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

(11) **EP 3 845 735 A1**

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

(43) Date of publication:
07.07.2021 Bulletin 2021/27

(21) Application number: **19855302.6**

(22) Date of filing: **20.08.2019**

(51) Int Cl.:
E06B 7/22 *(2006.01)* ***E05D 15/10*** *(2006.01)*
E06B 3/46 *(2006.01)* ***E06B 3/66*** *(2006.01)*

(86) International application number:
PCT/JP2019/032472

(87) International publication number:
WO 2020/045170 (05.03.2020 Gazette 2020/10)

(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
KH MA MD TN

(30) Priority: **31.08.2018 JP 2018163829**
31.08.2018 JP 2018163830
31.08.2018 JP 2018163831
31.08.2018 JP 2018163832

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(54) MULTI-LAYERED GLASS AND FITTING PROVIDED THEREWITH

(57) Provided are a multi-layered glass and a fitting, which are configured so as to prevent formation of a gap connecting the inside of a room to the outside thereof. Multi-layered glasses 310, 320 are provided with first glasses 311, 323, second glasses 313, 321, and reinforcement materials 316, 325 disposed between the first glasses 311, 323 and the second glasses 313, 321, respectively, wherein: at least at one respective ends of the multi-layered glasses, one respective ends of the second glasses 313, 321 have protruding parts 313b, 321b that protrude toward a planar-direction outer side of the glass surfaces of the second glasses 313, 321 beyond end surfaces 311a, 323a of the first glasses 311, 323; and shielding parts 316a, 325a are provided to portions, of the multi-layered glasses 310, 320, each corresponding at least to an interior-side glass surface or an exterior-side glass surface of the protruding part 313b, 321b.

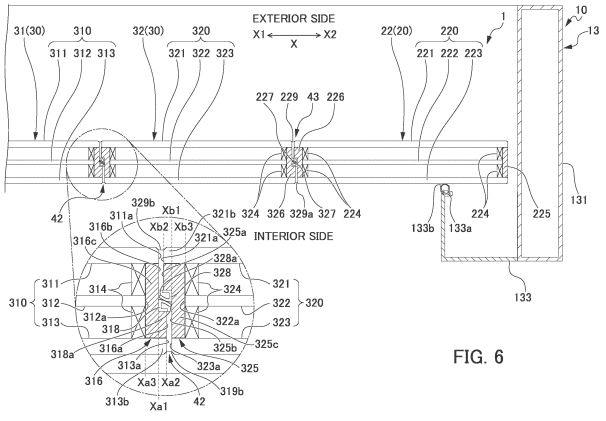

FIG. 6

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Description

TECHNICAL FIELD

[0001] The present invention relates to a multi-layered glass and a fitting including the multi-layered glass.

BACKGROUND ART

[0002] First, in a case where a plurality of multi-layered glasses are aligned to form a fitting, a structure has conventionally been employed in which end faces of the multi-layered glasses are abutted against each other while preventing surfaces of the multi-layered glasses from being out of coplanarity (see, for example, Patent Document 1).

[0003] Second, a ribbon window (fitting) has conventionally been known which includes a frame assembly and glass panels (sashes) fitted to the frame assembly (see, for example, Patent Document 2). The plurality of glass panels (sashes) of Patent Document 2 are each constituted by a FIX panel, and are aligned with each other along a straight line in a front-face direction. Some of such ribbon windows having FIX panels fitted thereto are provided with a mullion having a reduced width such that improved viewability is provided to a person in a room who views the outside through the ribbon window.

[0004] Third, a fitting has conventionally been known which includes a frame assembly and a sash movable within the frame assembly. The fitting is provided with a cover member that can close a groove portion, the groove portion appearing when the sash has been moved in the front-face direction within the frame assembly (see, for example, Patent Document 3).

[0005] Fourth, a different fitting has conventionally been known which includes a sash frame, a door member that is disposed in the sash frame and can be opened and closed, a raising-lowering device disposed in a lower frame component (see, for example, Patent Document 4). The raising-lowering device disclosed in Patent Document 4 is configured to raise and lower a block member to open and close a gap between the door member and the ground.

Patent Document 1: Japanese Unexamined Utility Model Application, Publication No. H06-45074
Patent Document 2: Japanese Unexamined Patent Application, Publication No. 2018-105121
Patent Document 3: Japanese Patent No. 3550244
Patent Document 4: Japanese Unexamined Utility Model (Registration) Application Publication No. 3189401

DISCLOSURE OF THE INVENTION

Problems to be Solved by the Invention

[0006] First, in the case where a plurality of multi-layered glasses are aligned, depending on how well the multi-layered glasses are fitted, the multi-layered glasses may be tilted and a gap may be formed between the adjacent ones of the multi-layered glasses to allow communication between the interior and exterior of the room, thereby giving rise to the risk of leakage of light. The gap allowing communication between the interior and exterior of the room may make it impossible to ensure watertightness and airtightness between the adjacent multi-layered glasses.

[0007] Second, the ribbon window disclosed in Patent Document 2 includes the glass panels constituted by FIX panels and aligned with each other along a straight line in the front-face direction. Thus, the ribbon window disclosed in Patent Document 2 cannot be opened. However, it is sometimes desirable to open and close the glass panels even though glass panels are FIX panels. For this reason, there has been a demand for a fitting including FIX panels to be capable of opening and closing the FIX panels while ensuring viewability.

[0008] Third, it is conceivable to move a sash within a frame assembly in an interior-exterior direction of a room. In a case where the sash is moved within the frame assembly in the interior-exterior direction, it has been also required for the frame assembly to close, with a cover member, a groove portion formed in the frame assembly after the sash has been moved.

[0009] Fourth, in the raising-lowering device disclosed in Patent Document 4, the drive shaft is driven in the vertical direction that is perpendicular to the longitudinal direction of the lower frame component. Therefore, the lower frame component tends to be designed to have a large dimension in the vertical direction. For this reason, there has been a demand for a compact sash frame including a raising-lowering device.

[0010] First, an object of the present invention is to provide a multi-layered glass and a fitting that are configured to prevent formation of a gap allowing communication between the interior and exterior of a room.

[0011] Second, another object of the present invention is to provide a fitting including a sash that can be opened and closed while ensuring viewability.

[0012] Third, yet another object of the present invention is to provide a fitting that includes a sash movable in an interior-exterior direction of a room, and can close, with a cover member, a groove portion formed in a frame assembly after the sash has been moved.

[0013] Fourth, still yet another object of the present invention is to provide a compact sash frame including a raising-lowering device.

Means for Solving the Problems

[0014] First, an aspect of the present invention is directed to a multi-layered glass (e.g., a multi-layered glass 310, 320) including a first glass (e.g., an exterior-side glass panel 311 and an interior-side glass panel 323 to be described later); a second glass (e.g., an interior-side

glass panel 313 and an exterior-side glass panel 321 to be described later); and a reinforcing member (e.g., a reinforcing member 316, 325 to be described later) disposed between the first glass and the second glass. In at least one end portion of the multi-layered glass, the second glass has a protruding portion (e.g., an extension portion 313b, 321b to be described later) at one end thereof, the protruding portion protruding outward in comparison with an end face (e.g., an end face 311a, 323a to be described later) of the first glass in an in-plane direction of a glass surface of the second glass. The multi-layered glass is provided with a shield portion (e.g., a stepwise protruding shield portion 316a, 325a to be described later) that is disposed in a portion corresponding to an interior-side glass surface or an exterior-side glass surface of at least the protruding portion.

[0015] Preferably, the multi-layered glass further includes a sealing member (e.g., an airtight member 318, 328 to be described later) in the one end portion thereof where the protruding portion is provided, the sealing member being disposed on an outer side surface of the multi-layered glass.

[0016] The reinforcing member preferably includes a reinforcing portion (e.g., a reinforcing portion 316c, 325c to be described later) disposed between the first glass and the second glass, and the shield portion protruding outward in comparison with the end face of the first glass in a direction in which the protruding portion of the second glass protrudes, and extending along the protruding portion.

[0017] The shield portion of the reinforcing member preferably extends in the direction in which the protruding portion of the second glass protrudes and lies over an entire length of the protruding portion.

[0018] The reinforcing member preferably has a flat surface (e.g., a stepwise flat portion 316b, 325b to be described later) that is located between the shield portion of the reinforcing member and the first glass, the flat surface being coplanar with the end face of the first glass.

