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

(11) **EP 3 587 952 A1**

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

(43) Date of publication:
01.01.2020 Bulletin 2020/01

(21) Application number: **17897295.6**

(22) Date of filing: **27.02.2017**

(51) Int Cl.:
F24F 13/32 *(2006.01)* ***F24F 13/20*** *(2006.01)*

(86) International application number:
PCT/JP2017/007402

(87) International publication number:
WO 2018/154765 (30.08.2018 Gazette 2018/35)

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

(71) Applicant: **Toshiba Carrier Corporation**
Kawasaki-shi, Kanagawa 212-8585 (JP)

(72) Inventors:
- **YOSHITAKE, Nobusato**
  Fuji-shi
  Shizuoka 416-8521 (JP)
- **HIRAOKA, Takashi**
  Fuji-shi
  Shizuoka 416-8521 (JP)
- **GAJINA, Kenji**
  Fuji-shi
  Shizuoka 416-8521 (JP)

(74) Representative: **Gramm, Lins & Partner**
Patent- und Rechtsanwälte PartGmbB
Theodor-Heuss-Straße 1
38122 Braunschweig (DE)

(54) CEILING PANEL AND AIR CONDITIONER

(57) A ceiling panel includes a frame body having corner parts, and corner covers which detachably cover the corner parts. Each of the corner parts includes an outer circumferential part including engaging holes, a screw-receiving part positioned on the inner side of the outer circumferential part, and a cover-fixing screw screwed into the screw-receiving part. Each of the corner covers includes engaging claws, and a screw-fixing part protruded toward the screw-receiving part. The screw-fixing part includes a guide slot which is opened at a tip of the screw-fixing part, and guide walls protruded from the screw-fixing part so as to surround the guide slot. The guide walls move the corner cover toward a regular position on the corner part when the cover-fixing screw is tightened.

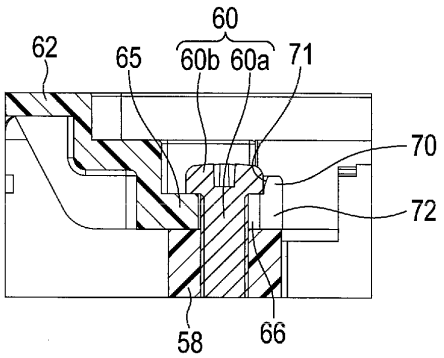


FIG. 15

EP 3 587 952 A1

Description

Technical Field

[0001] Embodiments described herein relate generally to a ceiling panel to be used for an air conditioner and to ceiling-embedded air conditioner.

Background Art

[0002] A ceiling-embedded air conditioner is provided with a ceiling panel configured to cover a lower end of an indoor unit installed in the ceiling space. The ceiling panel includes a square frame body and each of four corner parts of the frame body is fixed to the lower end of the indoor unit through a panel-fixing screw and fixing bracket.

[0003] Each of the corner parts of the frame body is covered with a detachable corner cover. After the attitude of the corner cover is manually adjusted by the worker in order that the corner cover may be at an appropriate position with respect to the corner part, the corner cover is fixed to the corner part by using a screw.

Citation List

Patent Literature

[0004] Patent Literature 1: JP 4916552 B2

Summary of Invention

Technical Problem

[0005] However, when the screw is tightened without being ware that the corner cover is out of the regular position, it is undeniable that the juncture of the frame body and corner cover is shifted from the regular position or a large gap is created at the part of the juncture. The gap of this kind is liable to catch the eyes of people looking up at the ceiling panel, thereby deteriorating the appearance of the ceiling panel.

[0006] Moreover, the worker must tighten the screw while taking care not to shift the corner cover from the regular position, and there is room for improvement from the viewpoint of workability.

[0007] An embodiment described herein aims to obtain a ceiling panel corner covers of which can easily be fixed to the regular positions of the corner parts, and which is excellent in appearance and workability.

Solution to Problem

[0008] According to this embodiment, a ceiling panel is provided with a frame body including a plurality of corner parts, and a plurality of corner covers configured to detachably cover the corner parts of the frame body. Each of the corner parts includes an outer circumferential part defining a contour of the frame body and including a plurality of engaging holes, a screw-receiving part positioned on the inner side of the outer circumferential part, and a cover-fixing screw screwed into the screw-receiving part. Each of the corner covers includes a plurality of engaging claws detachably hooked to the engaging holes, and a screw-fixing part protruded toward the screw-receiving part. The screw-fixing part includes a guide slot through which a stem of the cover-fixing screw passes in a penetrating manner and which is opened at a tip of the screw-fixing part, and guide walls protruded from the screw-fixing part so as to surround the guide slot. The guide walls are configured to move the corner cover toward a regular position on the corner part by being brought into contact with an outer peripheral edge of a head of the cover-fixing screw when the cover-fixing screw is tightened.

Brief Description of Drawings

[0009]

FIG. 1 is a perspective view of an air conditioner according to an embodiment.

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

FIG. 3 is a perspective view of the air conditioner showing the state where one corner cover is detached from the ceiling panel.

FIG. 4 is a perspective view of the ceiling panel showing a positional relationship between a frame body and inlet grille.

FIG. 5 is a plan view of the ceiling panel showing the state where a corner cover is detached from one corner part of the frame body.

FIG. 6 is a perspective view of the inlet grille.

FIG. 7 is a perspective view showing the enlarged part F7 of FIG. 6.

FIG. 8 is a perspective view showing a positional relationship between the frame body and hinge of the inlet grille.

FIG. 9 is a perspective view showing a positional relationship between a grille part of the inlet grille and operating part of a hook.

FIG. 10 is a plan view showing a positional relationship between the grille part of the inlet grille and operating part of the hook.

FIG. 11 is a plan view of the corner cover.

FIG. 12 is a perspective view of the corner cover viewed from the backside thereof.

FIG. 13 is a plan view showing a positional relationship between a screw-fixing part of the corner cover and cover-fixing screw.

FIG. 14 is a cross-sectional view showing a positional relationship between the head of the cover-fixing screw and guide wall.

FIG. 15 is a cross-sectional view showing the posi-

tional relationship between the head of the cover-fixing screw and guide wall at the time when the cover-fixing screw is tightened.

FIG. 16 is a perspective view showing a positional relationship between the screw-fixing part of the corner cover and cover-fixing screw screwed into the screw-receiving part.

FIG. 17 is a perspective view showing the state where the corner cover is fixed to the regular position on the corner part of the frame body.

Mode for Carrying Out the Invention

[0010] Hereinafter, an embodiment of the present invention will be described below with reference to the accompanying drawings.

[0011] FIG. 1 is a perspective view of a ceiling-embedded air conditioner, FIG. 2 is a perspective view showing the state where the indoor unit and ceiling panel are separated from each other, and FIG. 3 is a perspective view showing the state where one corner cover is detached from the frame body of the ceiling panel.

[0012] As shown in FIG. 1 through FIG. 3, an air conditioner 1 is provided with an indoor unit 2 installed in the ceiling space, and ceiling panel 3 attached to the lower end of the indoor unit 2 as essential elements. The indoor unit 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).

[0013] The casing 4 includes a side part 5 continuous in the circumferential direction. The side part 5 includes four outer circumferential corner parts 5a, and a hanging hook 6 is fixed to each outer circumferential corner part 5a. The hanging hooks 6 are horizontally protruded on all sides of the casing 4, and a lower end of the hanging bolt is coupled to the hanging hook 6.

[0014] Furthermore, four brackets 7 are fixed to the casing 4. The bracket 7 is positioned at a lower end part of each outer circumferential corner part 5a of the casing 4 in such a manner as to be positioned directly under the hanging hook 6. The brackets 7 are horizontally protruded on all sides of the casing 4.

[0015] A panel-fixing screw 8 is attached to the protruding end part of each bracket 7. The panel-fixing screw 8 is an element to be used when the ceiling panel 3 is to be fixed to the indoor unit 2, and is downwardly protruded from the bracket 7.

[0016] As shown in FIG. 2, an air blower 10 is 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 of the casing 4, and hence the lower end of the air blower 10 serves as the suction side.

[0017] A drain pan 11 is fitted to the lower end of the casing 4. The drain pan 11 is an element configured to receive drain water dropping from the heat exchanger arranged around the air blower 10, and is constituted of, for example, foamed polystyrene which is a kind of foamed plastics. The drain pan 11 includes a circular opening part 12. The opening part 12 is positioned at a central part of the drain pan 11. A bell-mouth 13 is fitted to the opening part 12 of the drain pan 11. The bell-mouth 13 defines a suction opening 14 continuous with the suction side of the air blower 10. The suction opening 14 is positioned at the central part of the lower end of the casing 4.

[0018] As shown in FIG. 2, the drain pan 11 includes a peripheral edge part surrounding the suction opening 14. Four cutout parts 15 through which air passed through the heat exchanger is guided are formed in the peripheral edge part of the drain pan 11. Each of the cutout parts 15 has a long and thin shape extending along the peripheral edge part of the drain pan 11. All the pairs of two of the cutout parts 15 adjacent to each other in the circumferential direction of the drain pan 11 are kept in a positional relationship in which the cutout parts 15 are perpendicular to each other.

[0019] The drain pan 11 is detachably supported on the lower end of the casing 4 through four pieces of drain-pan fixing metal fittings 17. Each of the pieces of the drain-pan fixing metal fittings 17 is screwed to the underside of the bracket 7. The drain-pan fixing metal fittings 17 horizontally extend from the lower end of the outer circumferential corner part 5a of the casing 4 toward each of the four corner parts of the drain pan 11, and the underside of the corner part of the drain pan 11 is placed on the drain-pan fixing metal fittings 17. Thereby, the drain pan 11 is held on the lower end of the casing 4 so that the drain pan 11 may not fall off the casing 4.

[0020] The ceiling panel 3 is an element configured to cover the indoor unit 2 from the inside of the room, and is arranged in an attitude along the ceiling not shown. As shown in FIG. 4, the ceiling panel 3 is provided with an inlet grille 20 and frame body 21. The inlet grille 20 is positioned at the central part of the ceiling panel 3.

