through-hole of the fixing part to the engaging hole to get caught on the engaging hole, and the bell mouth is fixed to the drain pan.

2. The indoor unit for air conditioner of Claim 1, further comprising:

at least one claw-receiving part provided in the inner circumferential wall of the drain pan; and
at least one claw part provided in the outer circumferential part of the bell mouth and configured to be detachably fitted into the claw-receiving part when the bell mouth is rotated inside the bell-mouth mounting hole in the circumferential direction.

3. The indoor unit for air conditioner of Claim 2, wherein the claw-receiving part is positioned between the coupling fittings separate from each other in the circumferential direction of the inner circumferential wall, and the claw part is positioned between the fixing parts of the bell mouth.

4. The indoor unit for air conditioner of Claim 2, wherein the drain pan includes a main body formed by foam molding and a sheet material made of a resin and integrated with the main body so as to cover the main body when the main body is formed by foam molding, and the claw-receiving part is formed integral with the sheet material.

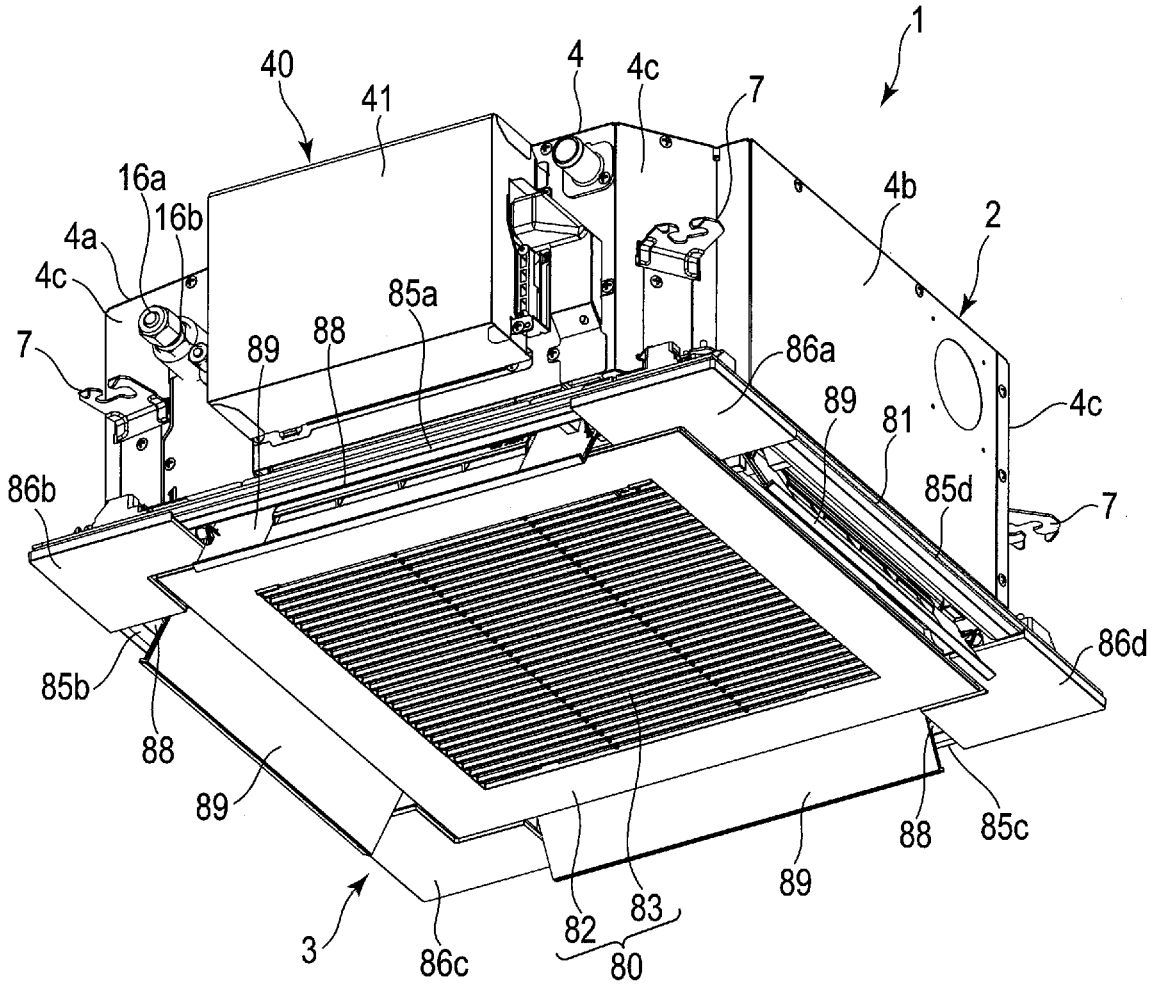
5. The indoor unit for air conditioner of Claim 4, wherein the claw-receiving part includes a fitting slot into which the claw part of the bell mouth is detachably fitted, and a cavity part configured to absorb foam pressure at the time when the main body is formed by foam molding, and
the cavity part is provided at a position adjacent to the fitting slot.

6. The indoor unit for air conditioner of Claim 4, wherein the sheet material of the drain pan includes a boss part configured to receive and catch the shank of the coupling fittings.

7. The indoor unit for air conditioner of Claim 1, wherein both when the bell mouth is attached to the drain pan and when the bell mouth is detached from the drain pan, the coupling fittings are kept in a state where the coupling fittings are supported by the inner circumferential wall of the drain pan.

8. The indoor unit for air conditioner of Claim 7, wherein the coupling fittings are screws.

9. The indoor unit for air conditioner of Claim 1, further comprising a ceiling panel configured to cover a lower end of the unit main body, wherein
the ceiling panel includes temporary latches configured to temporarily fix the ceiling panel to the lower end of the unit main body,
hooking parts to which the temporary latches are detachably hooked are provided in the outer circumferential part of the bell mouth, and the inner circumferential wall of the drain pan includes depressed parts possessing a shape formed by partially hollowing out the wall so as to avoid the temporary latch at positions opposed to the hooking parts.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4c
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16b
4a
4c
4b
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88
85c
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86c
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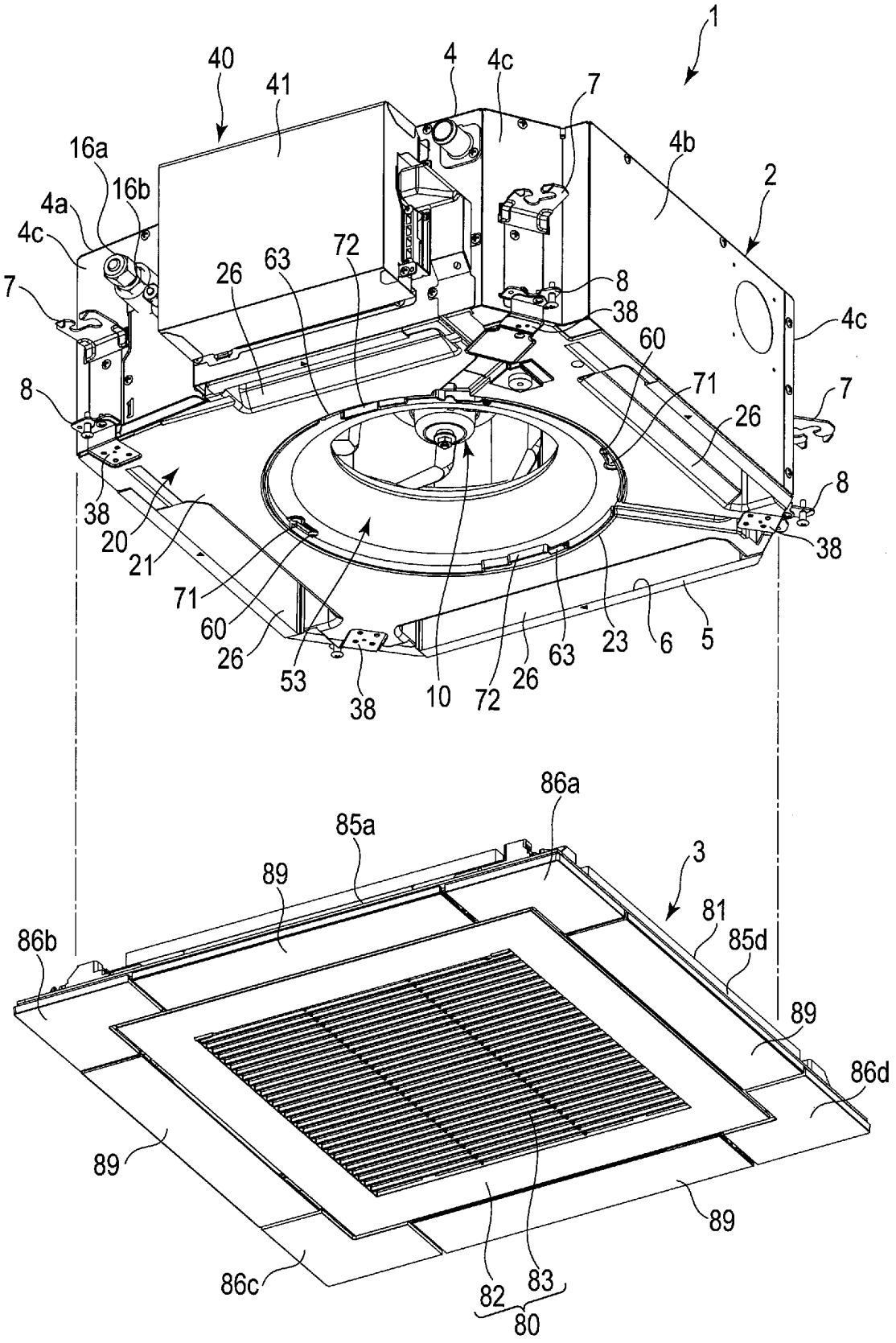
83
80