[0019] Another aspect of the present invention is directed to a fitting (e.g., sliding window 1 to be described later; a ribbon window 1A, 1B, 1C to be described later) including: a frame assembly (e.g., a frame assembly 10, 10A to be described later) fittable to an opening of a building; and a plurality of sashes (e.g., a first front-face direction slidable panel assembly 31, 31A and a second front-face direction slidable panel assembly 32, 32A to be described later) aligned within the frame assembly. Adjacent sashes of the plurality of sashes each include a multi-layered glass including a first glass, a second glass, and a reinforcing member disposed between the first glass and the second glass. In at least one end portion of the multi-layered glass, the second glass has a protruding portion at one end thereof, the protruding portion protruding outward in comparison with an end face of the first glass in an in-plane direction of a glass surface of the second glass.

The multi-layered glasses of the adjacent sashes are adjacent to each other, and at least one of the multi-layered glasses adjacent to each other is provided with a shield portion that is disposed in a portion corresponding to an interior-side glass surface or an exterior-side glass surface of at least the protruding portion. One sash of the adjacent sashes is abutted against the other sash in an abutment section (e.g., an abutment section 42 to be described later). In the abutment section, the protruding portion provided to the second glass of the multi-layered glass of the one sash is disposed close to one of an interior side and an exterior side, whereas the protruding portion provided to the second glass of the multi-layered glass of the other sash is disposed close to the other of the interior side and the exterior side. The multi-layered glasses adjacent to each other have interior-side front-face surfaces that are coplanar with each other and exterior-side front-face surfaces that are coplanar with each other.

[0020] Preferably, the fitting further includes a sealing member in the one end portion of the multi-layered glass where the protruding portion is provided, the sealing member being disposed on an outer side surface of the multi-layered glass.

[0021] The reinforcing member preferably includes a reinforcing portion disposed between the first glass and the second glass, and the shield portion protruding outward in comparison with the end face of the first glass in a direction in which the protruding portion of the second glass protrudes, and extending along the protruding portion.

[0022] The shield portion of the reinforcing member preferably extends in a direction in which the protruding portion of the second glass protrudes and lies over an entire length of the protruding portion.

[0023] The reinforcing member preferably has a flat surface that is located between the shield portion of the reinforcing member and the first glass, the flat surface being coplanar with the end face of the first glass.

[0024] Preferably, each of the multi-layered glasses adjacent to each other is provided with the shield portion. In the abutment section where the one sash of the adjacent sashes of the plurality of sashes is abutted against the other sash of the adjacent sashes, the shield portion of the reinforcing member of the one sash preferably overlaps with the shield portion of the reinforcing member of the other sash.

[0025] Second, another aspect of the present invention is directed to a fitting (e.g., a sliding window 1 to be described later) including: a frame assembly (e.g., a frame assembly 10 to be described later) fittable to an opening of a building; and a first sash (e.g., a front-back direction slidable panel assembly 20 to be describes later) and a second sash (e.g., a front-face direction slidable panel assembly 30 to be described later) disposed within the frame assembly. The first sash and the second sash are movable, within the frame assembly, between a closed position in which the first sash and the second sash are aligned along a straight line in a front-face direction and

an open position in which the first sash overlaps with the second sash when viewed in an interior-exterior direction of a room. The first sash is movable exclusively in the interior-exterior direction within the frame assembly.

[0026] Preferably, the second sash is movable exclusively in the front-face direction within the frame assembly.

[0027] Preferably, the fitting further includes an interior-exterior direction movement mechanism (e.g., a front-back direction movement mechanism 5 to be described later) coupled to a peripheral portion of the first sash, the interior-exterior direction movement mechanism being configured to move the first sash exclusively in the interior-exterior direction.

[0028] Preferably, the fitting is configured to move the first sash and the second sash from the closed position to the open position by moving the first sash in the interior-exterior direction, and thereafter, by moving the second sash in the front-face direction.

[0029] Preferably, the fitting further includes a first airtight member (e.g., an airtight member 116b, 125b, 133b to be described later) and a second airtight member (e.g., an airtight member 116b, 125b, 133b to be described later). When the first sash and the second sash are in the closed position, the first airtight member is disposed between the first sash and the frame assembly while the second airtight member is disposed between the second sash and the frame assembly.

[0030] Third, yet another aspect of the present invention is directed to a fitting (e.g., a sliding window 1 to be described later) including: a frame assembly (e.g., a frame assembly 10 to be described later) fittable to an opening of a building; and a sash (e.g., a first window assembly 200 including a front-back direction slidable panel assembly 20 and a front-back direction movable sash roller 203 to be described later) disposed within the frame assembly. The frame assembly has an exterior-side part (e.g., an upper frame component's exterior-side extension portion 112, a lower frame component's exterior-side extension portion 122 to be described later) that faces an exterior-side surface of the sash, an interior-side part (e.g., an upper frame component's interior-side extension portion 114, a lower frame component's interior-side extension portion 124 to be described later) that faces an interior-side surface of the sash, and a bottom part (e.g., a lower part 111t, an upper part 121t to be described later) that continuously extends from an end of the exterior-side part to an end of the interior-side part. The sash includes a cover member (e.g., an upper frame component's exterior-side lid 118, a lower frame component's exterior-side lid 128 to be described later) for covering a space (e.g., an upper frame component's space S1, a lower frame component's space S2 to be described later) that is formed between the sash and the exterior-side part or a space that is formed between the sash and the interior-side part when the sash has moved in an interior-exterior direction of a room.

[0031] Preferably, the fitting further includes a turnable member (e.g., a lower opening-closing turnable member 711, an upper opening-closing turnable member 721 to be described later) that supports the cover member such that the cover member is turnable in an inside of the frame assembly.

[0032] Preferably, the fitting further includes a lock unit (e.g., a restraining rod 713b, a restraining rod 723b, a motor 52 to be described later) that is switchable between a locked state in which the cover member is restrained from moving and an unlocked state in which the cover member is released from the locked state.

[0033] Preferably, the fitting further includes a drive unit (e.g., a motor 52 to be described later), wherein driving the drive unit causes the sash to be moved in the interior-exterior direction within the frame assembly.

[0034] Fourth, still yet another aspect of the present invention is directed to a sash frame including a frame assembly (e.g., a frame assembly 10) fittable to an opening of a building. The frame assembly has a groove portion (e.g., a groove portion M, a recessed portion K to be described later) capable of receiving a sash (e.g., a front-back direction slidable panel assembly 20, a front-face direction slidable panel assembly 30 to be described later) configured to close the opening. The frame assembly includes a raising-lowering device (e.g., a middle-positioned lid raising/lowering mechanism 8 to be described later) that is disposed in the frame assembly and is capable of raising and lowering a lid member (e.g., a vertically-movable lid member 89 to be described later) in the groove portion of the frame assembly. The lid member is capable of covering the groove portion when the lid member is raised to become coplanar with an upper end of the groove portion. The raising-lowering device includes a raising-lowering drive unit (e.g., a motor 82 to be described later) having a drive shaft (e.g., a rotary shaft 83), and is capable of raising and lowering the lid member by means of a rotational drive force of the drive shaft. The drive shaft extends in a longitudinal direction of the frame assembly.

[0035] The raising-lowering device preferably includes a scissor arm (e.g., a scissor arm 86 to be described later) that includes a pair of crossing arm parts (e.g., arm parts 861 to be described later) and is capable of extending and contracting in a direction in which the lid member is raised and lowered.

[0036] The drive shaft preferably includes a screw mechanism that is connected to an end of the scissor arm in the longitudinal direction of the frame assembly, the screw mechanism being driven and rotated to raise and lower the lid member.

[0037] The frame assembly is preferably provided with a rib (e.g., a frame-side rising-bent part 121a to be described later) that projects from the frame assembly toward an inside of the frame assembly, the rib being intended for mounting of the raising-lowering device to the frame assembly.

Effects of the Invention

[0038] First, the present invention provides a multi-layered glass and a fitting that are configured to prevent formation of a gap allowing communication between the interior and exterior of a room.

[0039] Second, the present invention provides a fitting including a sash that can be opened and closed while ensuring viewability.

[0040] Third, the present invention provides a fitting that includes a sash movable in an interior-exterior direction of a room, and that can close, with a cover member, a groove portion formed in a frame assembly after the sash has been moved.

[0041] Fourth, the present invention provides a compact sash frame including a raising-lowering device.