[0021] As shown in FIG. 4 and FIG. 6, the inlet grille 20 is constituted of an outer frame part 22 and grille part 23. The outer frame part 22 is a square element including first to fourth side parts 24a, 24b, 24c, and 24d. Each of the first to fourth side parts 24a, 24b, 24c, and 24d is formed of a long and thin flat plate having a predetermined width, and lengths of the inner peripheral edge and outer peripheral edge of each of all the first to fourth side parts 24a, 24b, 24c, and 24d are equal to each other. Furthermore, the outer peripheral edges of the first to fourth side parts 24a, 24b, 24c, and 24d are perpendicular to each other, whereby the outer peripheral edges define outer circumferential corner parts 22a pointed at right angles at the four corners of the outer frame part 22.

[0022] As shown in FIG. 4 and FIG. 6, a first rib 25 and second rib 26 are formed on the back surface of the outer frame part 22. The first rib 25 is raised from the inner peripheral edges of the first to fourth side parts 24a, 24b,

24c, and 24d, and is formed into a square frame-like shape continuous in the circumferential direction of the outer frame part 22.

[0023] The second rib 26 is raised from the back surface of outer frame part 22 in such a manner as to surround the first rib 25. The second rib 26 is positioned on the inner side of the outer peripheral edge of the outer frame part 22, and is formed into a square frame-like shape continuous in the circumferential direction of the outer frame part 22. The second rib 26 includes four corner parts 26a pointed at right angles. The corner part 26a is positioned on the inner side of the outer frame part 22 at a position farther from the outer frame part 22 than the outer circumferential corner part 22a at a position corresponding to the outer circumferential corner part 22a of the outer frame part 22.

[0024] As shown in FIG. 6 and FIG. 7, a reinforcing rib 28 is formed at each of four positions of the back surface of the outer frame part 22. Each reinforcing rib 28 is raised from the back surface of the outer frame part 22 in such a manner as to connect the corner part 26a of the second rib 26 and outer circumferential corner part 22a of the outer frame part 22 to each other.

[0025] More specifically, the reinforcing rib 28 includes a first reinforcing wall 28a and second reinforcing wall 28b. The first reinforcing wall 28a extends from an apex of the corner part 26a of the second rib 26 toward an apex of the outer circumferential corner part 22a of the outer frame part 22 in the direction of the diagonal line of the outer frame part 22. The second reinforcing wall 28b is bifurcated from the tip of the first reinforcing wall 28a. The tips of the second reinforcing wall 28b reach the outer peripheral edges of the two adjacent side parts 24a, 24b, 24c, and 24d defining the outer circumferential corner parts 22a of the outer frame part 22.

[0026] Accordingly, by the existence of the reinforcing ribs 28, the four outer circumferential corner parts 22a of the outer frame part 22 are reinforced from the back surface side, and the flatness of the outer circumferential corner parts 22a and, by extension the flatness of the first to fourth side parts 24a, 24b, 24c, and 24d are sufficiently secured.

[0027] As a result, even when the wall thickness of the hemming part 29 defining the contour of the outer frame part 22 is made thin, it is possible to suppress a warp, distortion or the like of the first to fourth side parts 24a, 24b, 24c, and 24d and outer circumferential corner parts 22a.

[0028] As shown in FIG. 6, a pair of hinges 30 is formed integral with the third side part 24c of the outer frame part 22. One of the hinges 30 is positioned at the outer circumferential corner part 22a defined by the third side part 24c and fourth side part 24d. The other of the hinges 30 is positioned at the outer circumferential corner part 22a defined by the third side part 24c and second side part 24b. Accordingly, the hinges 30 are separate from each other in the longitudinal direction of the third side part 24c.

[0029] Each of the hinges 30 includes an arm part 31. The arm part 31 outwardly protrudes from the outer frame part 22 over the outer peripheral edge of the third side part 24c. At the tip of the arm part 31, an axis part 32 in the longitudinal direction of the third side part 24c is formed.

[0030] As shown in the best manner in FIG. 8, the second reinforcing wall 28b of the reinforcing rib 28 doubles as part of the arm part 31. That is, the reinforcing rib 28 is continuous with the arm part 31 of the hinge 30, whereby the arm part 31 and reinforcing rib 28 constitute an integral structure and the strength of the arm part 31 is sufficiently secured.

[0031] As shown in FIG. 4 and FIG. 6, the grille part 23 of the inlet grille 20 is surrounded by the first rib 25 of the outer frame part 22. The grille part 23 includes a plurality of horizontal frames 34. The horizontal frames 34 are arranged in parallel with each other with intervals held between them in such a manner as to connect the second side part 24b and fourth side part 24d of the outer frame part 22 to each other. Furthermore, a square filter 35 is arranged behind the grille part 23. The filter 35 is detachably supported on the first reinforcing rib 25.

[0032] As shown in FIG. 1 through FIG. 4, the frame body 21 of the ceiling panel 3 surrounds the outer frame part 22 of the inlet grille 20. The frame body 21 is provided with first to fourth panel segmental parts 38a, 38b, 38c, and 38d, and first to fourth corner parts 39a, 39b, 39c, and 39d.

[0033] The first to fourth panel segmental parts 38a, 38b, 38c, and 38d linearly extend along the first to fourth side parts 24a, 24b, 24c, and 24d of the outer frame part 22 of the inlet grille 20, and lengths of the inner peripheral edges and outer peripheral edges of all the first to fourth panel segmental parts 38a, 38b, 38c, and 38d are equal to each other. All the pairs of two of the first to fourth panel segmental parts 38a, 38b, 38c, and 38d adjacent to each other are kept in a positional relationship in which they are perpendicular to each other.

[0034] The first to fourth corner parts 39a, 39b, 39c, and 39d are positioned at the four corners of the ceiling panel 3, and respectively connect all the pairs of two of the first to fourth panel segmental parts 38a, 38b, 38c, and 38d adjacent to each other in the circumferential direction of the frame body 21 integrally to each other.

[0035] More specifically, the first corner part 39a connects the first panel segmental part 38a and fourth panel segmental part 38d to each other. The second corner part 39b connects the first panel segmental part 38a and second panel segmental part 38b to each other. The third corner part 39c connects the second panel segmental part 38b and third panel segmental part 38c to each other. The fourth corner part 39d connects the third panel segmental part 38c and fourth panel segmental part 38d to each other.

[0036] Accordingly, the first to fourth panel segmental parts 38a, 38b, 38c, and 38d are formed into a square framework respective through the first to fourth corner parts 39a, 39b, 39c, and 39d. The square area surround-

ed by the inner peripheral edges of the first to fourth panel segmental parts 38a, 38b, 38c, and 38d defines a work opening 40.

[0037] As shown in FIG. 4, a pair of locking holes 41 is formed in each of the inner peripheral edges of the first to fourth panel segmental parts 38a, 38b, 38c, and 38d, the inner peripheral edges facing the work opening 40. The locking holes 41 are separate from each other respectively in the longitudinal directions of the first to fourth panel segmental parts 38a, 38b, 38c, and 38d in such a manner as to be respectively adjacent to the first to fourth corner parts 39a, 39b, 39c, and 39d of the frame body 21.

[0038] Furthermore, a pair of temporary latches 42 (only one of them is shown) is attached to the inner peripheral edges of the first panel segmental part 38a and third panel segmental part 38c, the inner peripheral edges facing the work opening 40. Each of the temporary latches 42 is an element to be used when the ceiling panel 3 is to be temporarily fixed to the indoor unit 2, and is protruded from an intermediate part of each of the first panel segmental part 38a and third panel segmental part 38c in the longitudinal direction thereof toward a part above the frame body 21.

[0039] An upper end of the temporary latch 42 is detachably hooked to a lower end of the bell-mouth 13 facing the suction opening 14. Thereby, the air conditioner 1 is configured in such a manner that the ceiling panel 3 is temporarily fixed to the indoor unit 2 in the state where the ceiling panel 3 is suspended from the bell-mouth 13.

[0040] As shown in FIG. 4, the hinges 30 of the outer frame part 22 are selectively hooked to one of the first to fourth panel segmental parts 38a, 38b, 38c, and 38d, whereby the inlet grille 20 of this embodiment is rotatably supported on the frame body 21.

[0041] More specifically, in each of the first to fourth corner parts 39a, 39b, 39c, and 39d of the frame body 21, a depressed part 43 and clearance groove 44 are formed. As FIG. 8 shows the third corner part 39c as a representative, the depressed part 43 is an element in which the arm part 31 of the hinge 30 and second reinforcing wall 28b of the reinforcing rib 28 come, and has a downwardly opened square shape.

[0042] The clearance groove 44 is an element in which the first reinforcing wall 28a of the reinforcing rib 28 comes, and extends in the direction of the diagonal line of the frame body 21 in such a manner as to connect the depressed part 43 and work opening 40. The clearance groove 44 is downwardly opened toward a part below the frame body 21 in such a manner as to be continuous with the depressed part 43.

[0043] In this embodiment, each of the arm parts 31 of the hinges 30 is inserted in each of the depressed parts 43 positioned on both sides of the third panel segmental part 38c, and the axis part 32 at the tip of each of the arm parts 31 is rotatably hooked to the end of the depressed part 43.

[0044] Accordingly, the inlet grille 20 is supported on the frame body 21 in such a manner as to be rotatable around the axis parts 32 of the hinges 30 between a first position at which the work opening 40 is closed by the inlet grille 20 and second position at which the work opening 40 is opened.

[0045] FIG. 1 and FIG. 3 show the state where the inlet grille 20 is rotated to the first position. At the first position, the outer circumferential part of the outer frame part 22 of the inlet grille 20 continuously covers the inner circumferential part of the frame body 21 in the circumferential direction, and the second rib 26 is fitted into the inside of the work opening 40 defined by the first to fourth panel segmental parts 38a, 38b, 38c, and 38d.

[0046] When the inlet grille 20 is rotated to the first position, the arm parts 31 of the hinges 30 and second reinforcing walls 28b of the reinforcing ribs 28 come into the depressed parts 43 of the third corner part 39c and fourth corner part 39d. Furthermore, the first reinforcing walls 28a of the reinforcing ribs 28 come into the clearance grooves 44 of the third corner part 39c and fourth corner part 39d.

[0047] Accordingly, despite the fact that the reinforcing rib 28 reinforcing the outer circumferential corner part 22a of the outer frame part 22 is continuous with the arm part 31 of the hinge 30, it is possible to prevent the reinforcing rib 28 and arm part 31 from interfering with the frame body 21 of the inlet grille 20.