FIG. 1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4c
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FIG. 2

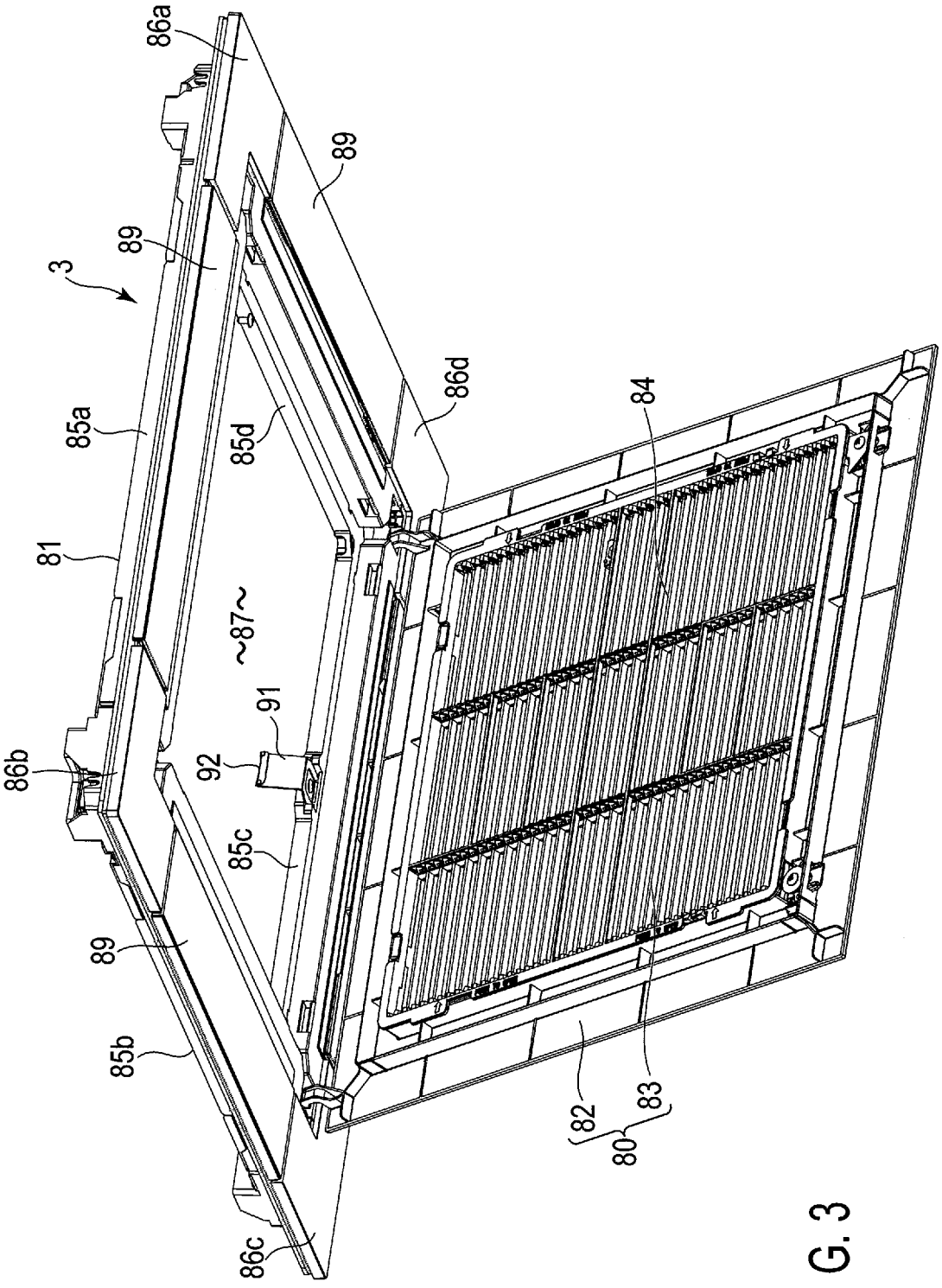
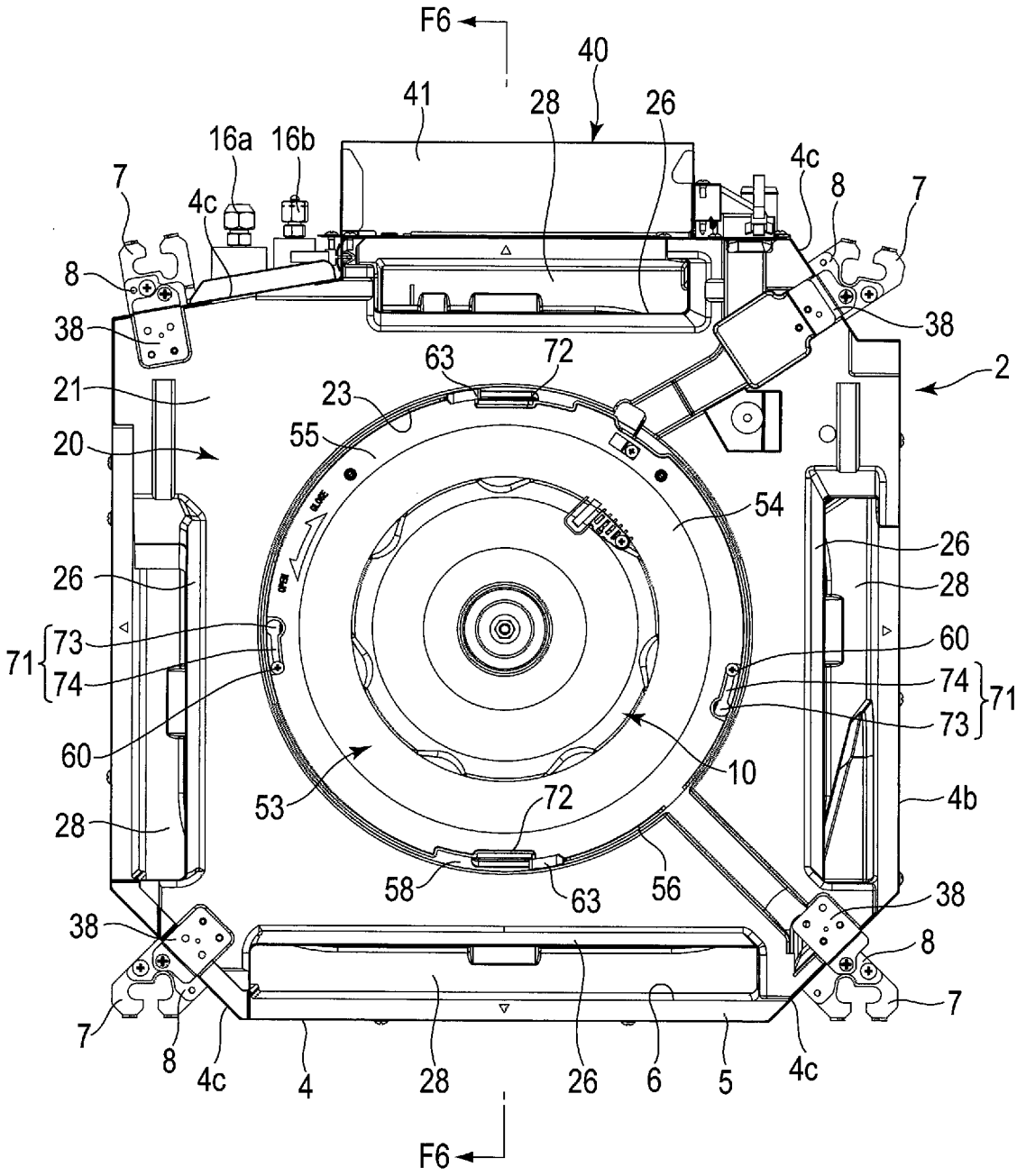