BRIEF DESCRIPTION OF THE DRAWINGS

[0042]

FIG. 1 is a front view of a sliding window according to a first embodiment of the present invention, and shows the sliding window in a closed position;
FIG. 2 is a transverse cross-sectional view taken along line A-A in FIG. 1, and shows the sliding window of the first embodiment in the closed position;
FIG. 3 is a transverse cross-sectional view of the sliding window that has transitioned to an intermediate position from the closed position shown in FIG. 2, with front-back direction slidable panel assemblies moved toward an exterior side;
FIG. 4 is a vertical cross-sectional view of the sliding window that has transitioned to a closed position from the intermediate position shown in FIG. 3, with front-face direction slidable panel assemblies moved outwardly away from each other in a lateral direction;
FIG. 5 shows, on an enlarged scale, a left end portion of the sliding window shown in FIG. 2;
FIG. 6 shows, on an enlarged scale, a right end portion of the sliding window shown in FIG. 2;
FIG. 7 is a cross-sectional view taken along line B-B in FIG. 1;
FIG. 8 is a cross-sectional view taken along line C-C in FIG. 1;
FIG. 9 is a cross-sectional view taken along line D-D in FIG. 1;
FIG. 10 shows a vertically-movable lid member that has been raised from the state shown in FIG. 9;
FIG. 11A and 11B each shows arrangements of front-face direction movable sash rollers, where 11A shows a first arrangement example and 11B shows a second arrangement example;
FIG. 12A is a perspective view of a front-back direction movement mechanism, and shows a state in which a front-back direction slidable panel assembly is positioned close to an interior side;
FIG. 12B is a perspective view of the front-back direction movement mechanism, and shows a state in which the front-back direction slidable panel assembly is positioned close to the exterior side;
FIG. 13 is a perspective view showing front-back direction movement mechanisms and a front-face direction movement mechanism that are disposed in an upper frame component;
FIG. 14 shows how a lower frame component's exterior-side lid is opened and closed;
FIG. 15 shows how an upper frame component's exterior-side lid is opened and closed;
FIG. 16A is a perspective view of a middle-positioned lid raising-lowering mechanism, and shows a state in which the raising-lowering mechanism is in a descent position;
FIG. 16B is a perspective view of the middle-positioned lid raising-lowering mechanism, and shows a state in which the raising-lowering mechanism is in an ascent position;
FIG. 17A to 17C each shows boundaries at a lower rail, where 17A shows the joint of a first example, 17B shows the joint of a second example, and 18C shows the joint of a third example.;
FIG. 18 shows a lower lid opening-closing mechanism according to a second embodiment of the present invention;
FIG. 19 shows how the lower lid opening-closing mechanism according to the second embodiment of the present invention opens and closes a lid;
FIG. 20 shows a lower portion of sliding window according to a third embodiment of the present invention, when viewed from the exterior side;
FIG. 21 is an exploded perspective view of the portion shown in FIG. 20;
FIG. 22 is a perspective view showing an end-positioned lid raising-lowering mechanism and a front-back direction movement mechanism of the third embodiment that are disposed on a lower frame component;
FIG. 23A shows a state in which a vertically-movable lid member has been lowered from the state shown in FIG. 20;
FIG. 23B shows a state in which a front-back direction slidable member has been moved toward the exterior side, from the state shown in FIG. 23A;
FIG. 24 is a transverse cross-sectional view of a ribbon window including FIX panels according to a fourth embodiment of the present invention;
FIG. 25 is a transverse cross-sectional view of a ribbon window including FIX panels according to a fourth embodiment of the present invention;
FIG. 26 is a transverse cross-sectional view of a ribbon window including FIX panels according to a sixth embodiment of the present invention;
FIG. 27 is a transverse cross-sectional view of a ribbon window including FIX panels according to a seventh embodiment of the present invention;
FIG. 28 is a transverse cross-sectional view of a slid-

ing window according to an eighth embodiment, taken along a line corresponding to the line A-A in FIG. 1, and shows the sliding window in a closed position;
FIG. 29 is a transverse cross-sectional view showing the sliding window that has transitioned to an intermediate position from the closed position shown in FIG. 28, with front-back direction slidable panel assemblies moved toward the exterior side;
FIG. 30 is a vertical cross-sectional view showing the sliding window that has transitioned to the closed position from the intermediate position shown in FIG. 29, with front-face direction slidable panel assemblies moved outwardly away from each other in a lateral direction;
FIG. 31 is a cross-sectional view taken along a line corresponding to the line B-B in FIG. 1;
FIG. 32 is a cross-sectional view taken along a line corresponding to the line C-C in FIG. 1; and
FIG. 33 is a cross-sectional view taken along a line corresponding to the line D-D in FIG. 1.

PREFERRED MODE FOR CARRYING OUT THE INVENTION

First Embodiment

[0043] A sliding window 1 as a fitting according to a first embodiment of the present invention will be described with reference to the drawings. FIG. 1 is a front view of the sliding window 1 according to the first embodiment of the present invention, and shows the sliding window 1 in a closed position. FIG. 2 is a transverse cross-sectional view taken along line A-A in FIG. 1, and shows the sliding window 1 of the first embodiment in the closed position. FIG. 3 is a transverse cross-sectional view of the sliding window 1 that has transitioned to an intermediate position from the closed position shown in FIG. 2, with front-back direction slidable panel assemblies 20 moved toward an exterior side. FIG. 4 is a vertical cross-sectional view of the sliding window 1 that has transitioned to the closed position from the intermediate position shown in FIG. 3, with front-face direction slidable panel assemblies 30 moved outwardly away from each other in a lateral direction X. FIG. 5 shows, on an enlarged scale, a left end portion of the sliding window 1 shown in FIG. 2. FIG. 6 shows, on an enlarged scale, a right end portion of the sliding window 1 shown in FIG. 2.

[0044] Note that the "front-face direction" as used herein refers to an in-plane direction of a sash fitted in a frame assembly of a fitting that is installed in an opening of a building. The "front-back direction" as used herein refers to an interior-exterior direction of a room (i.e., a depth direction). In the front-face direction, the lateral direction in FIG. 1 is referred to as "the lateral direction X". In the lateral direction X, a leftward side (one side) in FIG. 1 is referred to as the "X1 side" and a rightward side (the other side) in FIG. 1 is referred to as the "X2 side". Further, the front-back direction in FIG. 2 is referred to as the "front-back direction Y". In the front-back direction Y, the side facing away from the viewer is referred to as the "exterior side" and the side facing the viewer is referred to as the "interior side".

[0045] As shown in FIGS. 1 and 2, the sliding window 1 of the first embodiment includes a frame assembly 10 fittable to an opening of a building, a pair of first window assemblies 200, a pair of second window assemblies 300, front-back direction movement mechanisms 5 (interior-exterior direction movement mechanisms), front-face direction movement mechanisms 6, end-positioned lid opening-closing mechanisms 7, and middle-positioned lid raising-lowering mechanisms 8 (raising-lowering devices). In the sliding window 1 of the present embodiment, a structure excluding the pair of front-back direction slidable panel assemblies 20 and the pair of front-face direction slidable panel assemblies 30, but including the frame assembly 10 is referred to as a sash frame.

[0046] The first window assemblies 200 are movable in the front-back direction Y, and each include the front-back direction slidable panel assembly 20 (first sash), a front-back direction movable sash roller 203 (to be described later), an upper frame component's exterior-side lid 118 (cover member; see FIGS. 7 and 8), and a lower frame component's exterior-side lid 128 (cover member; see FIGS. 7 and 8). The second window assemblies 300 are movable in the lateral direction X of the front-face direction, and each include the front-face direction slidable panel assembly 30 (second sash), and a front-face direction movable sash roller 303 (to be described later). The front-back direction slidable panel assemblies 20 and the front-face direction slidable panel assemblies 30 are intended to close the opening of the building.

[0047] First, a configuration of the frame assembly 10 will be described. As shown in FIG. 1, the frame assembly 10 includes an upper frame component 11, a lower frame component 12, and a pair of vertical frame components 13, 13. These frame components are assembled into the quadrilateral frame assembly. The upper frame component 11, the lower frame component 12, and the pair of vertical frame components 13, 13 are each produced by extrusion molding of, for example, aluminum. In the frame assembly 10, the pair of front-back direction slidable panel assemblies 20 and the pair of front-face direction slidable panel assemblies 30 are arranged.

[0048] As shown in FIGS. 1 to 4, the sliding window 1 of the first embodiment is configured such that the pair of front-back direction slidable panel assemblies 20 and the pair of front-face direction slidable panel assemblies 30 can be moved within the frame assembly 10. Thus, the sliding window 1 of the first embodiment can transition between the closed position (FIGS. 1 and 2), the intermediate position (FIG. 3), and the open position (FIG. 4).

[0049] In the closed position, the pair of front-back direction slidable panel assemblies 20 are positioned close to both ends of the frame assembly 10 in the lateral direction X, and are movable in the front-back direction Y by means of the front-back direction movement mecha-

nisms 5 (see FIG. 1). In the closed position, the pair of front-face direction slidable panel assemblies 30 are positioned in a vicinity of the middle of the frame assembly 10 in the lateral direction, and are movable in the lateral direction X of the front-face direction by means of the front-face direction movement mechanisms 6 (see FIG. 1).