[0048] Furthermore, in the state where the inlet grille 20 is rotated to the first position, the four outer circumferential corner parts 22a of the outer frame part 22 cover the inner circumferential parts of the first to fourth corner parts 39a, 39b, 39c, and 39d of the frame body 21 to thereby conceal the depressed parts 43 and clearance grooves 44. Accordingly, the apexes of the four outer circumferential corner parts 22a largely extend from the inner circumferential parts of the first to fourth corner parts 39a, 39b, 39c, and 39d toward the outer circumferential parts.

[0049] FIG. 4 shows the state where the inlet grille 20 is rotated to the second position. At the second position, the inlet grille 20 is downwardly rotated with respect to the frame body 21, and is held in the attitude of being suspended from the third panel segmental part 38c. Thereby, it is possible to carry out the daily maintenance work such as detaching the filter 35 from the first rib 25 of the inlet grille to clean the filter 35, replacing the filter 35 with new one, and the like.

[0050] As shown in FIG. 4, a pair of hooks 46 configured to retain the inlet grille 20 at the first position is attached to the first side part 24a of the outer frame part 22. The hooks 46 are separate from each other in the longitudinal direction of the first side part 24a in such a manner as to be respectively adjacent to the corner parts 26a of the second rib 26. Each of the hooks 46 is supported on the outer frame part 22 in such a manner as to be slidable between an engagement-released position at which the hook 46 stays in the part between the first rib 25 and second rib 26, and engagement position at which the hook 46 protrudes from the second rib 26 to-

ward a part around the outer frame part 22.

[0051] When the hooks 46 are slid to the engagement positions in the state where the inlet grille 20 is rotated to the first position, the tips of the hooks 46 penetrate the second rib 26 and are fitted into the locking holes 41 of the first panel segmental part 38a. Thereby, the inlet grille 20 is retained at the first position at which the work opening 40 is blocked by the inlet grille 20.

[0052] When each of the hooks 46 is slid from the engagement position to the engagement-released position, the tip of each of the hooks 46 comes off the locking hole 41 of the first panel segmental part 38a. Thereby, it is possible to rotate the inlet grille 20 from the first position to the second position.

[0053] Each hook 46 includes a plate-like operating part 47. The operating part 47 is an element configured to slide the hook 46, and has a size of such a degree that the worker can hook a fingertip of his or her hand thereto. As shown in FIG. 1, FIG. 9, and FIG. 10, the operating part 47 is arranged in parallel with the horizontal frame 34 of the grille part 23 at both ends of the first side part 24a in the longitudinal direction thereof.

[0054] According to this embodiment, the operating part 47 is exposed to the outside of the grille part 23 from a gap g between the inner peripheral edge of the first side part 24a and one horizontal frame 34 adjacent to the inner peripheral edge. Furthermore, when the hook 46 is slid to the engagement position, the operating part 47 comes into a depressed part 48 formed in the inner peripheral edge of the first side part 24a.

[0055] Accordingly, in the state where the inlet grille 20 is retained at the first position, the operating part 47 of the hook 46 stays in the depressed part 48 on the outer side of the grille part 23 at each of both ends of the first side part 24a in the longitudinal direction thereof. Accordingly, a configuration in which the operating part 47 is embedded in the first side part 24a is created, whereby the operating part 47 becomes hardly conspicuous.

[0056] As shown in FIG. 1, the ceiling panel 3 includes four air outlets 50 from which air passing through the heat exchanger is discharged into the room. The air outlets 50 are formed in the first to fourth panel segmental parts 38a, 38b, 38c, and 38d of the frame body 21 in opposition to the four cutout parts 15 belonging to the drain pan 11.

[0057] Four louvers 51 are supported on the frame body 21 of the ceiling panel 3. The louver 51 is an element configured to change the direction in which the air is discharged from the air outlet 50 into the room, and is formed into a flat, long and thin plate-like shape. The louver 51 is rotatable between a closing position at which the lover 51 closes the air outlet 50 and opening position at which the louver 51 inclines to open the air outlet. In the state where the louvers 51 are rotated to the closing position, the louvers 51 are configured to become horizontal to thereby entirely cover the first to fourth panel segmental parts 38a, 38b, 38c, and 38d.

[0058] As shown in FIG. 2, the ceiling panel 3 is detachably coupled to the lower end of the indoor unit 2 at parts of the first to fourth corner parts 39a, 39b, 39c, and 39d of the frame body 21. The parts of the first to fourth cover parts 39a, 39b, 39c, and 39d of the frame body 21 at which the indoor unit 2 and frame body 21 are coupled to each other respectively have configurations similar to each other, and hence in this embodiment, the third corner part 39c will be described as an representative.

[0059] As show in FIG. 3, FIG. 5, and FIG. 8, the third corner part 39c of the frame body 21 includes an accommodation part 52 positioned directly beneath the one outer circumferential corner part 5a of the indoor unit 2. The accommodation part 52 is defined as a depression downwardly opened from the third corner part 39c. The panel-fixing screw 8 downwardly protruded from the bracket 7 of the casing 4 is made to penetrate the top-plate part 53 of the accommodation part 52 and protrude into the accommodation part 52.

[0060] A fixing bracket 55 is rotatably supported on the top-plate part 53 of the accommodation part 52. The fixing bracket 55 includes a slit-like cut 56. The fixing bracket 55 is rotatable between an engagement position at which the cut 56 gets caught on the lower end of the panel-fixing screw 8 and engagement-released position at which the cut 56 separates from the lower end of the panel-fixing screw 8. By rotating the fixing bracket 55 to the engagement position, the fixing bracket 55 is held between a head of the panel-fixing screw 8 positioned at the lower end thereof and top-plate part 53 of the accommodation part 52. Thereby, the ceiling panel 3 is fixed to the lower end of the indoor unit 2 so as to cover the lower end of the indoor unit 2 from below.

[0061] Furthermore, the third corner part 39c of the frame body 21 includes a plurality of engaging holes 57 and screw-receiving part 58. The engaging holes 57 are arranged at positions on the outer circumferential part of the third corner part 39c defining the contour of the frame body 21. The engaging holes 57 are separate from each other in the circumferential direction of the frame body 21 so as to be positioned around the accommodation part 52.

[0062] As shown in FIG. 8, the screw-receiving part 58 is downwardly protruded from the top-plate part 53 of the accommodation part 52 at a position adjacent to the depressed part 43 belonging to the third corner part 39c. A cover-fixing screw 60 is attached to the protruding end of the screw-receiving part 58. The cover-fixing screw 60 includes a stem 60a screwed into the screw-receiving part 58 and head 60b coaxially provided at an end of the stem 60a. The head 60b includes a circular outer peripheral edge having an outer diameter greater than the stem 60a.

[0063] The cover-fixing screw 60 is positioned on the diagonal line connecting between the first corner part 39a of the frame body 21 and third corner part 39c thereof. Furthermore, the screw-receiving part 58 and head 60b of the cover-fixing screw 60 are provided at a position covered with one apex 22a of the inlet grille 20 retained at the first position.

[0064] The engaging holes 57, screw-receiving part 58, and cover-fixing screw 60 are provided not only in the third corner part 39c but also in the first corner part 39a, second corner part 39b, and fourth corner part 39d in the same manner.

[0065] As shown in FIG. 1 through FIG. 3, each of the first to fourth corner parts 39a, 39b, 39c, and 39d of the frame body 21 is covered with a detachable corner cover 62. The corner cover 62 is a flat plate-like element having such a size as to wholly cover each of the first to fourth corner parts 39a, 39b, 39c, and 39d from below. The outer circumferential part of the corner cover 62 has a shape pointed at right angles including two sides perpendicular to each other. At the inner circumferential part of the corner cover 62, a cut part 63 inwardly cut out at right angles so as to avoid the outer circumferential corner part 22a of the inlet grille 20 is formed.

[0066] The structures configured to attach the corner cover 62 to the frame body 21 is common to all the corner covers 62, and hence the structure associated with the third corner part 39c of the frame body 21 will be described as a representative. As shown in FIG. 11 through FIG. 13, the corner cover 62 includes a plurality of engaging claws 64 and screw-fixing part 65. The engaging claws 64 are protruded from the back surface of the outer circumferential part of the corner cover 62 so as to correspond, in terms of positions, to the engaging holes 57 of the third corner part 39c. At the tip of each of the engaging claws 64, a hook 64a bent at right angles toward the cut part 63 of the corner cover 62 is formed.

[0067] The screw-fixing part 65 is protruded from the center of the cut part 63 toward the screw-receiving part 58. The screw-fixing part 65 includes a guide slot 66 through which the stem 60a of the cover-fixing screw 60 slidably passes. The guide slot 66 extends in the direction along the diagonal line connecting between the first corner part 39a of the frame body 21 and third corner part 39c thereof, and is opened at the tip of the screw-fixing part 65.

[0068] As shown in FIG. 11 through FIG. 15, guide walls 70 are formed at the protruded end of the screw-fixing part 65. The guide walls 70 are raised from the outer circumferential part of the screw-fixing part 65 so as to surround the guide slot 66, and are curved in such a manner that the closer to the opening end of the guide slot 66, the closer the guide walls 70 become to each other. Furthermore, the inner faces of the guide walls 70 constitute guide faces 71 inclined in such a manner that the outer peripheral edge of the head 60b of the cover-fixing screw 60 becomes closer to the opening edges of the guide slot 66.

[0069] As shown in the best manner in FIG. 14, in the state where the cover-fixing screw 60 is loosened, the guide faces 71 lie between the head 60b of the cover-fixing screw 60 and screw-fixing part 65, and is inclined so as to be on the inner side of outer peripheral edge of the head 60b in the radial direction of the head 60b. Furthermore, the edges of the guide faces 71 reach the screw-fixing part 65.

[0070] Besides, the guide walls 70 include an opening part 72 cut out so as to enable the stem 60a of the cover-fixing screw 60 to pass through it. The opening part 72 leads to the tips of the guide slot 66.

[0071] In this embodiment, in order to attach the corner covers 62 to the first to fourth corner parts 39a, 39b, 39c, and 39d of the frame body 21, first, the cover-fixing screws 60 are loosened, and heads 60b of the cover-fixing screws 60 are kept away from the screw-receiving parts 58.