FIG. 3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4c
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F6

FIG. 4

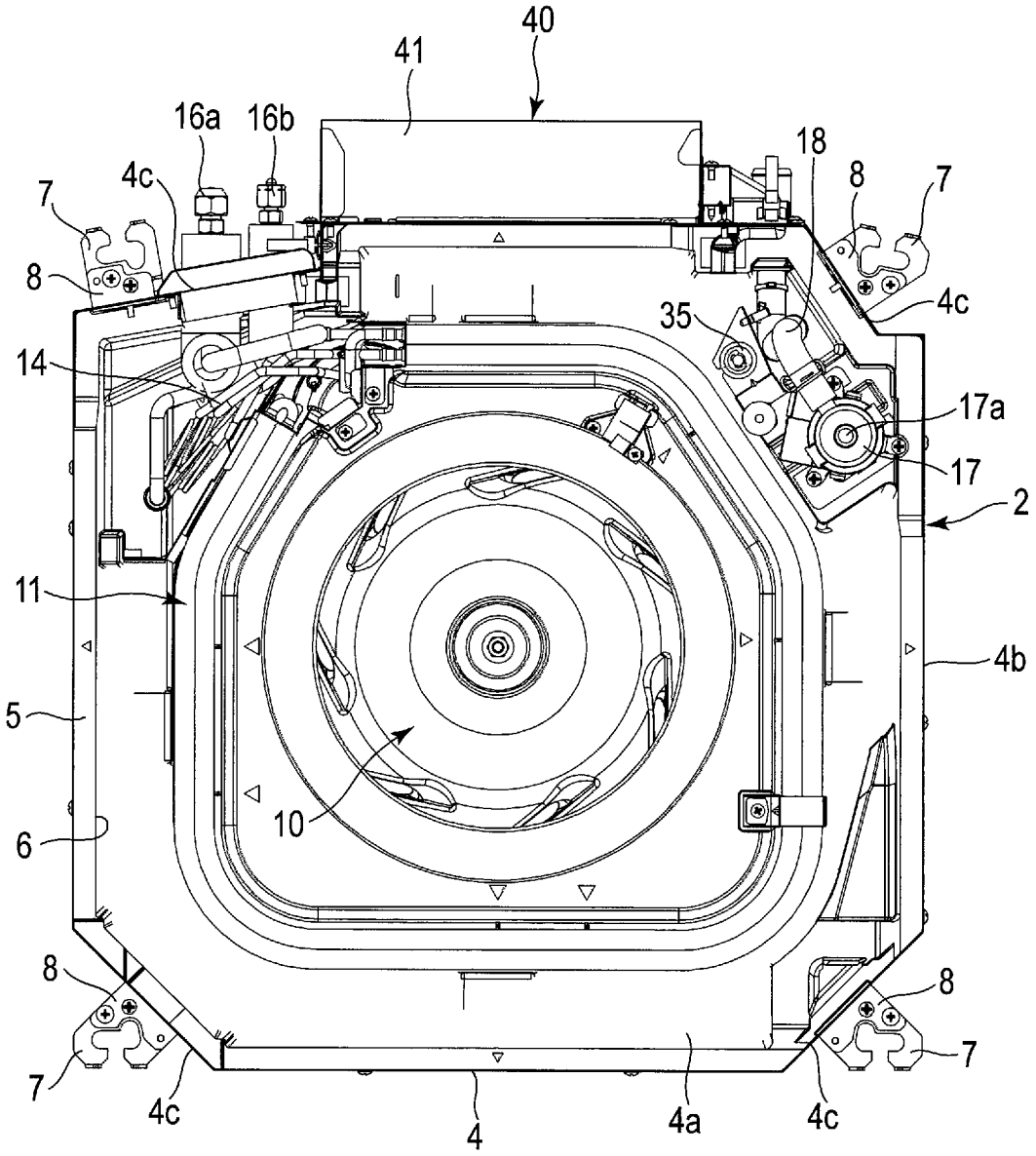
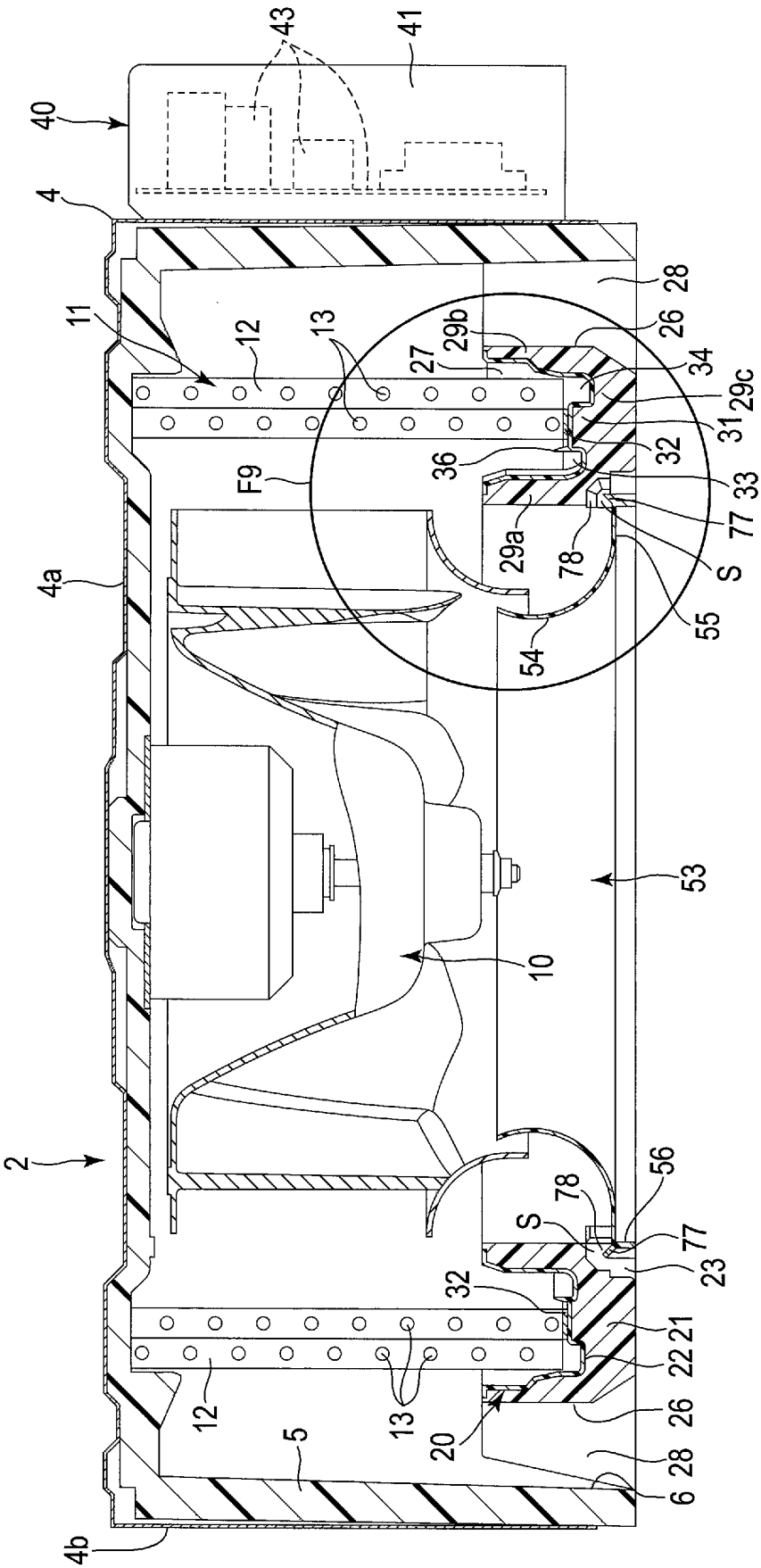