[0050] The front-back direction slidable panel assemblies 20 of the present embodiment are movable exclusively in the front-back direction Y within the frame assembly 10. Therefore, after the front-back direction slidable panel assemblies 20 have been moved exclusively in the front-back direction Y within the frame assembly 10, the front-face direction slidable panel assemblies 30 can be opened. Thus, the sliding window 1 is achieved which can be opened and closed while ensuring viewability. The front-face direction slidable panel assemblies 30 are movable exclusively in the lateral direction X of the front-face direction within the frame assembly 10. Therefore, after the front-back direction slidable panel assemblies 20 have been moved exclusively in the front-back direction Y within the frame assembly 10, the front-face direction slidable panel assemblies 30 are moved exclusively in the lateral direction X of the front-face direction, whereby the sliding window 1 can easily be opened and closed.

[0051] As shown in FIGS. 2, 5 and 6, when the sliding window 1 is in the closed position, the pair of front-back direction slidable panel assemblies 20 and the pair of front-face direction slidable panel assemblies 30 are aligned with each other along a straight line in the lateral direction X of the front-face direction within the frame assembly 10. From the closed position shown in FIG. 2, the pair of front-back direction slidable panel assemblies 20 are moved toward the exterior side in the front-back direction Y within the frame assembly 10, so that the transition to intermediate position shown in FIG. 3, in which the pair of front-back direction slidable panel assemblies 20 are positioned at exterior-side locations in the vicinities of both ends of the frame assembly 10 in the lateral direction X, is achieved. From the intermediate position shown in FIG. 3, the pair of front-face direction slidable panel assemblies 30 are moved outwardly away from each other in the lateral direction X within the frame assembly 10, so that transition to the open position shown in FIG. 4, in which the pair of front-face direction slidable panel assemblies 30 are positioned at outward locations in the lateral direction X, is achieved. When the sliding window 1 is in the open position, the pair of front-back direction slidable panel assemblies 20 overlap with the pair of front-face direction slidable panel assemblies 30 within the frame assembly 10, when viewed in the front-back direction Y.

[0052] The frame assembly 10 has a length in the lateral direction X which allows the pair of front-back direction slidable panel assemblies 20 and the pair of front-face direction slidable panel assemblies 30 to be aligned with each other along a straight line in the lateral direction X within the frame assembly 10. The frame assembly 10 has a length in the front-back direction Y which allows the front-back direction slidable panel assemblies 20 and the front-face direction slidable panel assemblies 30 to be arranged in two lines in the front-back direction Y within the frame assembly 10.

[0053] FIG. 7 is a cross-sectional view taken along line B-B in FIG. 1. FIG. 8 is a cross-sectional view taken along line C-C in FIG. 1. FIG. 9 is a cross-sectional view taken along line D-D in FIG. 1. FIG. 10 shows a vertically-movable lid member 89 raised from the state shown in FIG. 9.

[0054] As shown in FIGS. 7 to 9, the upper frame component 11 has an upper frame component body 111 that has a hollow quadrilateral shape in cross section, an upper frame component's exterior-side extension portion 112 that extends downward from a lower exterior-side portion of the upper frame component body 111, an upper frame component's exterior-side lower projection 113 that projects from a lower end of the upper frame component's exterior-side extension portion 112 toward the inside of the upper frame component 11 in the front-back direction Y, an upper frame component's interior-side extension portion 114 that extends downward from a lower interior-side portion of the upper frame component body 111, an upper frame component's interior-side lower projection 115 that projects from a lower end of the upper frame component's exterior-side lower projection 113 toward the inside of the upper frame component 11 in the front-back direction Y, an upper frame component's interior-side cover 116 that is detachably engaged with the upper frame component's interior-side lower projection 115 and is disposed to extend from the upper frame component's interior-side lower projection 115 toward the inside of the upper frame component 11 in the front-back direction Y, and an upper frame component's exterior-side fixed lid 119 (see FIG. 9). The upper frame component body 111 has a shape elongate in the front-back direction Y.

[0055] As shown in FIGS. 7 to 9, the upper frame component 11 has, in a lower portion thereof, an upper frame component's downward opening 117 that opens downward. The upper frame component's downward opining 117 has a width in the front-back direction Y and extends in the lateral direction X over the entire upper frame component 11. The upper frame component's downward opining 117 opens downward between an interior-side end of the upper frame component's exterior-side lower projection 113 and an exterior-side end of the upper frame component's interior-side lower projection 115.

[0056] As shown in FIG. 8, the upper frame component 11 has the upper frame component's exterior-side extension portion 112 (exterior-side part) that faces an exterior-side surface of the front-back direction slidable panel assembly 20, the upper frame component's interior-side extension portion 114 (interior-side part) that faces an interior-side surface of the front-back direction slidable panel assembly 20, and a lower part 111t (bottom part) that forms part of the upper frame component body 111

and continuously extends from an end of the upper frame component's exterior-side extension portion 112 to an end of the upper frame component's interior-side extension portion 114. Above the upper frame component's downward opining 117, an upper frame component's space S1 (space) is formed close to the exterior side. The upper frame component's space S1 is located between the front-back direction slidable panel assembly 20 and the upper frame component's exterior-side extension portion 112.

[0057] When the sliding window 1 is in the closed position, in the upper frame component's downward opining 117, upper end portions of the front-back direction slidable panel assemblies 20 are positioned close to both ends of the sliding window 1 in the lateral direction X, while upper end portions of the front-face direction slidable panel assemblies 30 are positioned in the vicinity of the middle of the sliding window 1 in the lateral direction X. In the vicinities of both ends of the sliding window 1 in the lateral direction X, the front-back direction slidable panel assemblies 20 are arranged to be movable in the front-back direction Y. The front-face direction slidable panel assemblies 30 are arranged to be movable in the lateral directions X of the sliding window 1.

[0058] As shown in FIG. 8, in the vicinities of both ends of the sliding window 1 in the lateral direction X, exterior-side portions of the upper frame component's downward opening 117 can be opened and closed by the upper frame component's exterior-side lids 118 of the first window assemblies 200 when the front-back direction slidable panel assemblies 20 are moved toward the exterior side. When the upper end portions of the front-back direction slidable panel assemblies 20 are moved in the front-back direction Y in the upper frame component 11, the upper frame component's exterior-side lids 118 move between a closure position and an open position with the help of the movement of the front-back direction slidable panel assemblies 20 in the front-back direction Y. In the closure position, the upper frame component's exterior-side lid 118 closes the upper frame component's space S1 present in a groove portion of the upper frame component's downward opening 117 of the upper frame component 11, whereas in a non-closure position, the upper frame component's exterior-side lid 118 leave the upper frame component's space S1 open. As shown in FIG. 9, in the vicinity of the middle of the sliding window 1 in the lateral direction X, an exterior-side portion of the upper frame component's downward opening 117 is closed with an upper frame component's exterior-side fixed lid 119. The upper frame component's exterior-side fixed lid 119 is unopenable and fixed to the upper frame component 11.

[0059] The upper frame component's interior-side cover 116 lies over an entire interior-side portion of the upper frame component's downward opening 117 in the lateral direction X of the sliding window 1. The upper frame component's interior-side cover 116 extends from end to end of the sliding window 1 in the lateral direction X, and is detachably engaged with the upper frame component's interior-side lower projection 115 so as to cover the interior-side portion of the upper frame component's downward opening 117 from below. The upper frame component's interior-side cover 116 is detached when the front-back direction slidable panel assemblies 20 or the front-face direction slidable panel assemblies 30 are going to be mounted, and is attached after the front-back direction slidable panel assemblies 20 or the front-face direction slidable panel assemblies 30 have been mounted. Since the upper frame component's interior-side cover 116 is detachable, it also functions as a detachable cover of an inspection opening that allows inspection of the inside of the upper frame component 11.

[0060] The upper frame component's interior-side cover 116 has an engaging portion 116a at an exterior-side end thereof. The engaging portion 116a receives airtight members 116b (a first airtight member, a second airtight member) attached thereto. The airtight members 116b attached to the engaging portion 116a are located between the upper frame component 11 and the front-back direction slidable panel assemblies 20 and between the upper frame component 11 and the front-face direction slidable panel assemblies 30, and are pressed onto upper interior-side portions of the front-face surfaces of the pair of front-back direction slidable panel assemblies 20 and the pair of front-face direction slidable panel assemblies 30. The airtight members 116b have a hollow structure having a hollow portion, and are configured to ensure airtightness and watertightness of the upper frame component 11 and the slidable panel assemblies 20 and 30. Due to the hollow structure having the hollow portion, the airtight members 116b are inhibited from being rolled up even when the front-back direction slidable panel assemblies 20 or the front-face direction slidable panel assemblies 30 are moved.