[0072] Thereafter, each of the corner covers 62 is slid in the direction of the diagonal line of the frame body 21 so that the engaging claws 64 of the corner covers 62 may be inserted into the engaging holes 57 of the first to fourth corner parts 39a, 39b, 39c, and 39d, and the guide slots 66 of the screw-fixing parts 65 may get closer to the stems 60a of the cover-fixing screws 60.

[0073] By the sliding described above, the hook 64a at the tip of each of the engaging claws 64 is hooked to the opening edge of the engaging hole 57, and stem 60a of the cover-fixing screw 60 is slidably fitted into the guide slot 66 of the screw-fixing part 65. The stem 60a is fitted into the guide slot 66, whereby the guide walls 70 are positioned around the outer peripheral edge of the head 60b of the cover-fixing screw 60 as shown in FIG. 14 and FIG. 16.

[0074] In this state, when the cover-fixing screw 60 is tightened, the outer peripheral edge of the head 60b slidably comes into contact with the guide faces 71 of the guide walls 70. By this contact, such force as to draw the corner cover 62 toward the screw-receiving part 58 on the basis of the inclination of the guide faces 71 is applied to the corner cover 62, and the corner cover 62 is moved along the diagonal line of the frame body 21 toward the center of the frame body 21 with the guide slot 66 used as a guide. That is, when the aforementioned force is applied to the corner cover 62, the guide slot 66 guides the corner cover 62 in the moving direction.

[0075] As shown in FIG. 15, when the outer peripheral edge of the head 60b reaches the boundary between the guide faces 71 and screw-fixing part 65 concomitantly with the tightening of the cover-fixing screw 60, the head 60b strikes against the screw-fixing part 65, the screw-fixing part 65 is put between the head 60b and screw-receiving part 58. As a result, the corner covers 62 are fixed to the regular positions of the first to fourth corner parts 39a, 39b, 39c, and 39d of the frame body 21 as shown in FIG. 17.

[0076] At the regular position, each of the corner covers 62 is positioned flush with the outer frame part 22 of the inlet grille 20 and louver 51 rotated to the closing position. Furthermore, gaps occurring at the juncture of the cut part 63 of the corner cover 62 and outer circumferential corner part 22a of the outer frame part 22, and juncture of the corner cover 62 and louver 51 become approximately equal to each other at all the corner parts 39a, 39b, 39c, and 39d of the frame body 21.

[0077] At the same time, the outer circumferential part of the corner cover 62 is continuous with the outer peripheral edge of the louver 51 rotated to the closing position in a straight line, and a feeling of unity between the corner cover 62 and louver 51 is obtained.

[0078] On the other hand, by only the work of simply loosening the cover-fixing screw 60, squeezing of the screw-fixing part 65 by the cover-fixing screw 60 can be released. Accordingly, it is possible to draw the corner cover 62 out of each of the first to fourth corner parts 39a, 39b, 39c, and 39d of the frame body 21 in the direction in which the guide slot 66 of the corner cover 62 separates from the stem 60a of the cover-fixing screw 60.

[0079] Accordingly, it is possible to detach the corner cover 62 from the frame body 21 without detaching the cover-fixing screw 60 from the screw-receiving part 58, and prevent the cover-fixing screw 60 from being lost.

[0080] According to this embodiment, in fixing the corner covers 62 to the first to fourth corner parts 39a, 39b, 39c, and 39d of the frame body 21, when the cover-fixing screw 60 is tightened, the outer peripheral edge of the head 60b of the cover-fixing screw 60 is brought into contact with the guide faces 71 of the guide walls 70. Thereby, the force of drawing the corner cover 62 toward the screw-receiving part 58 is applied to the corner cover 62. As a result, the corner cover 62 is moved along the diagonal line of the frame body 21, and is fixed to the regular position.

[0081] Accordingly, position adjustment of the corner covers 62 is carried out with respect to all the first to fourth corner parts 39a, 39b, 39c, and 39d with a high degree of accuracy, and thus the appearance of the ceiling panel 3 becomes fine.

[0082] Particularly, in this embodiment, the flatness of the louver 51 is secured by the reinforcing rib 28, and hence in the state where the louver 51 is rotated to the first position, it is possible to prevent large steps from occurring at the junctures of the both ends of the lover 51 and corner covers 62. At the same time, the gaps occurring at the junctures of the both ends of the lover 51 and corner covers 62 become hardly conspicuous, this being favorable to maintaining the appearance of the ceiling panel 3 and, by extension the air conditioner 1 in good condition.

[0083] Furthermore, the corner cover 62 is fixed to the regular position by the simple work of only tightening the cover-fixing screw 60, and hence the troublesome and time-consuming work of tightening the cover-fixing screw while paying the closest attention to the corner cover 62 in order that the attitude thereof may not be changed is made unnecessary. Therefore, it is possible to easily fix the corner cover 62 to the frame body 21, whereby the workability is improved.

[0084] 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.

Reference Signs List

[0085] 1 ··· air conditioner, 2 ··· indoor unit, 3 ··· ceiling panel, 21 ··· frame body, 39a, 39b, 39c, 39d ··· first to fourth corner parts, 57 ··· engaging hole, 58 ··· screw-receiving part, 60 ··· cover-fixing screw, 60b ··· head, 62 ··· corner cover, 64 ··· engaging claw, 65 ··· screw-fixing part, and 70 ··· guide wall.

Claims

1. A ceiling panel comprising:

a frame body including a plurality of corner parts; and

a plurality of corner covers configured to detachably cover the corner parts of the frame body, wherein

each of the corner parts includes an outer circumferential part defining a contour of the frame body and including a plurality of engaging holes, a screw-receiving part positioned on the inner side of the outer circumferential part, and a cover-fixing screw screwed into the screw-receiving part,

each of the corner covers includes a plurality of engaging claws detachably hooked to the engaging holes, and a screw-fixing part protruded toward the screw-receiving part, and

the screw-fixing part includes a guide slot through which a stem of the cover-fixing screw passes in a penetrating manner and which is opened at a tip of the screw-fixing part, and guide walls protruded from the screw-fixing part so as to surround the guide slot, and configured to move the corner cover toward a regular position on the corner part by being brought into contact with an outer peripheral edge of a head of the cover-fixing screw when the cover-fixing screw is tightened.

2. The ceiling panel of Claim 1, wherein

the guide walls include guide faces inclined with respect to the outer peripheral edge of the head and, the outer peripheral edge of the head is brought into contact with the guide faces, whereby such force as to draw the corner cover toward the screw-receiving part is applied to the corner cover.

3. The ceiling panel of Claim 2, wherein

when the force is applied to the corner cover, the guide slot guides the corner cover in the moving direction.

4. The ceiling panel of any one of Claims 1 to 3, wherein the guide walls include an opening part cut out in such a manner as to enable the stem of the cover-fixing screw to pass therethrough.

5. The ceiling panel of Claim 1, wherein the cover-fixing screw is maintained in a state where the stem thereof is screwed into the screw-receiving part both when the corner cover is to be fixed to the corner part and when the corner cover is to be detached from the corner part.

6. The ceiling panel of Claim 1, wherein the frame body includes panel segmental parts each of which is configured to connect between the corner parts adjacent to each other in the circumferential direction, air outlets opened at the panel segmental parts, and louvers supported on the frame body and configured to change the direction in which air is discharged from the air outlets, and in a state where the louvers close the air outlets, junctures are formed at boundaries between the corner covers and the louvers.

7. The ceiling panel of Claim 6, wherein in the state where the louver closes the air outlet, the corner cover and the louver are positioned flush with each other.

8. The ceiling panel of Claim 1, further comprising an inlet grille surrounded by the frame body, wherein the inlet grille includes a plurality of outer circumferential corner parts at positions corresponding to the corner covers, and the screw-fixing part and the head of the cover-fixing screw are concealed by an apex of each of the outer circumferential corner parts.

9. An air conditioner comprising:

an indoor unit to be installed in the ceiling space; and
a ceiling panel of any one of Claims 1 to 6 configured to cover a lower end of the indoor unit.