FIG. 5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29c
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29a
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FIG. 6

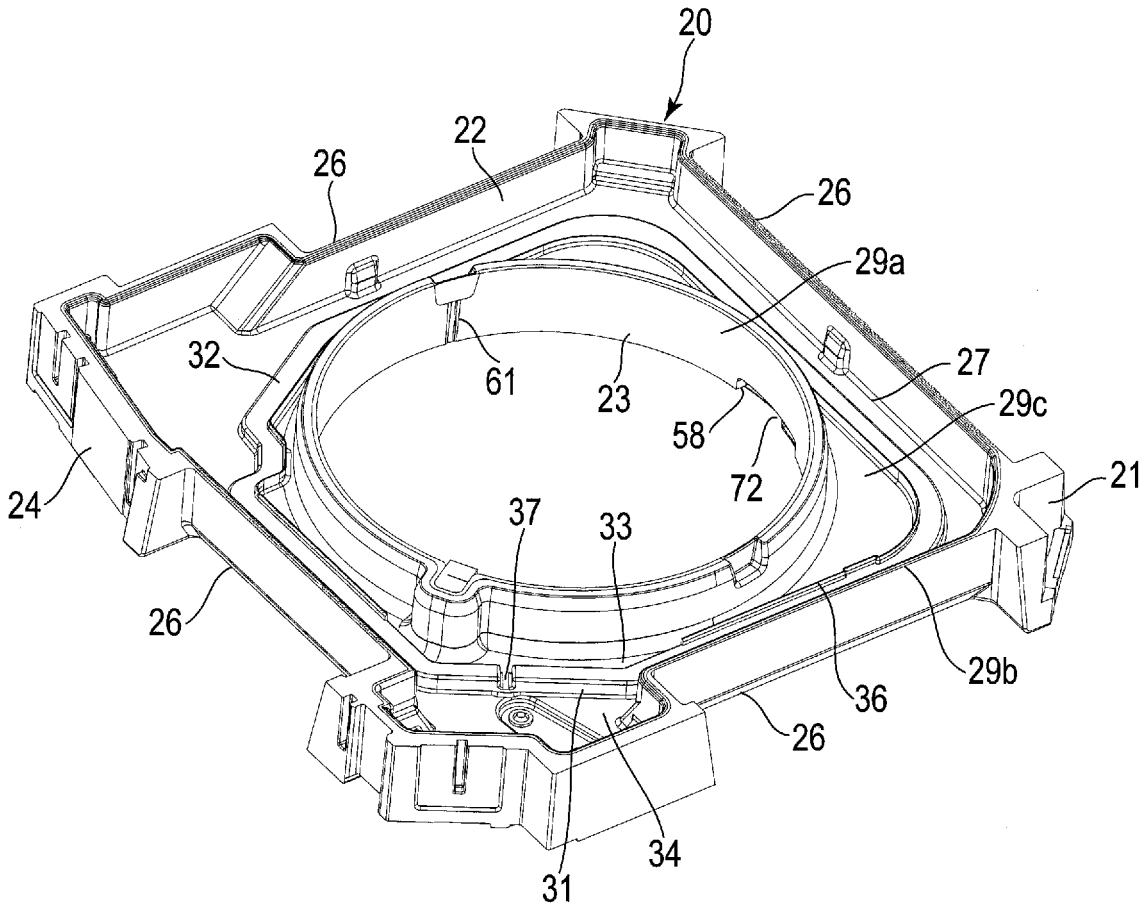


FIG. 7

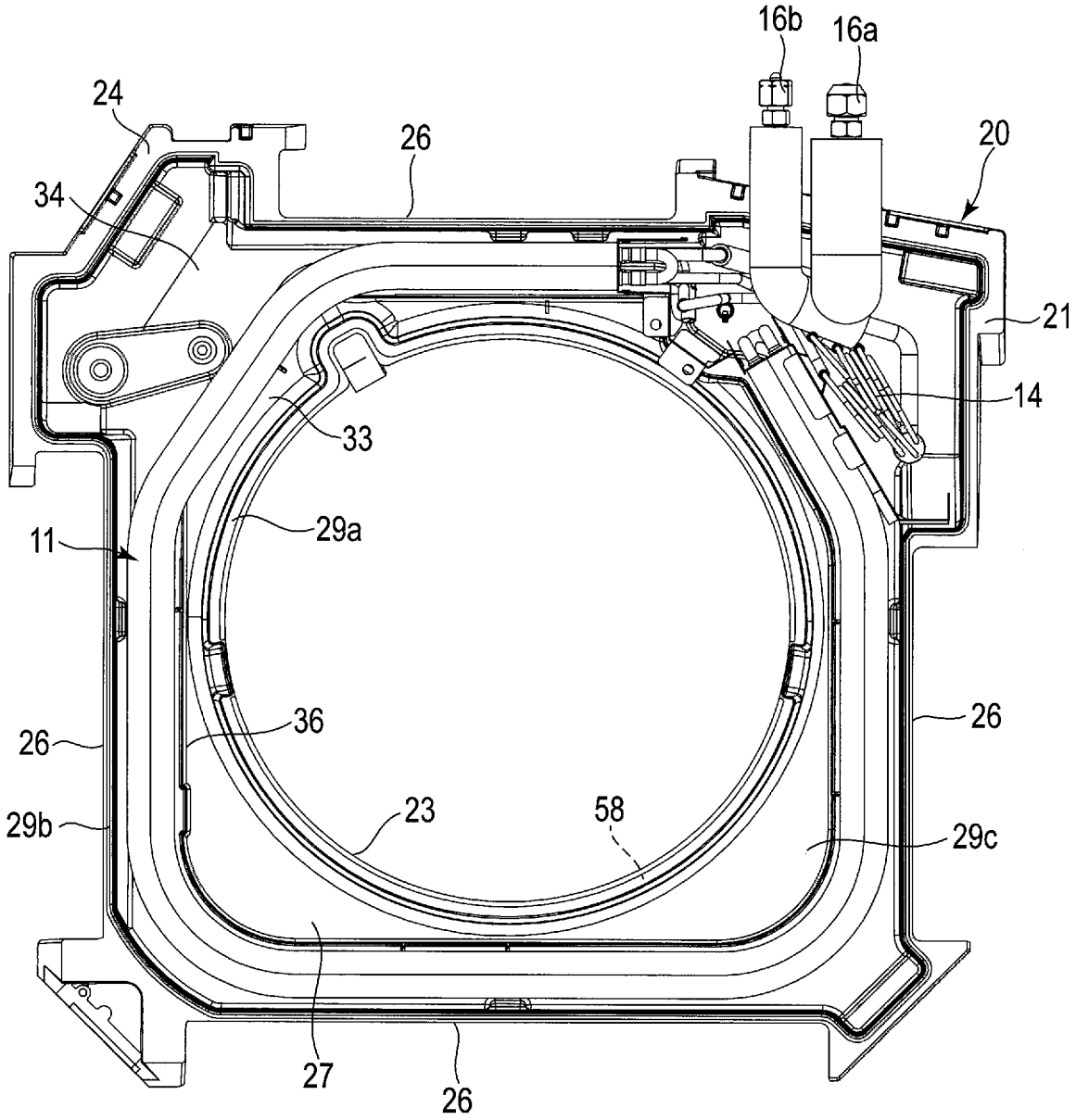
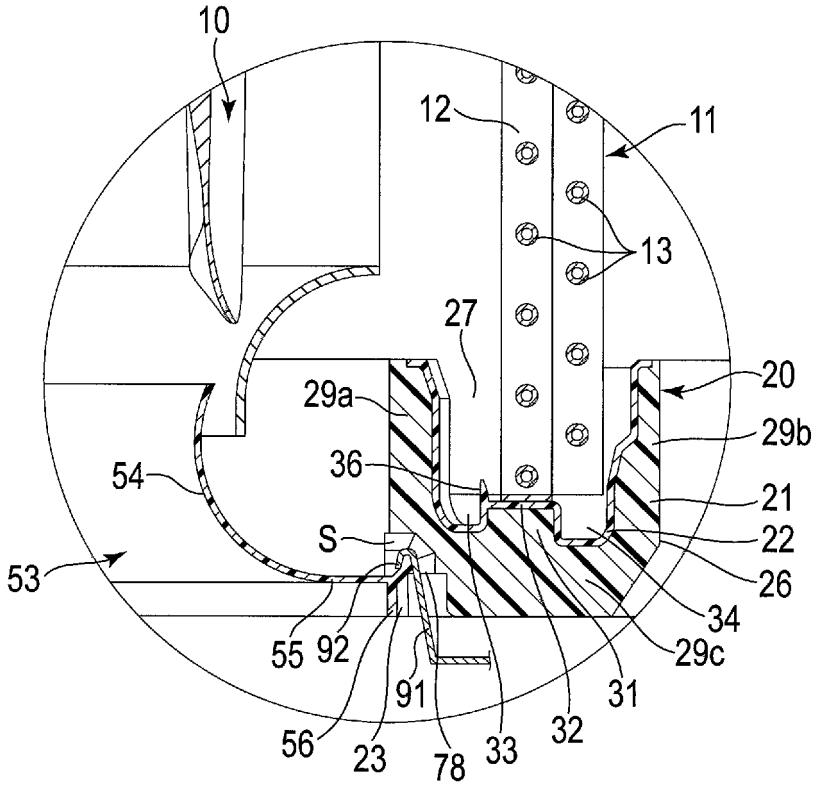


FIG. 8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29a
29b
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S
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92
29c
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FIG. 9