[0061] As shown in FIGS. 7 to 9, the lower frame component 12 has a lower frame component body 121 that has a hollow quadrilateral shape in cross section, a lower frame component's exterior-side extension portion 122 that extends upward from an upper exterior-side portion of the lower frame component body 121, a lower frame component's exterior-side upper projection 123 that projects from an upper end of the lower frame component's exterior-side extension portion 122 toward the inside of the lower frame component 12 in the front-back direction Y, a lower frame component's interior-side extension portion 124 that extends upward from an upper interior-side portion of the lower frame component body 121, a lower frame component's exterior-side upper projection 125 that projects from an upper end of the lower frame component's interior-side extension portion 124 toward the inside of the lower frame component 12 in the front-back direction Y, and a lower frame component's exterior-side fixed lid 129 (see FIG. 9). The lower frame component body 121 has a shape elongate in the front-back direction Y.

[0062] As shown in FIGS. 7 to 9, the lower frame com-

ponent 12 has, in an upper portion thereof, a lower frame component's upward opening 127 that opens upward. The lower frame component's upward opining 127 has a width in the front-back direction Y and extends in the lateral direction X over the entire lower frame component 12. The lower frame component's upward opining 127 opens upward between an interior-side end of the lower frame component's exterior-side upper projection 123 and an exterior-side end of the lower frame component's exterior-side upper projection 125.

[0063] As shown in FIG. 8, the lower frame component 12 has the lower frame component's exterior-side extension portion 122 (exterior-side part) that faces the exterior-side surface of the front-back direction slidable panel assembly 20, the lower frame component's interior-side extension portion 124 (interior-side part) that faces the interior-side surface of the front-back direction slidable panel assembly 20, and an upper part 121t (bottom part) that forms part of the lower frame component body 121 and continuously extends from an end of the lower frame component's exterior-side extension portion 122 to an end of the lower frame component's interior-side extension portion 124. Below the lower frame component's upward opining 127, a lower frame component's space S2 (space) is formed close to the exterior side. The lower frame component's space S2 is located between the front-back direction slidable panel assembly 20 and the lower frame component's exterior-side extension portion 122.

[0064] When the sliding window 1 is in the closed position, in the lower frame component's upward opining 127, lower end portions of the front-back direction slidable panel assemblies 20 are positioned in the vicinities of both ends of the sliding window 1 in the lateral direction X, while lower end portions of the front-face direction slidable panel assemblies 30 are positioned in the vicinity of the middle of the sliding window 1 in the lateral direction X. In the vicinities of both ends of the sliding window 1 in the lateral direction X, the front-back direction slidable panel assemblies 20 are arranged to be movable in the front-back direction Y. The front-face direction slidable panel assemblies 30 are arranged to be movable in the lateral directions X of the sliding window 1.

[0065] As shown in FIG. 8, in the vicinities of both ends of the sliding window 1 in the lateral direction X, exterior-side portions of the lower frame component's upward opening 127 can be opened and closed by the lower frame component's exterior-side lids 128 of the first window assemblies 200 when the front-face direction slidable panel assemblies 30 are moved toward the exterior side. When the upper end portions of the front-back direction slidable panel assemblies 20 are moved in the front-back direction Y in the lower frame component 12, the lower frame component's exterior-side lids 128 move between a closure position and an open position with the help of the movement of the front-back direction slidable panel assemblies 20 in the front-back direction Y. In the closure position, the lower frame component's exterior-side lids 128 close the lower frame component's space S2 present in a groove portion of the lower frame component's upward opening 127 of the lower frame component 12, whereas in the non-closure position, the lower frame component's exterior-side lids 128 leave the lower frame component's space S2 open.

[0066] In the vicinities of both ends of the sliding window 1 in the lateral direction X, the lower frame component 12 has therein sash roller placement frames 120 that are disposed on an upper surface of the lower frame component body 121. As shown in FIG. 7, the sash roller placement frame 120 has a sash roller movement upper surface 120a as an upper surface thereof. The sash roller movement upper surface 120a bears a front-back direction movable sash roller 203 (to be described later) of a first movable lower-end support 201 that supports a lower end of a front-back direction slidable panel assembly 21, 22 such that the front-back direction movable sash roller 203 is movable in the front-back direction Y. In the open position, on the sash roller movement upper surface 120a, a front-face direction movable sash roller 303 (to be described later) of a second movable lower-end support 301 that supports a lower end of an associated one of a pair of front-face direction slidable panel assemblies 31 and 32 is placed movably in the lateral direction X.

[0067] As shown in FIG. 9, in the vicinity of the middle of the sliding window 1 in the lateral direction X, an exterior-side portion of the lower frame component's upward opening 127 is closed with the lower frame component's exterior-side fixed lid 129. The lower frame component's exterior-side fixed lid 129 is unopenable and fixed to the lower frame component 12. In the vicinity of the middle of the sliding window 1 in the lateral direction X, when the front-face direction slidable panel assemblies 30 have been moved outwardly away from each other in the lateral direction X, an interior-side groove portion M present in the lower frame component's upward opening 127 is closed with the vertically-movable lid member 89 due to movement of the middle-positioned lid raising-lowering mechanism 8 (to be described later) to an ascent position, as shown in FIG. 10.

[0068] As shown in FIGS. 9 and 10, the lower frame component's exterior-side fixed lid 129 includes a lid body plate 129a that extends horizontally, a downward projection part 129b that projects downward from an interior-side end of the lid body plate 129a, and a downward extension plate 129c that is provided closer than the downward projection part 129b to the exterior side and has a lower end located below that of the downward projection part 129b. The downward extension plate 129c has a position restraining piece 129d (to be described later) attached to an interior-side surface of the downward extension plate 129c.

[0069] The lower frame component's exterior-side upper projection 125 includes an engaging portion 125a at an exterior-side end thereof. The engaging portion 125a receives airtight members 125b (a first airtight member, a second airtight member) attached thereto. The airtight

members 125b attached to the engaging portion 125a are located between the lower frame component 12 and the front-back direction slidable panel assemblies 20 and between the lower frame component 12 and the front-face direction slidable panel assemblies 30, and are pressed onto upper interior-side portions of the front-face surfaces of the pair of front-back direction slidable panel assemblies 20 and the pair of front-face direction slidable panel assemblies 30. The airtight members 125b have a hollow structure having a hollow portion, and are configured to ensure airtightness and watertightness of the lower frame component 12 and the slidable panel assemblies 20 and 30. The airtight members 125b are disposed above the first movable lower-end supports 201 and are pressed onto upper interior-side portions of the front-face surfaces of the pair of front-back direction slidable panel assemblies 20 and the pair of front-face direction slidable panel assemblies 30, so that the airtightness and watertightness are ensured. Due to the hollow structure having the hollow portion, the airtight members 125b are inhibited from being rolled up when the middle-positioned lid raising-lowering mechanism 8 moves vertically.

[0070] As shown in FIG. 2, each of the pair of vertical frame components 13, 13, has a vertical frame component body 131 that has a hollow quadrilateral shape in cross section, a vertical frame component's interior-side extension portion 132 that extends inward in the lateral direction X from an interior-side end of the vertical frame component body 131, and a vertical frame component's front-back direction extension portion 133 that extends toward the exterior side in the front-back direction Y from an inward end of the vertical frame component's interior-side extension portion 132 in the lateral direction X. The vertical frame component body 131 has a shape elongate in the front-back direction Y.

[0071] Each vertical frame component's front-back direction extension portion 133 has an engaging portion 133a at an exterior-side end thereof. The engaging portions 133a receive airtight members 133b (a first airtight member, a second airtight member) attached thereto. The airtight members 132b attached to the engaging portions 133a are located between the vertical frame component 13 and the front-back direction slidable panel assembly 20 or between the vertical frame component 13 and the front-face direction slidable panel assembly 30. Thus, when the pair of front-back direction slidable panel assemblies 20 or the pair of front-face direction slidable panel assemblies 30 are positioned at outward locations in the lateral direction X within the frame assembly 10, the airtight members 132b are pressed onto laterally outward portions of the front-face surfaces of the pair of front-back direction slidable panel assemblies 20 or the pair of front-face direction slidable panel assemblies 30. The airtight members 133b have a hollow structure having a hollow portion, and are configured to ensure airtightness and watertightness of the vertical frame components 13 and the slidable panel assemblies 20 and 30. Due to the hollow structure having the hollow portion, the airtight members 133b are inhibited from being rolled up even when the front-back direction slidable panel assemblies 20 or the front-face direction slidable panel assemblies 30 are moved.

[0072] The pair of front-back direction slidable panel assemblies 20 and the pair of front-face direction slidable panel assemblies 30 are arranged close to the interior side within the frame assembly 10, and are aligned with each other along a straight line in the lateral direction X when they are in the closed position, as shown in FIG. 2. Specifically, in the closed position, the pair of front-back direction slidable panel assemblies 20 are positioned in the vicinities of both ends in the lateral direction X within the frame assembly 10, while the pair of front-face direction slidable panel assemblies 30 are positioned between the pair of front-back direction slidable panel assemblies 20 and are aligned with the pair of front-back direction slidable panel assemblies 20 along a straight line in the lateral direction X.