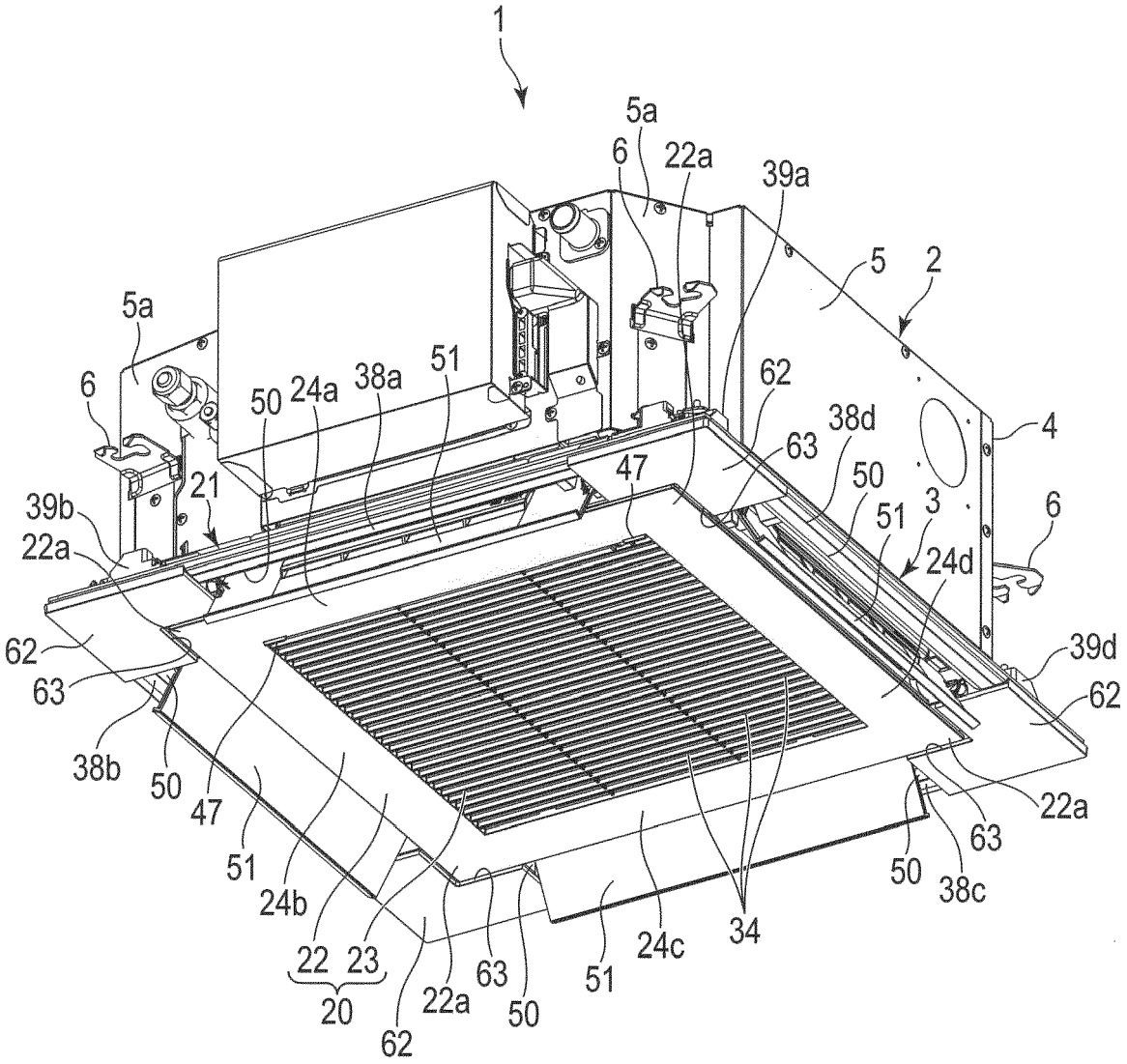

1
5a
6
22a
39a
5
2
5a
6
50
24a
38a
51
62
38d
4
63
47
50
3
6
39b
21
51
22a
24d
62
39d
63
62
38b
50
47
51
24b
22
23
20
62
22a
63
50
51
24c
34
50
38c
63
22a

FIG. 1

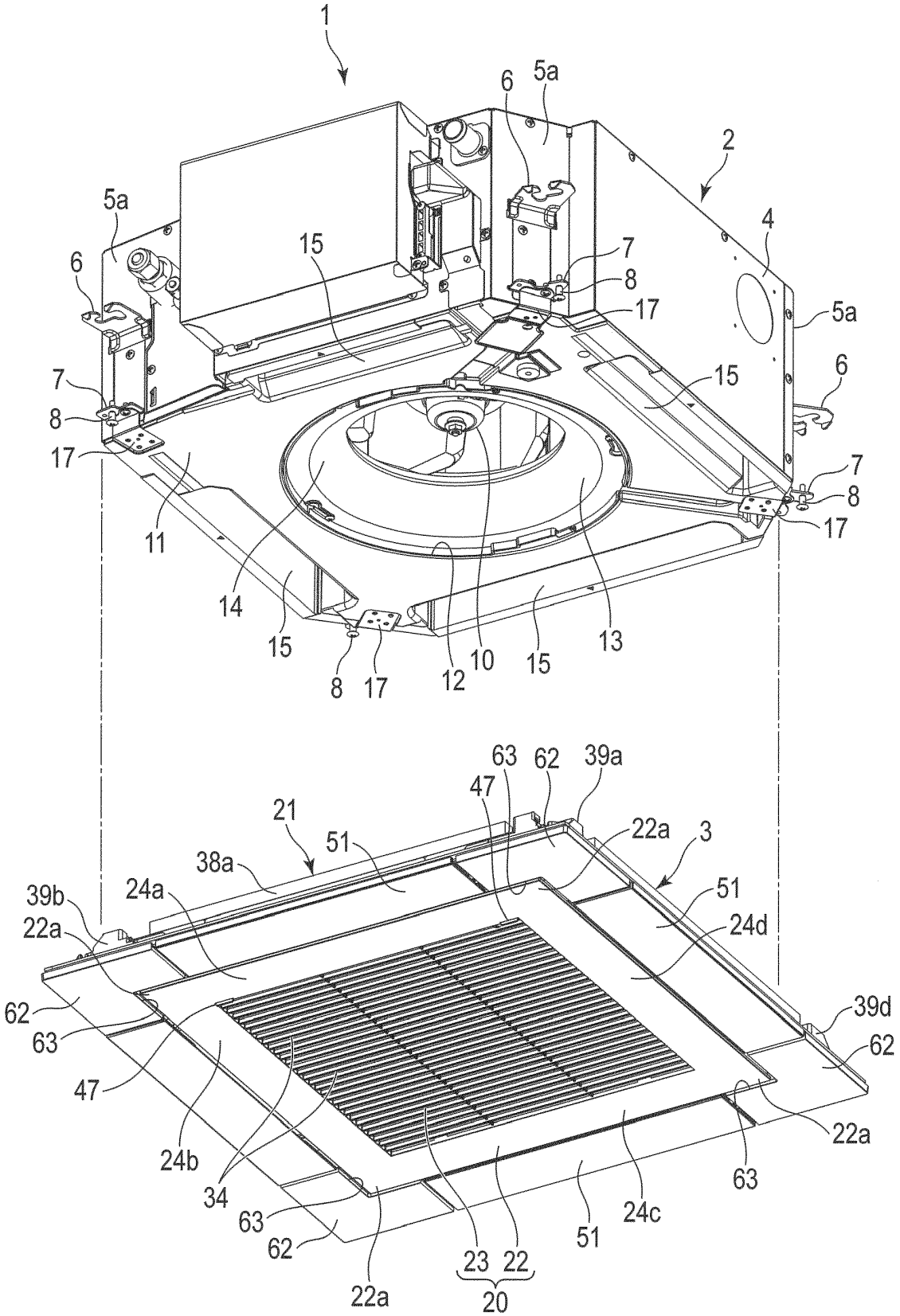

1
2
3
4
5a
6
7
8
11
12
13
14
15
17
10
20
21
22
22a
23
24a
24b
24c
24d
34
38a
39a
39b
39d
47
51
62
63

FIG. 2

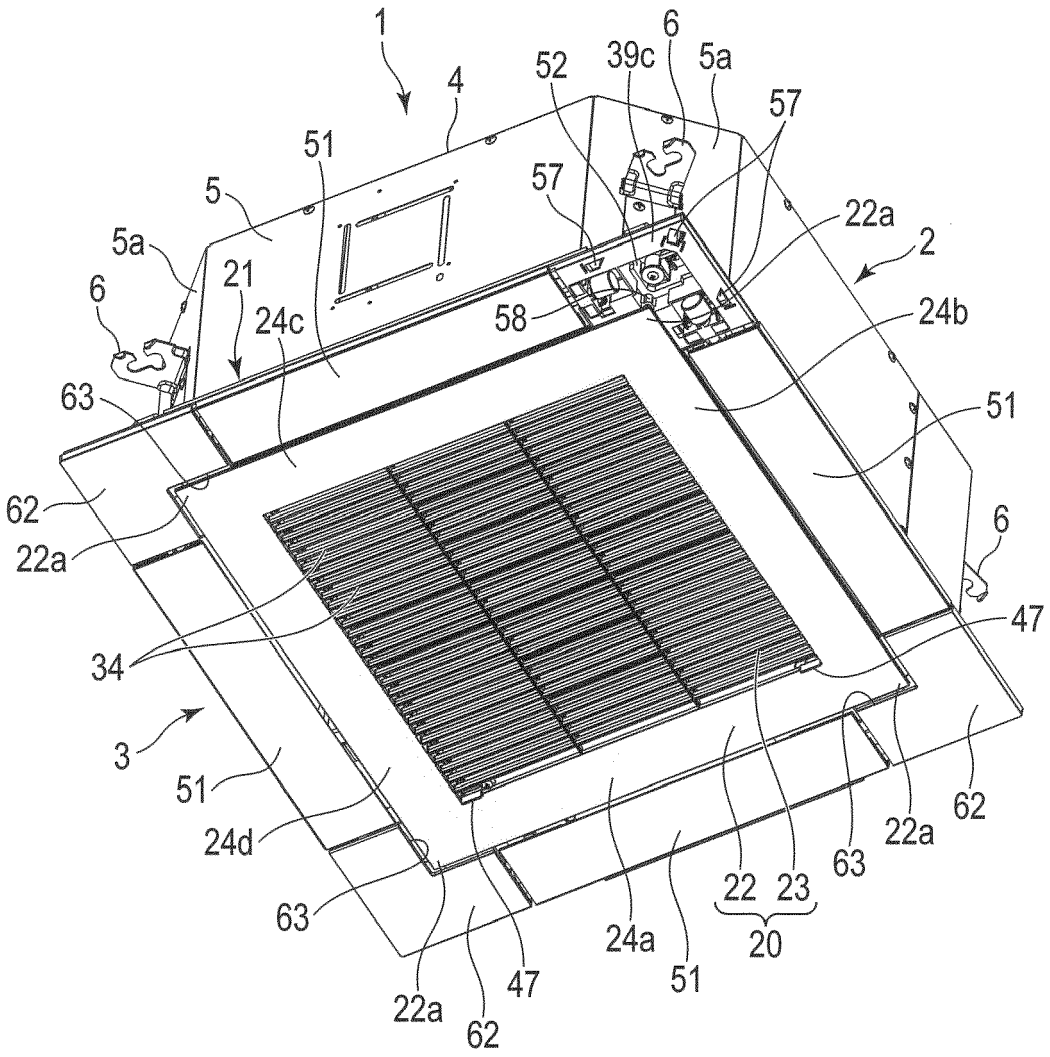

1
4
52
39c
6
5a
57
51
5
57
22a
2
5a
21
24c
58
24b
6
63
51
62
22a
6
47
34
3
51
24d
63
22a
62
22
23
63
22a
62
24a
20
51
47
22a
62