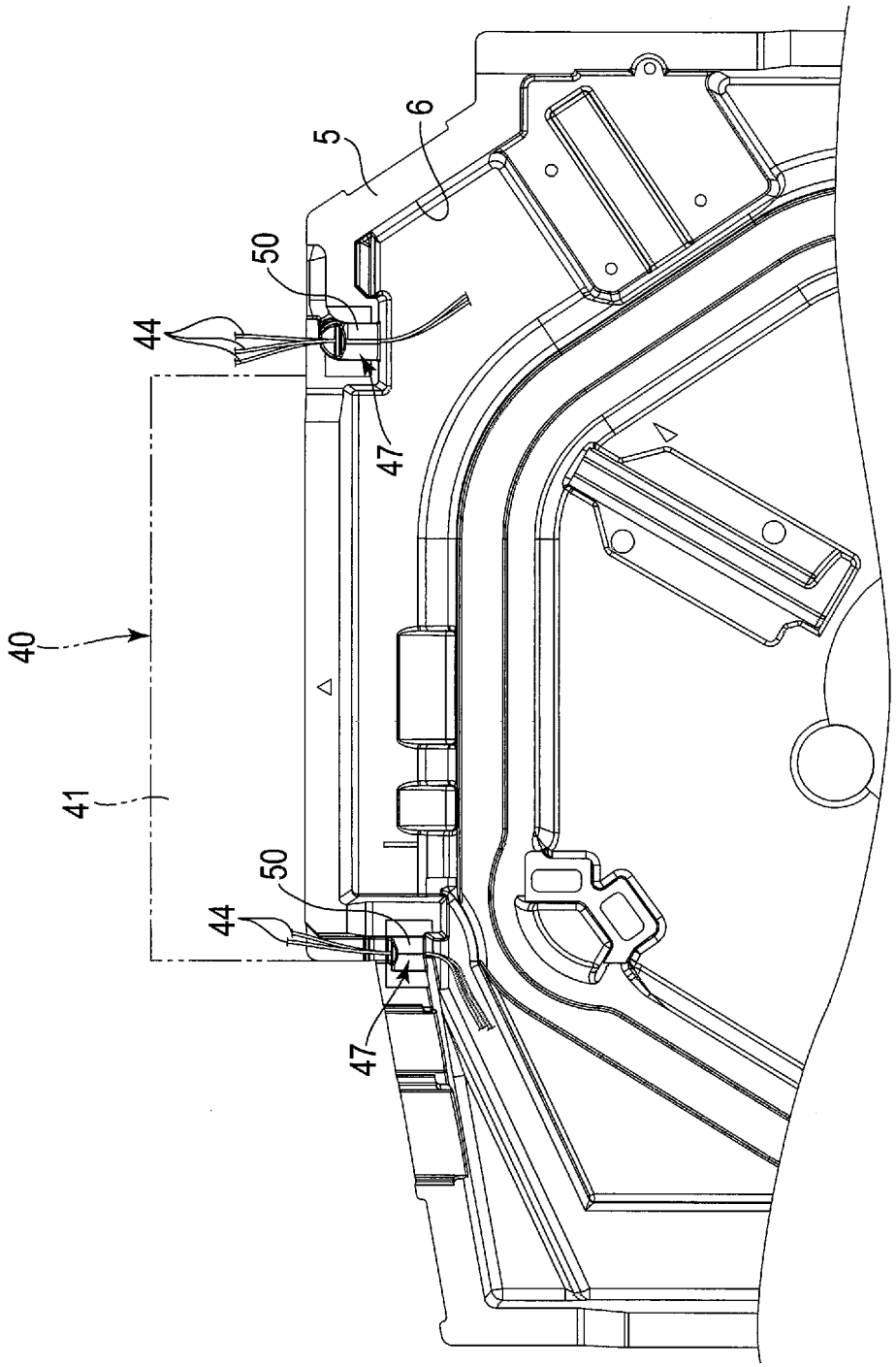

FIG. 10

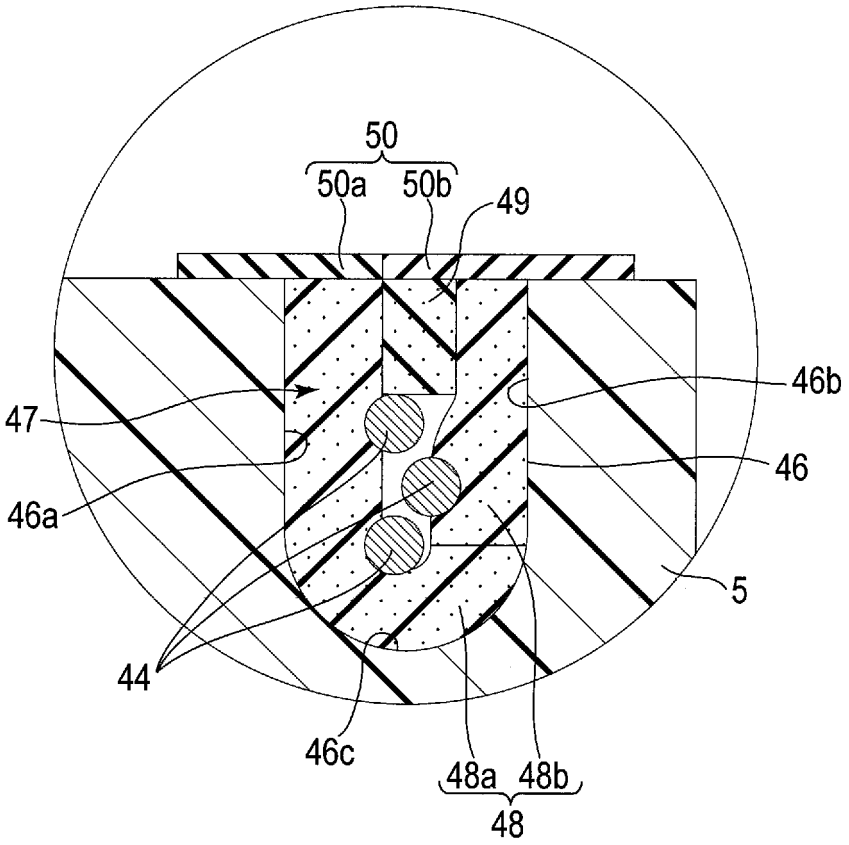

FIG. 11

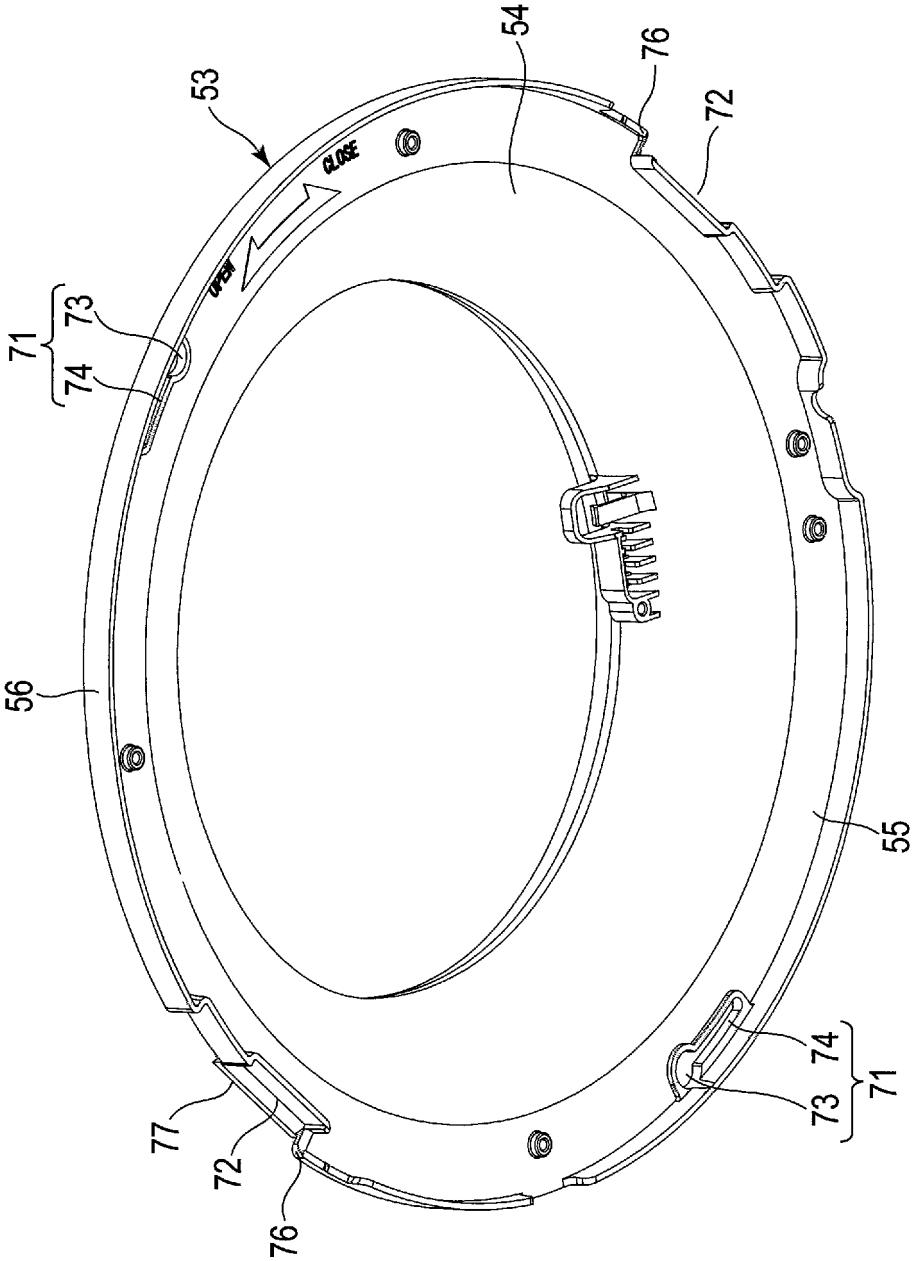

FIG. 12

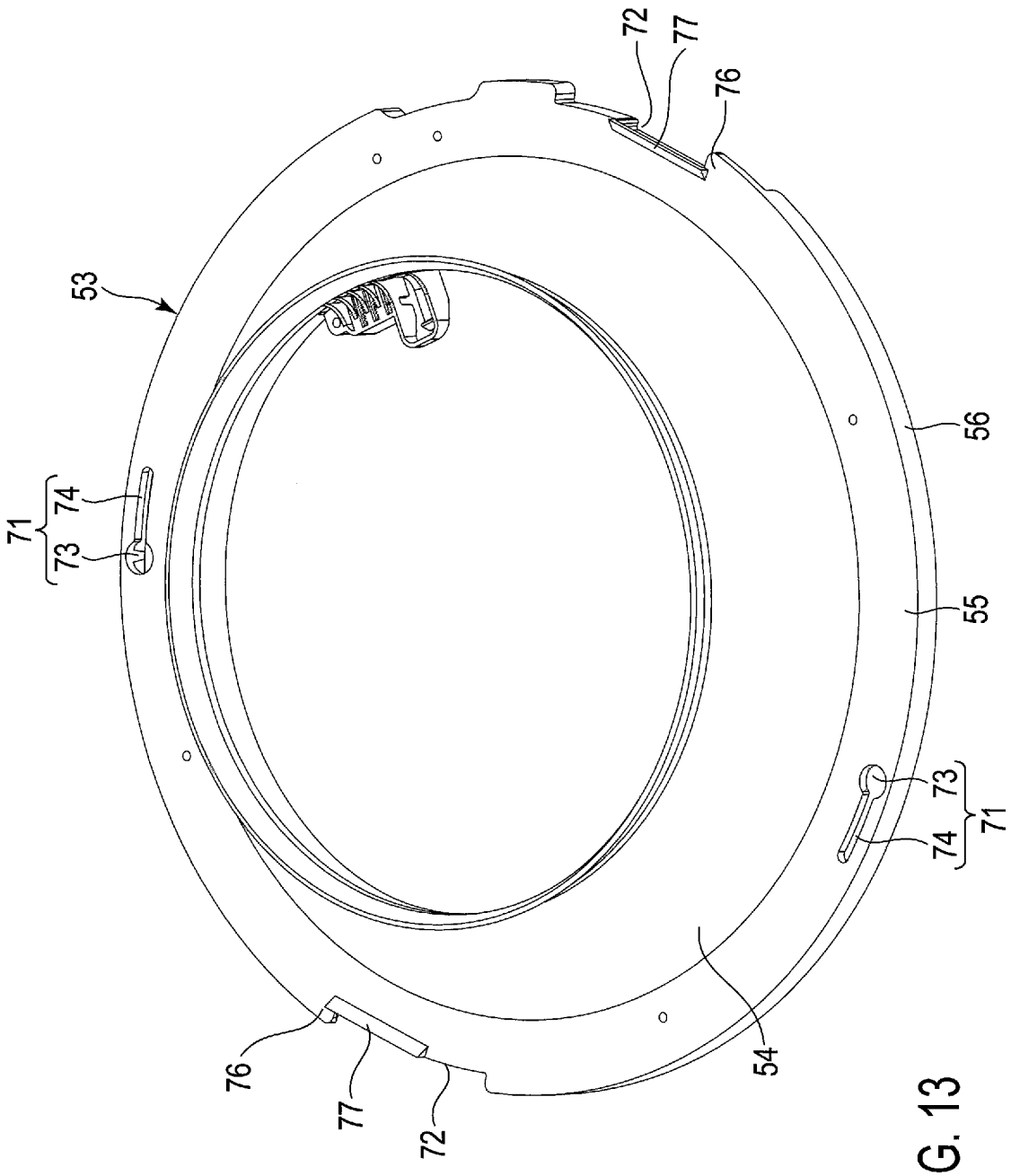

FIG. 13

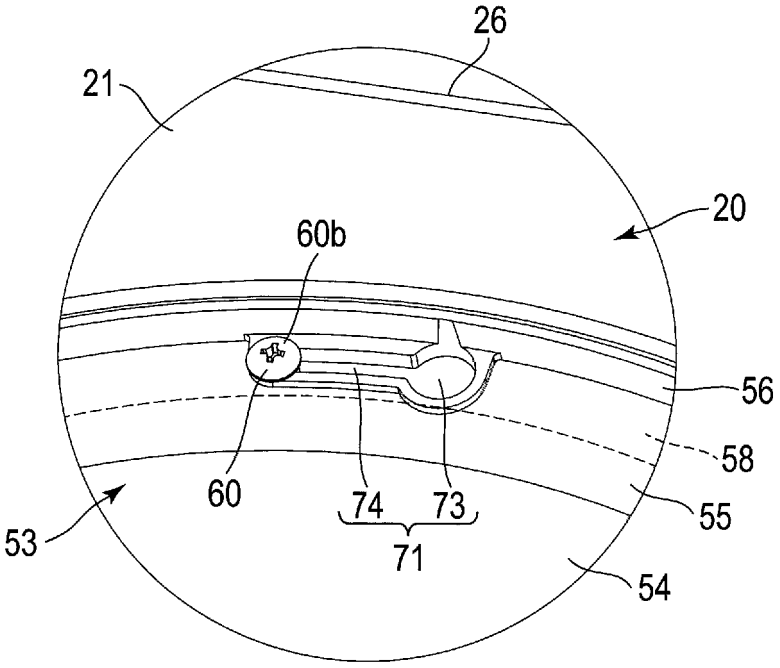

FIG. 14

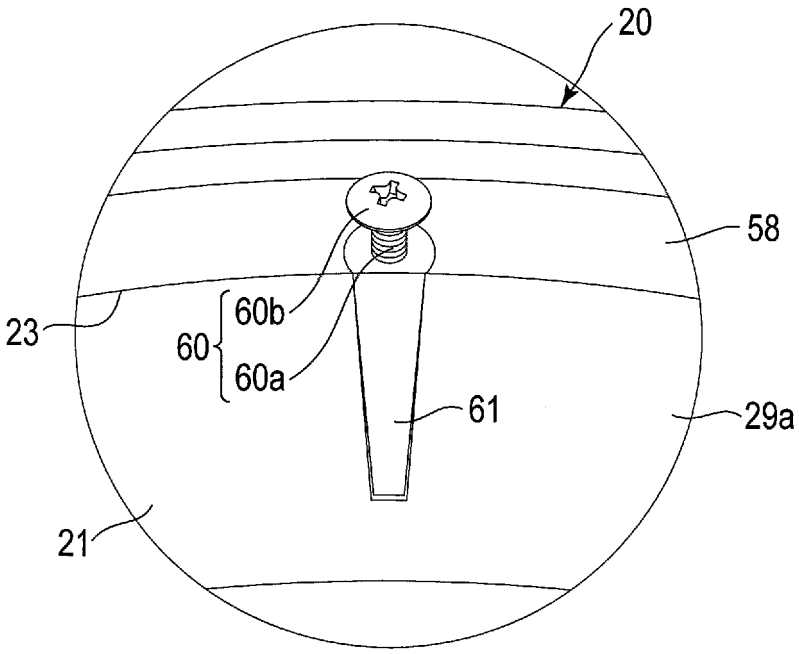

FIG. 15

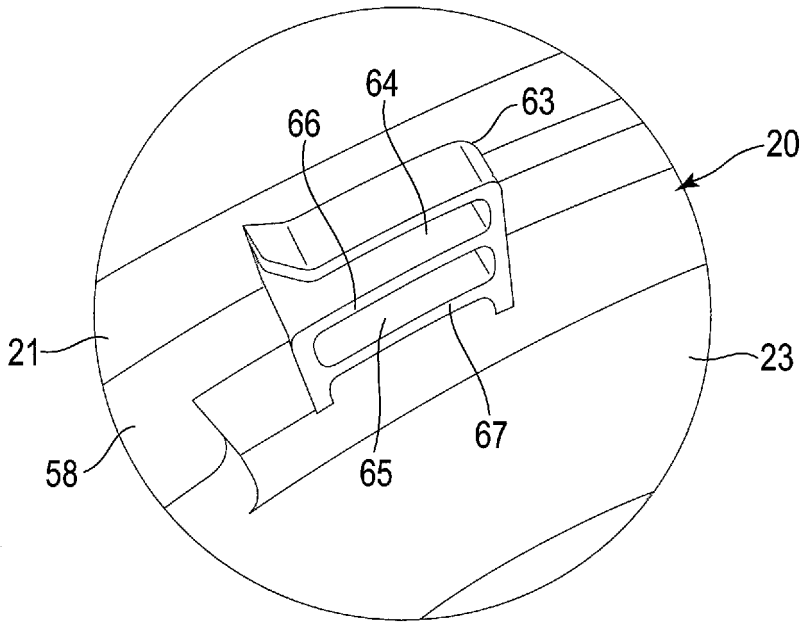

FIG. 16

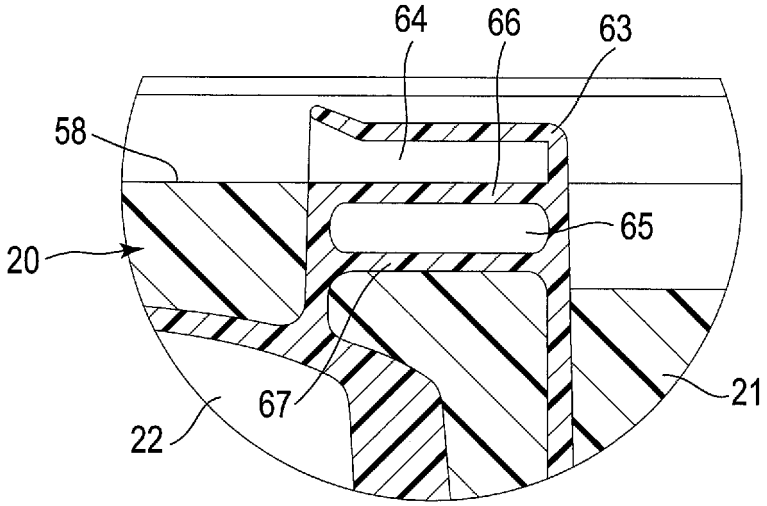

FIG. 17

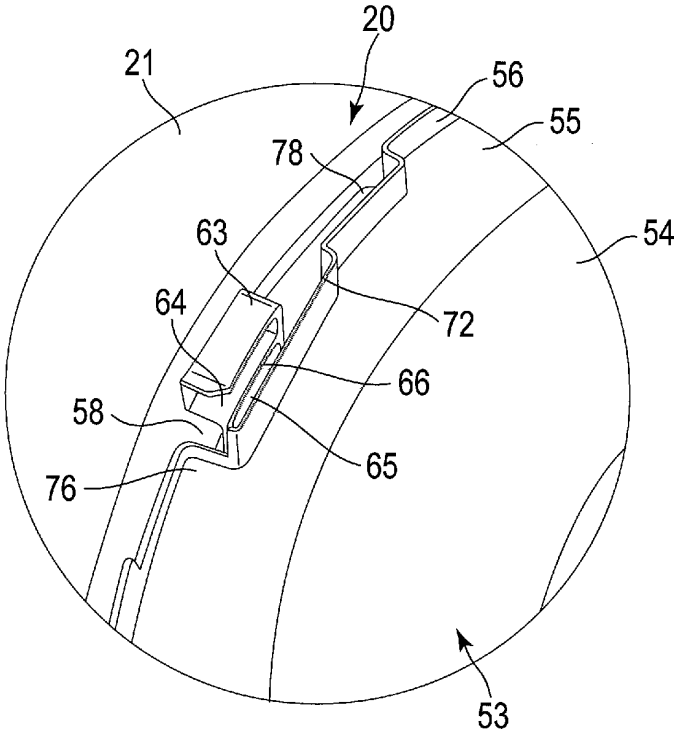