[0073] In detail, the front-back direction slidable panel assembly 21, the front-face direction slidable panel assembly 31, the front-face direction slidable panel assembly 32, and the front-back direction slidable panel assembly 22 are arranged in this order to be aligned with each other along a straight line, from the leftward side (one side) to the rightward side (the other side) in the lateral direction X. In the closed position, the front-back direction slidable panel assembly 21 and the front-face direction slidable panel assembly 31 are abutted against each other in an abutment section 41. The front-face direction slidable panel assembly 31 and the front-face direction slidable panel assembly 32 are abutted against each other in an abutment section 42. The front-face direction slidable panel assembly 32 and the front-back direction slidable panel assembly 22 are abutted against each other in an abutment section 43.

[0074] When the pair of front-back direction slidable panel assemblies 20 and the pair of front-face direction slidable panel assemblies 30 are in the closed position, the slidable panel assemblies 20, 30 are arranged adjacent to one another, while exterior-side front-face surfaces of exterior-side glass panels 211, 221, 311, 321 (to be described later) that are close to the exterior side are arranged coplanarly with one another, and interior-side front-face surfaces of interior-side glass panels 213, 223, 313, 323 (to be described later) that are close to the interior side are arranged coplanarly with one another.

[0075] Transition of the sliding window 1 (the front-back direction slidable panel assemblies 20 and the front-face direction slidable panel assemblies 30) from the closed position (see FIGS. 1 and 2) to the open position (see FIG. 4) is carried out in the following manner. From the closed position shown in FIG. 2, the pair of front-back direction slidable panel assemblies 20 are respectively moved by means of the front-back direction movement mechanisms 5 toward the exterior side in the front-back direction Y, whereby the sliding window 1 transitions to

the intermediate position shown in FIG. 3. From the intermediate position shown in FIG. 3, the pair of front-face direction slidable panel assemblies 30 are moved outwardly away from each other in the lateral direction X by means of the front-face direction movement mechanisms 16, whereby the sliding window 1 transitions to the open position shown in FIG. 4.

[0076] Transition of the sliding window 1 from the open position (see FIG. 4) to the closed position (see FIGS. 1 and 2) is carried out in the following manner. From the open position shown in FIG. 4, the pair of front-face direction slidable panel assemblies 30 are moved inwardly toward each other in the lateral direction X by means of the front-face direction movement mechanisms 6, whereby the sliding window 1 transitions to the intermediate position shown in FIG. 3. From the intermediate position shown in FIG. 3, the pair of front-back direction slidable panel assemblies 20 are respectively moved by means of the front-back direction movement mechanisms 15 toward the interior side in the front-back direction Y, whereby the sliding window 1 transitions to the closed position shown in FIG. 2.

[0077] Next, a configuration of the front-back direction slidable panel assembly 21, 22 and a configuration of the front-face direction slidable panel assembly 31, 32 are described in detail.

[0078] As shown in FIGS. 5 and 6, the pair of front-back direction slidable panel assemblies 21 and 22 and the pair of front-face direction slidable panel assemblies 31 and 32 are constituted by multi-layered glasses 210, 220, 310 and 320, respectively. The multi-layered glasses 210, 220, 310 and 320 each include three glass panels (exterior-side glass panels 211, 221, 311, 321, and intermediate glass panels 212, 222, 312, 322, interior-side glass panels 213, 223, 313, 323). The exterior-side glass panels 211, 221, 311, 321, the intermediate glass panels 212, 222, 312, 322, and the interior-side glass panels 213, 223, 313, 323 are arranged in the front-back direction in this order from the exterior side to the interior side, and are layered together with an air space interposed between adjacent two of the glass panels. The exterior-side glass panels 211, 221, 311, and 321 are closest to the exterior side in the multi-layered glasses 210, 220, 310, and 320, respectively. The interior-side glass panels 213, 223, 313, and 323 are the closest to the interior side in the multi-layered glasses 210, 220, 310, and 320, respectively.

[0079] As shown in FIGS. 5 and 6, the multi-layered glasses 210, 220, 310, and 320 have, at each of its outward ends in the lateral direction X of the front-face direction, a pair of glass panel spacers 214, a pair of glass panel spacers 224, a pair of glass panel spacers 314, and a pair of glass panel spacers 324, respectively, and reinforcing members 215, 216, 225, 226, 315, 316, 325, and 326, respectively. The pair of front-back direction slidable panel assemblies 21 and 22 and the pair of front-face direction slidable panel assembly 31 and 32 have airtight members 217, 227, 317, 318, 327, and 328 (sealing members), and buffers 219, 229, 319a, 319b, 329a, and 329b.

[0080] As shown in FIGS. 5 and 6, the reinforcing members 215, 216, 225, 226, 315, 316, 325, and 326 are each disposed at an associated one of the ends of the exterior-side glass panels 211, 221, 311, 321 and the ends of the interior-side glass panels 213, 223, 313, 323 in the lateral direction X. In the front-back direction, the reinforcing members 215, 216, 225, 226, 315, 316, 325, and 326 are disposed between associated two of the exterior-side glass panels 211, 221, 311, 321 and the interior-side glass panels 213, 223, 313, 323. The reinforcing members 215, 216, 225, 226, 315, 316, 325, and 326 may be fixed to the exterior-side glass panels 211, 221, 311, 321 and the interior-side glass panels 213, 223, 313, 323 with an adhesive.

[0081] Among the reinforcing members 215, 216, 225, 226, 315, 316, 325, and 326, the reinforcing members 215 and 225 disposed at locations other than the abutment sections 41, 42, and 43 have a flat plate shape extending in the front-back direction. Among the reinforcing members 215, 216, 225, 226, 315, 316, 325, and 326, the reinforcing members 216, 226, 315, 316, 325, and 326 that are each disposed in the abutment section 41, 42, or 43 have a step on its front-to-back surface facing outward in the lateral direction X. The reinforcing members 216, 226, 315, 316, 325, and 326 disposed in the abutment section 41, 42, or 43 will be detailed later.

[0082] The glass panel spacers 214, 224, 314, and 324 are arranged close to the ends of the pair of front-back direction slidable panel assemblies 21 and 22 and the pair of front-face direction slidable panel assemblies 31 and 32 in the lateral direction X, and are disposed inward in the lateral direction X in comparison with the associated one of the reinforcing members 215, 216, 225, 226, 315, 316, 325, and 326. The glass panel spacers 214, 224, 314, and 324 are disposed between associated two of the glass panels (the exterior-side glass panels 211, 221, 311, 321, the intermediate glass panels 212, 222, 312, 322, and the interior-side glass panels 213, 223, 313, 323) in the front-to-pack direction.

[0083] As shown in FIGS. 7 to 9, the pair of front-back direction slidable panel assemblies 21 and 22 and the pair of front-face direction slidable panel assemblies 31 and 32 each have, in its upper and lower end portions, a pair of glass panel spacers 231 or a pair of glass panel spacers 331, and reinforcing members 232 and 233 or reinforcing members 332 and 333.

[0084] As shown in FIG. 7, the pair of front-back direction slidable panel assemblies 21 and 22 have the lower end supported on the first movable lower-end support 201, and the upper end supported on a first upper end support 206. As shown in FIG. 9, the pair of front-face direction slidable panel assembly 31 and 32 have the lower end supported on the second movable lower-end support 301, and the upper end supported on a second movable upper-end support 306.

[0085] The reinforcing members 232 and 233 are each

arranged in an associated one of the upper and lower end portions of the pair of front-back direction slidable panel assemblies 21 and 22 and the upper and lower end portions of the pair of front-face direction slidable panel assemblies 31 and 32, and are each disposed between associated two of the exterior-side glass panels 211, 221, 311, 321 and the interior-side glass panels 213, 223, 313, 323. The reinforcing members 232, 233, 332, and 333 do not have any stepped portion, but have a flat-plate shape extending in the front-back direction.

[0086] The pair of glass panel spacers 231 are disposed in each of the upper and lower end portions of the pair of front-back direction slidable panel assemblies 21 and 22. The pair of glass panel spacers 331 are disposed in each of the upper and lower end portions of the pair of front-face direction slidable panel assemblies 31 and 32. The panel spacers 231 and 331 are arranged inward in comparison with the reinforcing members 232 and 233, respectively, while being disposed between the glass panels.