FIG. 3

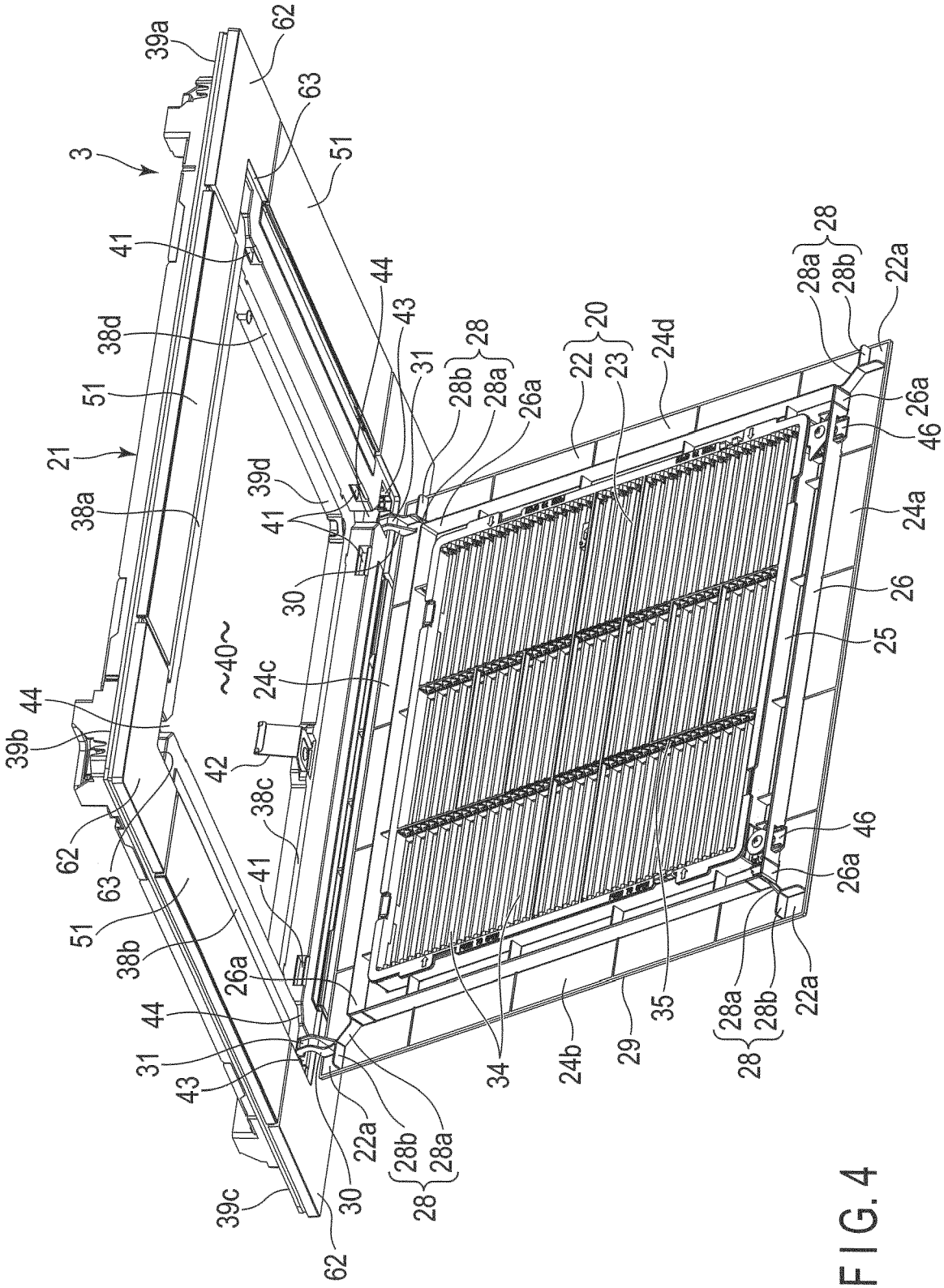

3
21
39a
62
63
51
41
38d
51
38a
39d
41
30
~40~
24c
42
38c
41
26a
44
31
43
22a
28b
28a
28
39c
62
39b
44
62
63
51
38b
22
23
20
24d
28a
28b
28
22a
26a
46
24a
26
25
46
26a
22a
28a
28b
28
24b
29
35
34

FIG. 4

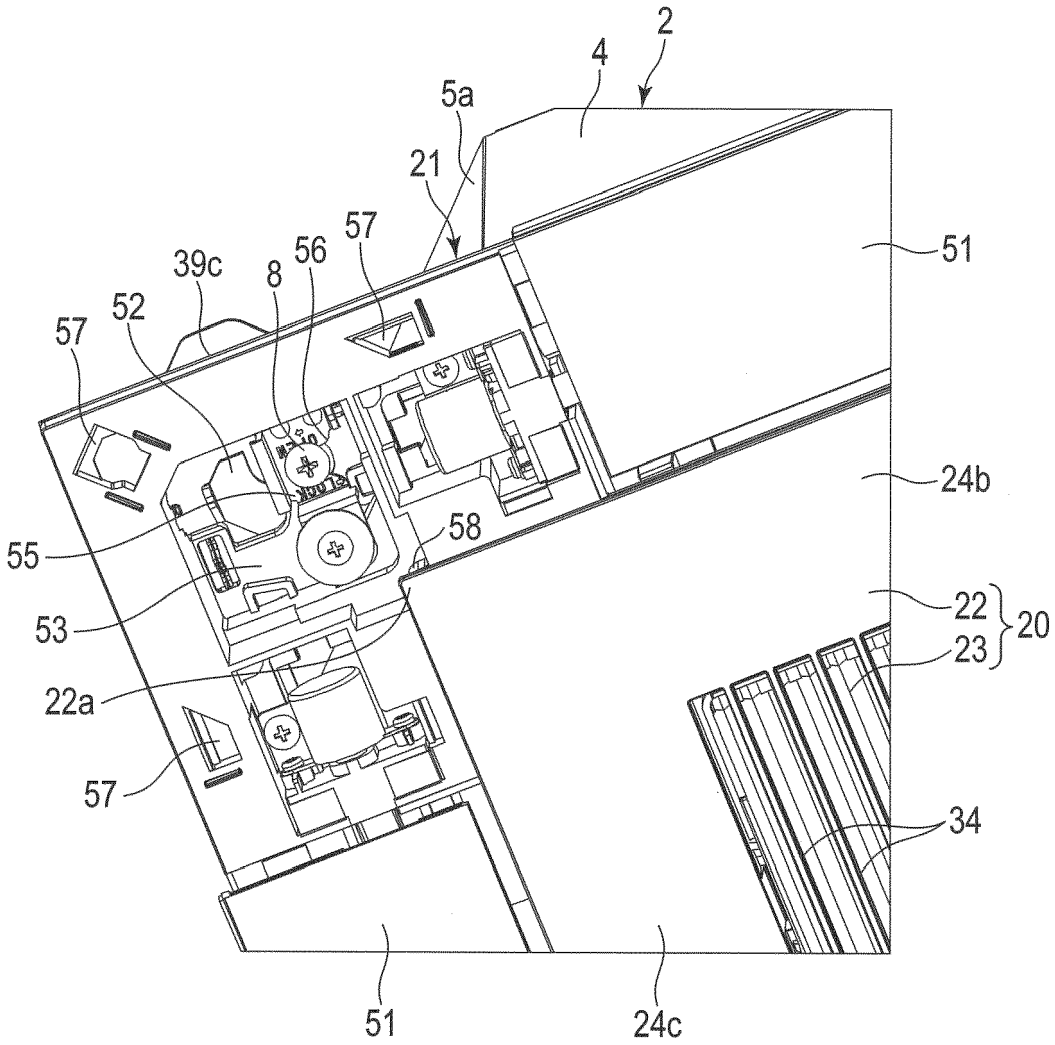


FIG. 5

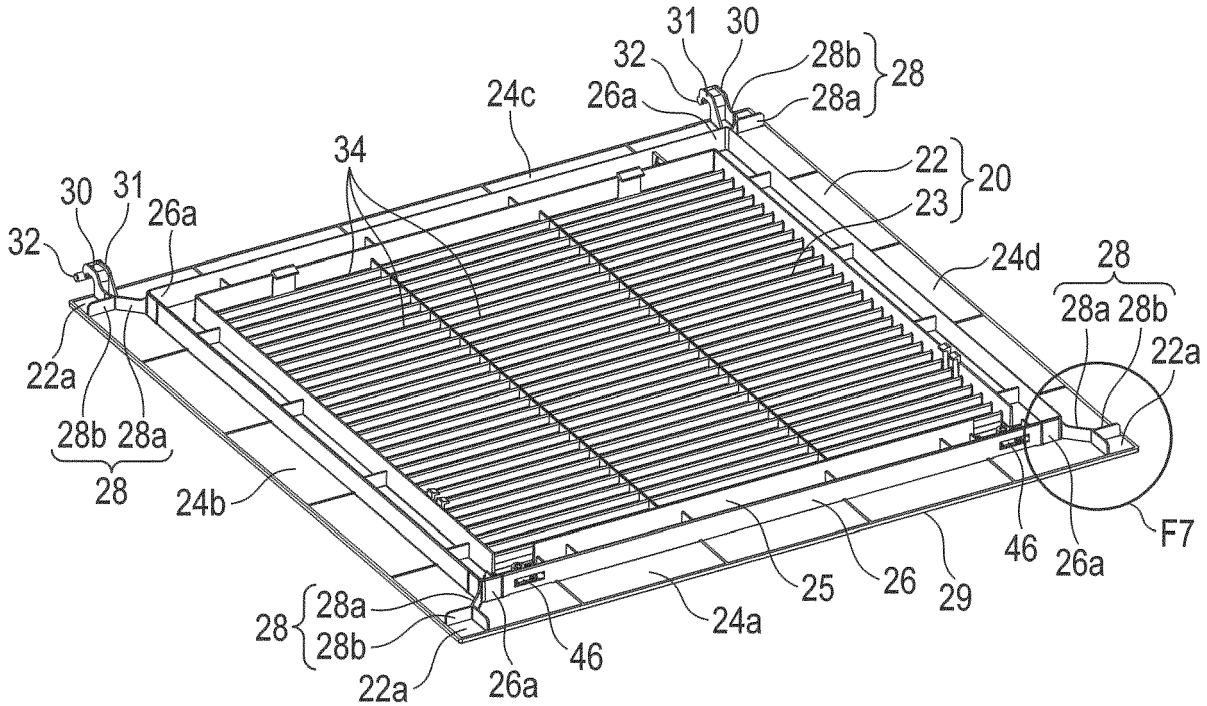

31
30
32
28b
28
26a
28a
24c
34
22
20
23
30
31
26a
32
24d
28
28a 28b
22a
22a
28b 28a
28
24b
F7
46
26a
25
26
29
28
28a
28b
24a
22a
26a
46