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FIG. 18

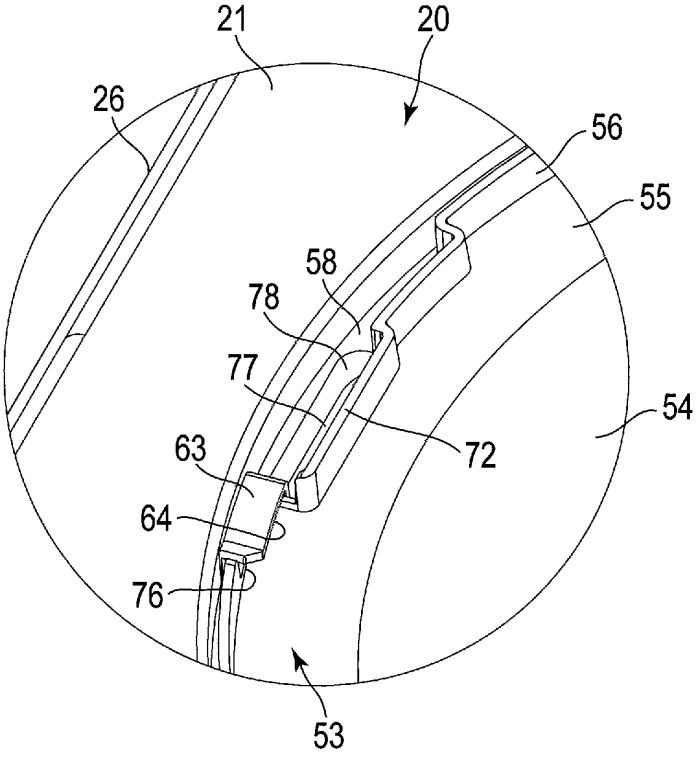
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FIG. 19

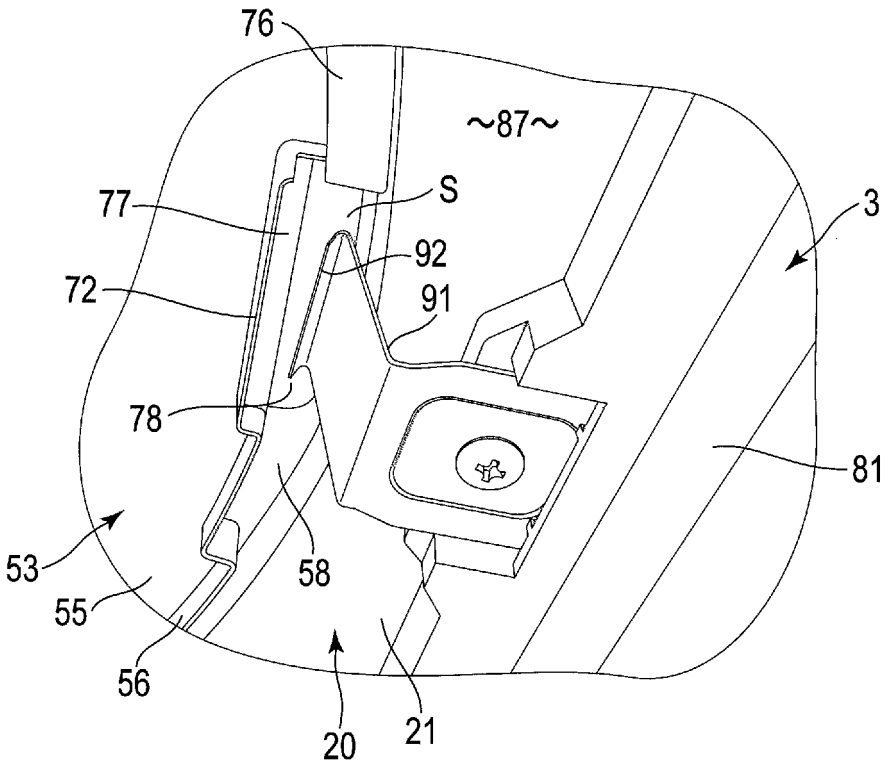

FIG. 20

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2017/010520

A. CLASSIFICATION OF SUBJECT MATTER
F24F13/20(2006.01)i, *F24F13/22*(2006.01)i

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)
F24F13/20, F24F13/22

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
Jitsuyo Shinan Koho 1922-1996 Jitsuyo Shinan Toroku Koho 1996-2017
Kokai Jitsuyo Shinan Koho 1971-2017 Toroku Jitsuyo Shinan Koho 1994-2017

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.
A	JP 2014-190655 A (Panasonic Corp.), 06 October 2014 (06.10.2014), paragraphs [0013] to [0030]; fig. 1 to 3 (Family: none)	1-9
A	JP 6083774 B1 (MEi Ltd.), 22 February 2017 (22.02.2017), paragraphs [0010] to [0029]; fig. 1 to 6 (Family: none)	1-9

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

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Date of the actual completion of the international search	Date of mailing of the international search report
25 May 2017 (25.05.17)	06 June 2017 (06.06.17)
Name and mailing address of the ISA/ Japan Patent Office 3-4-3,Kasumigaseki,Chiyoda-ku, Tokyo 100-8915,Japan	Authorized officer Telephone No.

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Patent documents cited in the description

- JP 4122396 B **[0004]**