[0087] As shown in FIGS. 7 to 9, at the upper and lower ends of the multi-layered glasses 210, 220, 310, and 320, upper end faces of the exterior-side glass panels 211, 221, 311, and 321 are coplanar with upper end faces of the interior-side glass panels 213, 223, 313, and 323 without any offset from each other. Lower end faces of the exterior-side glass panels 211, 221, 311, and 321 are coplanar with lower end faces of the interior-side glass panels 213, 223, 313, and 323 without any offset from each other. The reinforcing members 232, 233, 332, and 333 that are disposed at the upper and lower ends of the multi-layered glasses 210, 220, 310, and 320 do not have any stepped portion, but have a flat-plate shape extending in the front-back direction.

[0088] As shown in FIG. 5, in the abutment section 41 where the front-back direction slidable panel assembly 21 is abutted against the front-face direction slidable panel assembly 31, the reinforcing member 216 disposed at the end of the front-back direction slidable panel assembly 21 has an exterior-side portion protruding toward the X2 side whereas the reinforcing member 315 disposed at the end of the front-face direction slidable panel assembly 31 has an interior-side portion protruding toward the X1 side. Therefore, in the abutment section 41, the exterior-side portion, which forms part of the reinforcing member 216 disposed at the front-back direction slidable panel assembly 21 and which protrudes toward the X2 side, overlaps with the interior-side portion, which forms part of the reinforcing member 315 disposed at the front-face direction slidable panel assembly 31 and which protrudes toward the X1 side, when viewed in the front-back direction Y. Thus, when the front-back direction slidable panel assembly 21 has been moved away from the exterior side and toward the interior side, the exterior-side portion of the reinforcing member 216 of the front-back direction slidable panel assembly 21 is pressed onto the interior-side portion of the reinforcing member 315 of the front-face direction slidable panel assembly 31.

[0089] As shown in FIG. 6, in the abutment section 43 where the front-back direction slidable panel assembly 22 is abutted against the front-face direction slidable panel assembly 32, the reinforcing member 226 disposed at the end of the front-back direction slidable panel assembly 22 has an exterior-side portion protruding toward the X1 side whereas the reinforcing member 326 disposed at the end of the front-face direction slidable panel assembly 32 has an interior-side portion protruding toward the X2 side. Therefore, in the abutment section 43, the exterior-side portion, which forms part of the reinforcing member 226 disposed at the front-back direction slidable panel assembly 22 and which protrudes toward the X1 side, overlaps with the interior-side portion, which forms part of the reinforcing member 326 disposed at the front-face direction slidable panel assembly 32 and which protrudes toward the X1 side, when viewed in the front-back direction Y. Thus, when the front-back direction slidable panel assembly 22 has been moved away from the exterior side and toward the interior side, the exterior-side portion of the reinforcing member 226 of the front-back direction slidable panel assembly 22 is pressed onto the interior-side portion of the reinforcing member 326 of the front-face direction slidable panel assembly 31.

[0090] As shown in FIG. 6, in the abutment section 42 where the front-face direction slidable panel assemblies 31 and 32 are abutted against each other, the reinforcing member 316 disposed at one of the panel assemblies, i.e., the front-face direction slidable panel assembly 31 has an interior-side portion protruding toward the X2 side whereas the reinforcing member 325 disposed at the other, i.e., the front-face direction slidable panel assembly 32 has an exterior-side portion protruding toward the X1 side. In this state, in the abutment section 42, the interior-side portion of the reinforcing member 316 overlaps with the exterior-side portion of the reinforcing member 325 when viewed in the front-back direction Y. Thus, when the front-face direction slidable panel assemblies 31 and 32 have been moved inwardly toward each other in the lateral direction X of the front-face direction, the reinforcing member 316 of the front-face direction slidable panel assembly 31 is matched with the reinforcing member 325 of the front-face direction slidable panel assembly 32.

[0091] When the front-face direction slidable panel assemblies 31 and 32 are moved inwardly toward each other in the lateral direction X of the front-face direction, the front-face direction slidable panel assembles 31 and 32 cannot be pressed in the front-back direction Y because they are movable exclusively in the lateral direction X. For this reason, the present embodiment includes the position restraining pieces 129d mentioned earlier. As shown in FIGS. 1, 9 and 10, the position restraining pieces 129d are attached to the interior-side surface of the downward extension plate 129c of the lower frame component 12.

[0092] As shown in FIG. 1, the position restraining pieces 129d are provided in the lower frame component 12 to be located close to the ends of the front-face direction

slidable panel assemblies 31 and 32, the ends being adjacent to the abutment section 42. As shown in FIG. 9, when the pair of front-face direction slidable panel assemblies 30 are moved inwardly toward each other in the lateral direction X of the front-face direction, the position restraining pieces 129d each come into contact with an exterior-side surface of the front-face direction movable sash roller 303 (to be described later) in the vicinity of the abutment section 42 where the pair of front-face direction slidable panel assemblies 30 are abutted against each other, so as to restrain the exterior-side surface of the front-face direction movable sash roller 303 (to be described later) from moving in the front-back direction Y, whereby the pair of front-face direction slidable panel assemblies 30 can be pressed toward the interior side.

[0093] Next, an abutment structure of the abutment section 42 will be described in detail. Since the abutment sections 41, 42, and 43 of the present embodiment are basically same in the abutment structure, the abutment structure of the abutment section 42 (at which the first front-face direction slidable panel assembly 31 is abutted against the second front-face direction slidable panel assembly 32) will be described. The description of the abutment section 42 applies to the abutment sections 41 and 43. In the present embodiment, the abutment section 41 has the same structure as that of the abutment section 42, except that the structure of abutment section 41 is flipped left and right. The description of the structure of the abutment section 42 applies to the structure of the abutment section 41.

[0094] As shown in FIG. 6, the abutment section 42 is formed by way of abutting of the X2-side end portion in the lateral direction X of the first front-face direction slidable panel assembly 31 against the X1-side end portion in the lateral direction X of the second front-face direction slidable panel assembly 32.

[0095] A configuration of the X2-side end portion of the first front-face direction slidable panel assembly 31 in the lateral direction X is now described.

[0096] As shown in FIG. 6, in the X2-side end portion of the first front-face direction slidable panel assembly 31 in the lateral direction X, the exterior-side glass panel 311 (first glass) has an X2-side end face 311a located at a position Xa1 while the interior-side glass panel 313 (second glass) has an X2-side end face 313a located at a position Xa2, and the position Xa1 is closer than the position Xa2 to the X1 side in the lateral direction X. In other words, in the X2-side end portion of the multi-layered glass 310 in the lateral direction X, the interior-side glass panel 313 has, at one end adjacent to the abutment section 42, an extension portion 313b (protruding portion). The extension portion 313b is a part of the interior-side glass panel 313 having a flat plate shape, and protrudes outward in comparison with the end face 311a of the exterior-side glass panel 311, in an in-plane direction of a glass surface of the interior-side glass panel 313. The end face 311a of the exterior-side glass panel 311 is out of coincidence with the end face 313a of the interior-side glass panel 313 in the lateral direction X of the front-face direction of the multi-layered glass 310.

[0097] The position Xa1 of the X2-side end face 311a of the exterior-side glass panel 311 and the position Xa2 of the X2-side end face 313a of the interior-side glass panel 313 are closer than a position Xa3 of an X2-side end face 312a of the intermediate glass panel 312 to the X2 side in the lateral direction X.

[0098] The reinforcing member 316 that is disposed at the end of the first front-face direction slidable panel assembly 31 adjacent to the abutment section 42 is disposed between the exterior-side glass panel 311 and the interior-side glass panel 313 in the front-back direction. The reinforcing member 316 has a step on its front-to-back surface facing the X2 side in the lateral direction X, so that its interior-side portion protrudes toward the X2 side. Thus, the reinforcing member 316 has a reinforcing portion 316c that is disposed between the exterior-side glass panel 311 and the interior-side glass panel 313, and a stepwise protruding shield portion 316a (shield portion) that is formed in an interior-side portion of a front-to-back surface of the reinforcing portion 316c facing outward. The stepwise protruding shield portion 316a is disposed in contact with the extension portion 313b of the interior-side glass panel 313. The stepwise protruding shield portion 316a is located close to the interior-side glass panel 313 and disposed along the extension portion 313b. The reinforcing member 316 has a stepwise flat portion 316b (flat portion) that is located closer than the stepwise protruding shield portion 316a to the exterior side. The stepwise protruding shield portion 316a and the stepwise flat portion 316b each have a front-to-back surface that is flat and extends in the front-back direction. The front-to-back surface of the stepwise flat portion 316b is longer in the front-back direction than the front-to-back surface of the stepwise protruding shield portion 316a. In the direction in which the extension portion 313b of the interior-side glass panel 313 protrudes, the stepwise protruding shield portion 316a extends along the entire length in the lateral direction X of the extension portion 313b.