FIG. 6

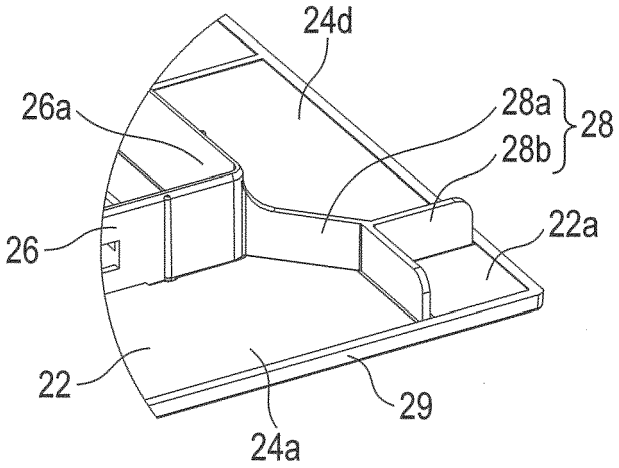

24d
26a
28a
28
28b
22a
26
22
29
24a

FIG. 7

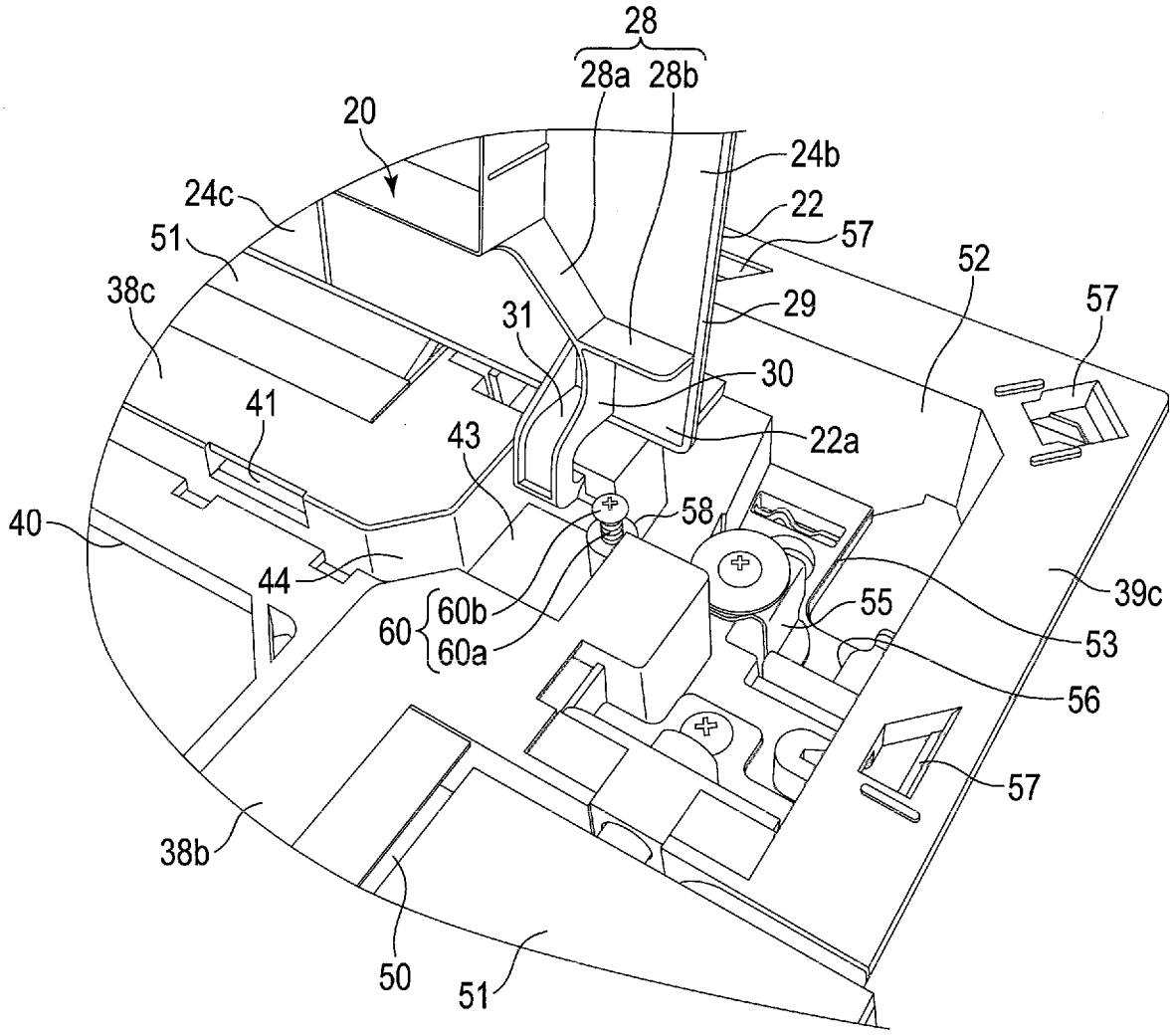

28
28a
28b
20
24b
24c
22
57
51
52
38c
31
29
57
30
41
43
22a
40
58
44
39c
60
60b
60a
55
53
56
57
38b
50
51

FIG. 8

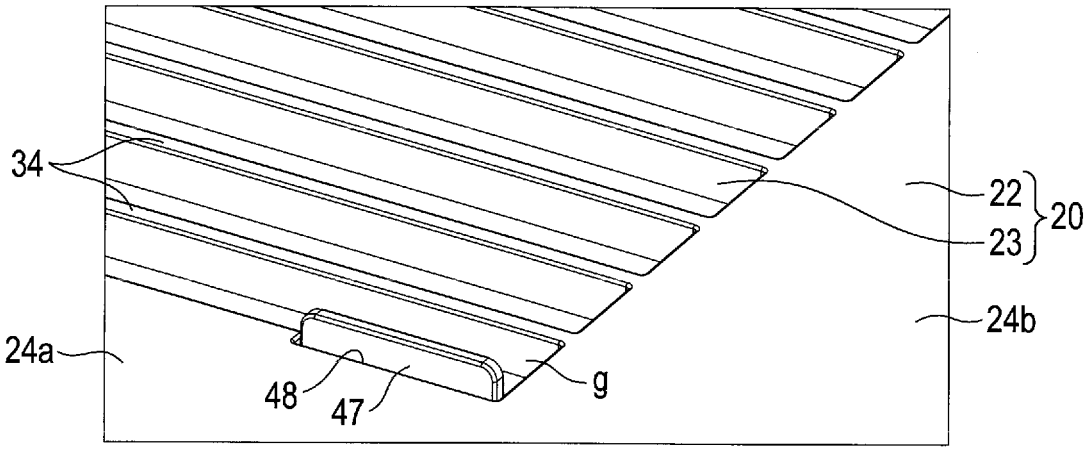


FIG. 9

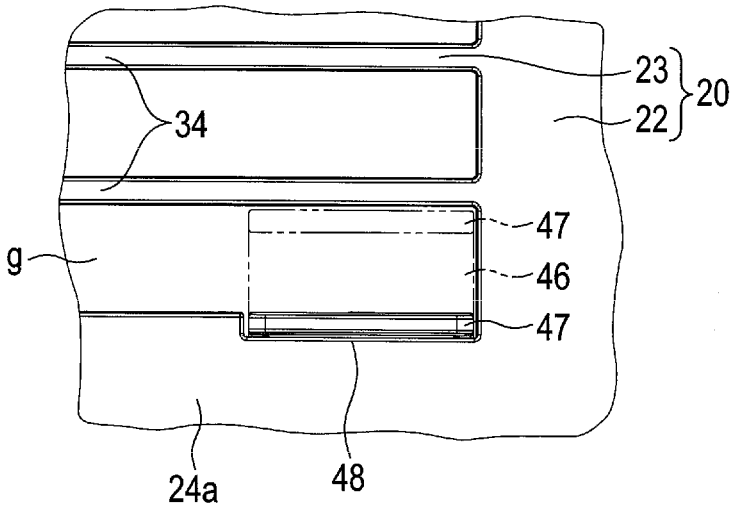


FIG. 10

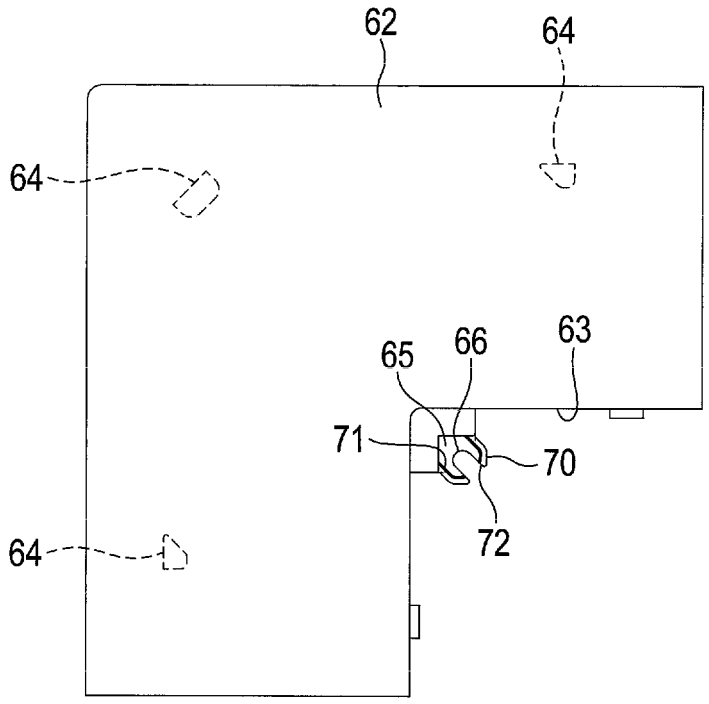


FIG. 11

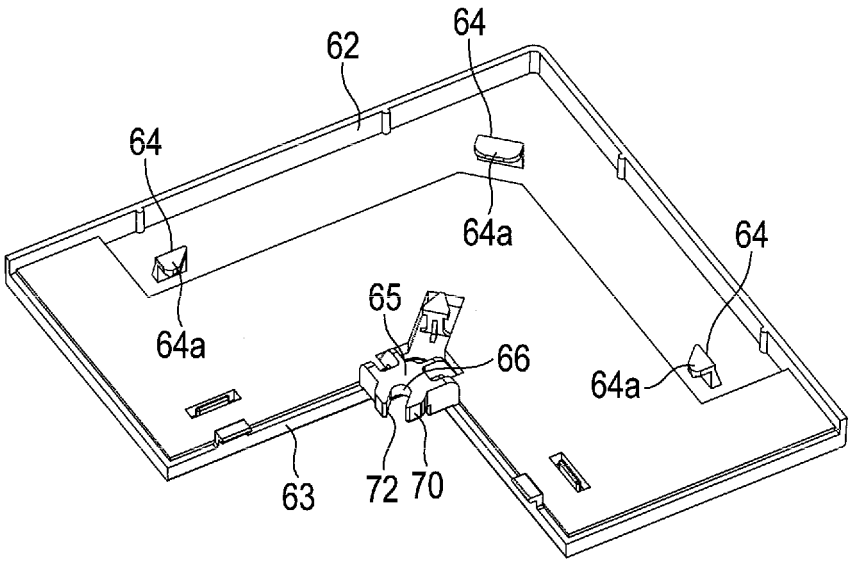


FIG. 12

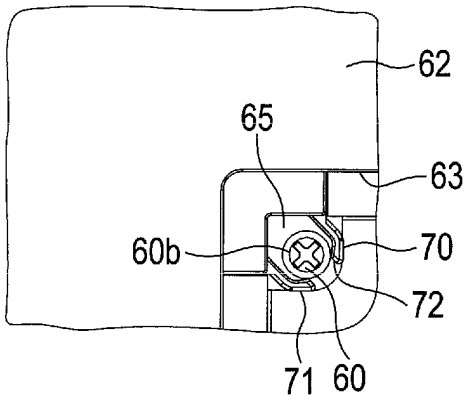


FIG. 13

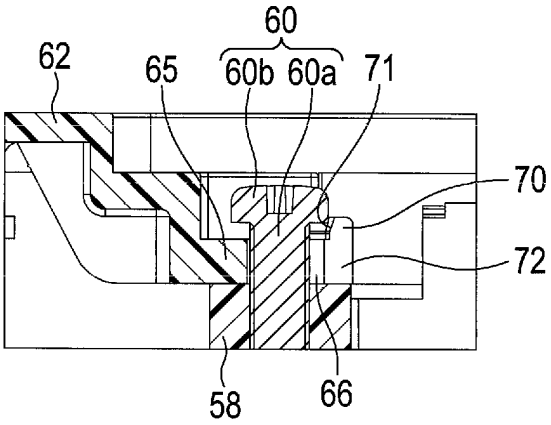


FIG. 14

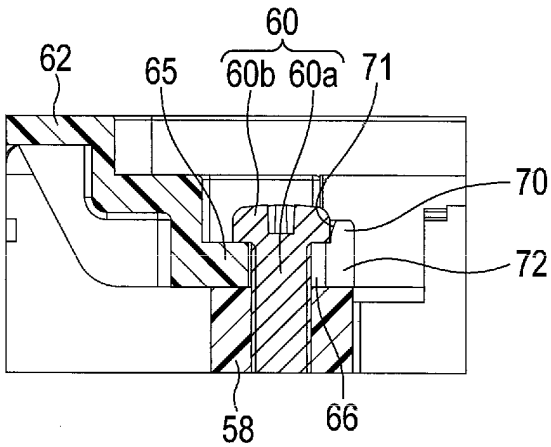


FIG. 15

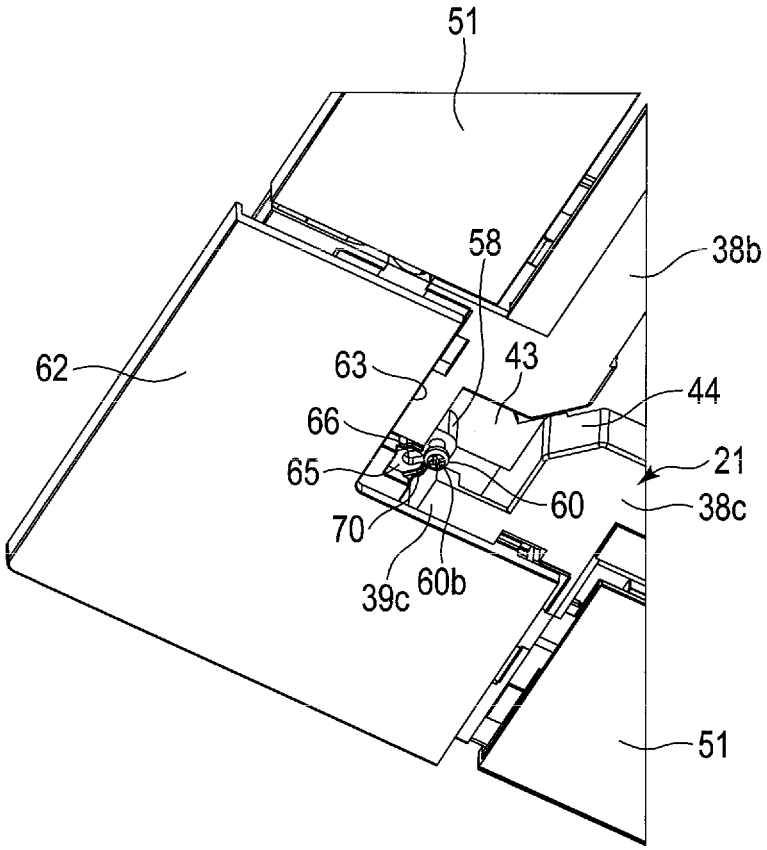


FIG. 16

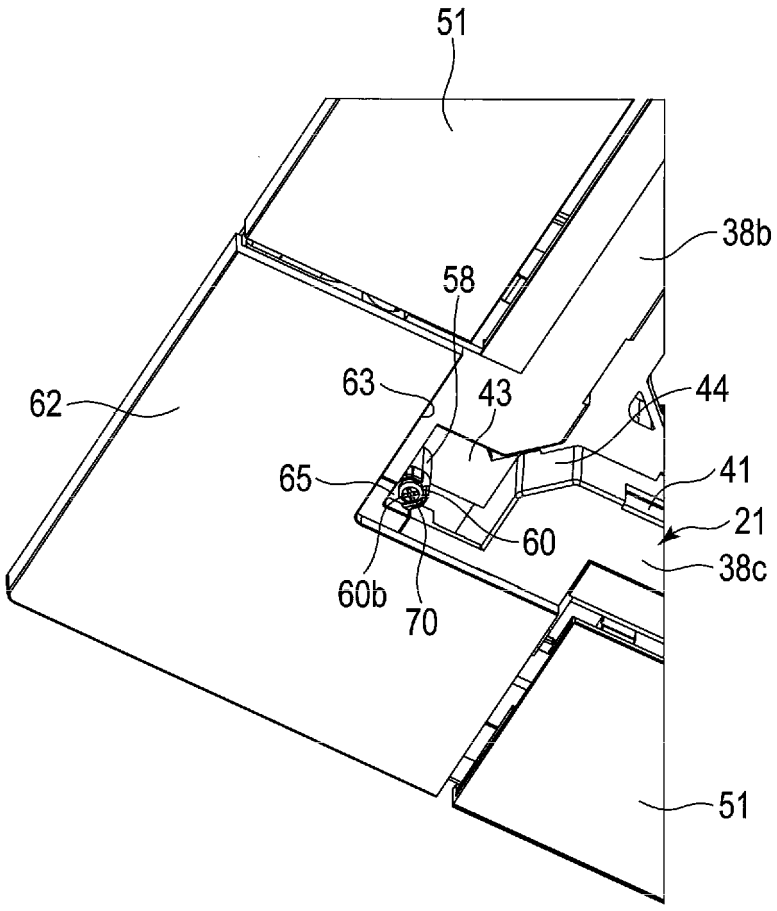


FIG. 17

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2017/007402

A. CLASSIFICATION OF SUBJECT MATTER
F24F13/32(2006.01)i, *F24F13/20*(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)
F24F13/32, F24F13/20

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.
Y A	JP 2003-202151 A (Mitsubishi Electric Corp.), 18 July 2003 (18.07.2003), paragraphs [0009] to [0020]; fig. 1 to 5 & EP 1327829 A1 paragraphs [0010] to [0021]; fig. 1 to 5 & ES 2249685 T	1-3,6-9 4-5
Y A	Microfilm of the specification and drawings annexed to the request of Japanese Utility Model Application No. 160506/1982(Laid-open No. 063205/1984) (Sharp Corp.), 25 April 1984 (25.04.1984), specification, page 2, line 8 to page 3, line 17; fig. 2 (Family: none)	1-3,6-9 4-5

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

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

Date of the actual completion of the international search	Date of mailing of the international search report
15 May 2017 (15.05.17)	23 May 2017 (23.05.17)
Name and mailing address of the ISA/ Japan Patent Office 3-4-3,Kasumigaseki,Chiyoda-ku, Tokyo 100-8915,Japan	Authorized officer Telephone No.

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

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2017/007402

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y A	Microfilm of the specification and drawings annexed to the request of Japanese Utility Model Application No. 069319/1973(Laid-open No. 016802/1975) (Matsushita Electric Industrial Co., Ltd.), 22 February 1975 (22.02.1975), specification, page 2, line 18 to page 3, line 7; fig. 3 to 4 (Family: none)	1-3,6-9 4-5
Y A	JP 2004-85002 A (Advanced Air-Conditioning Research and Development Center Co., Ltd.), 18 March 2004 (18.03.2004), paragraphs [0035], [0041]; fig. 1 to 9 (Family: none)	1-3,6-9 4-5
Y	JP 2006-234316 A (Mitsubishi Heavy Industries, Ltd.), 07 September 2006 (07.09.2006), paragraph [0012]; fig. 1 to 3 (Family: none)	6-7,9

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

REFERENCES CITED IN THE DESCRIPTION

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

Patent documents cited in the description

- JP 4916552 B **[0004]**