[0099] In the present embodiment, the front-to-back surface of the stepwise protruding shield portion 316a is closer than the front-to-back surface of the stepwise flat portion 316b to the X2 side. In the lateral direction X of the front-face direction, the front-to-back surface of the stepwise protruding shield portion 316a is located at the position Xa2, i.e., is in coincidence with the end face 313a of the interior-side glass panel 313, while the front-to-back surface of the stepwise flat portion 316b is located at the position Xa1, i.e., is in coincidence with the end face 311a of the exterior-side glass panel 311. The stepwise protruding shield portion 316a protrudes outward in comparison with the end face 311a of the exterior-side glass panel 311 in the direction in which the extension portion 313b of the interior-side glass panel 313 protrudes, and extends along the extension portion 313b of

the interior-side glass panel 313. The stepwise flat portion 316b is disposed between the stepwise protruding shield portion 316a and the exterior-side glass panel 311 in the front-back direction. The stepwise flat portion 316b is coplanar with the end face 311a of the exterior-side glass panel 311. That is, in the X2-side end portion of the multi-layered glass 310 in the front-face direction, the reinforcing member 316 has the stepwise protruding shield portion 316a and the stepwise flat portion 316b, which have the front-to-back surfaces out of coincidence with each other in the lateral direction X of the front-face direction of the multi-layered glass 310, whereby the front-to-back surfaces form the step.

[0100] On the front-to-back surface of the stepwise flat portion 316b, the airtight member 318 (sealing member) is disposed adjacent to in the front-back direction the stepwise protruding shield portion 316a. The airtight member 318 is disposed on an outer side surface of the end portion of the multi-layered glass 310 where the stepwise protruding shield portion 316a is provided. On the front-to-back surface of the reinforcing member 316, the airtight member 318 is disposed closer than the stepwise protruding shield portion 316a to the exterior-side glass panel 311. In the abutment section 42, the airtight member 318 is disposed between the first front-face direction slidable panel assembly 31 and the second front-face direction slidable panel assembly 32. The airtight member 318 has a slant projection 318a that projects in the lateral direction X toward the X2 side from a portion of the front-to-back surface of the stepwise flat portion 316b, the portion being adjacent in front-back direction to the stepwise protruding shield portion 316a. The slant projection 318a projects while slanting in the direction from the exterior side to the interior side and in the direction from the X1 side to the X2 side of the lateral direction X. In the abutment section 42, the slant projection 318a of the airtight member 318 is pressed by a slant projection 328a (to be described later) of the airtight member 328 of the second front-face direction slidable panel assembly 32 when the first front-face direction slidable panel assembly 31 is abutted against the second front-face direction slidable panel assembly 32.

[0101] The first front-face direction slidable panel assembly 31 has, in the X2-side end portion in the lateral direction X, the buffer 319b disposed close to the interior side. The buffer 319b extends in the front-back direction over the front-to-back surface of the stepwise protruding shield portion 316a of the reinforcing member 316 and the end face 313a of the interior-side glass panel 313, and is bonded to the front-to-back surface of the stepwise protruding shield portion 316a of the reinforcing member 316 and the end face 313a of the interior-side glass panel 313. In the abutment section 42, the buffer 319b becomes arranged between the first front-face direction slidable panel assembly 31 and the second front-face direction slidable panel assembly 32 when the first front-face direction slidable panel assembly 31 is abutted against the second front-face direction slidable panel assembly 32.

[0102] Next, a configuration of the Xl-side end portion of the second front-face direction slidable panel assembly 32 in the lateral direction X is described. As shown in FIG. 6, at the Xl-side end portion of the second front-face direction slidable panel assembly 32 in the lateral direction X, the interior-side glass panel 323 (first glass) has an Xl-side end face 323a located at a position Xb1 while the exterior-side glass panel 321 (second glass) has an Xl-side end face 321a located at a position Xb2, and the position Xb1 is closer than the position Xb2 to the X2 side in the lateral direction X. In other words, in the Xl-side end portion of the multi-layered glass 320 in the lateral direction X, the exterior-side glass panel 321 has, at one end adjacent to the abutment section 42, an extension portion 321b (protruding portion). The extension portion 321b is a part of the exterior-side glass panel 321 having a flat plate shape, and protrudes outward in comparison with the end face 323a of the interior-side glass panel 323 in an in-plane direction of a glass surface of the exterior-side glass panel 321. The end face 321a of the exterior-side glass panel 321 is out of coincidence with the end face 323a of the interior-side glass panel 323 in the lateral direction X of the front-face direction of the multi-layered glass 320.

[0103] The position Xb2 of the Xl-side end face 321a of the exterior-side glass panel 321 and the position Xb1 of the X1-side end face 323a of the interior-side glass panel 323 are closer than a position Xb3 of an Xl-side end face 322a of the intermediate glass panel 322 to the X1 side in the lateral direction X.

[0104] Here, the position Xb2 of the Xl-side end face 321a of the exterior-side glass panel 321 of the second front-face direction slidable panel assembly 32 is closer than the position Xa2 of the X2-side end face 313a of the interior-side glass panel 313 of the first front-face direction slidable panel assembly 31 to the X1 side. Therefore, the X2-side end portion of the interior-side glass panel 313 of the first front-face direction slidable panel assembly 31 overlaps with the Xl-side end portion of the exterior-side glass panel 321 of the second front-face direction slidable panel assembly 32 when viewed in the front-back direction.

[0105] The reinforcing member 325 that is disposed at the end of the second front-face direction slidable panel assembly 32 adjacent to the abutment section 42 is disposed between the exterior-side glass panel 321 and the interior-side glass panel 323 in the front-back direction.

[0106] In the present embodiment, the reinforcing member 325 disposed at the end of the second front-face direction slidable panel assembly 32 adjacent to the abutment section 42 has a step thereon and is point-symmetrical with the reinforcing member 316 disposed at the end of the first front-face direction slidable panel assembly 31 adjacent to the abutment section 42. Specifically, when rotated by 180 degrees about an axis extending in the front-back direction, the shape of the reinforcing member 325 disposed at the end of the second front-face direction slidable panel assembly 32 adjacent

to the abutment section 42 is the same as the shape of the reinforcing member 316 disposed at the end of the first front-face direction slidable panel assembly 31 adjacent to the abutment section 42. The reinforcing member 325 of the second front-face direction slidable panel assembly 32 and the reinforcing member 316 of the first front-face direction slidable panel assembly 31 are abutted against each other in the abutment section 42, while the protrusion of one reinforcing member faces the recess of the other reinforcing member and vice versa.

[0107] The reinforcing member 325 has a step on its front-to-back surface facing the X1 side in the lateral direction X, so that its exterior-side portion protrudes toward the X1 side. Thus, the reinforcing member 325 has a reinforcing portion 325c that is disposed between the exterior-side glass panel 321 and the interior-side glass panel 323, and a stepwise protruding shield portion 325a (shield portion) that is formed in an exterior-side portion of a front-to-back surface of the reinforcing portion 325c facing outward. The stepwise protruding shield portion 325a is disposed in contact with the extension portion 321b of the exterior-side glass panel 321. The stepwise protruding shield portion 325a is located close to the exterior-side glass panel 321 and disposed along the extension portion 321b. The reinforcing member 325 has a stepwise flat portion 325b (flat portion) that is located closer than the stepwise protruding shield portion 325a to the interior side. The stepwise protruding shield portion 325a and the stepwise flat portion 325b each have a front-to-back surface that is flat and extends in the front-back direction. The front-to-back surface of the stepwise flat portion 325b is longer in the front-back direction than the front-to-back surface of the stepwise protruding shield portion 325a. In the direction in which the extension portion 321b of the exterior-side glass panel 321 protrudes, the stepwise protruding shield portion 325a extends along the entire length in the lateral direction X of the extension portion 321b.

[0108] In the present embodiment, the front-to-back surface of the stepwise protruding shield portion 325a is closer than the front-to-back surface of the stepwise flat portion 325b to the X1 side. In the lateral direction X of the front-face direction, the front-to-back surface of the stepwise protruding shield portion 325a is located at the position Xb2, i.e., is in coincidence with the end face 321a of the exterior-side glass panel 321, while the front-to-back surface of the stepwise flat portion 325b is located at the position Xb1, i.e., is in coincidence with the end face 323a of the interior-side glass panel 323. The stepwise protruding shield portion 325a protrudes outward in comparison with the end face 323a of the interior-side glass panel 323 in the direction in which the extension portion 321b of the exterior-side glass panel 321 protrudes along the extension portion 321b of the exterior-side glass panel 321. The stepwise flat portion 325b is disposed between the stepwise protruding shield portion 325a and the interior-side glass panel 323 in the front-back direction. The stepwise flat portion 325b is coplanar with the end face 323a of the interior-side glass panel 323. That is, in the Xl-side end portion of the multi-layered glass 320 in the front-face direction, the reinforcing member 325 has the stepwise protruding shield portion 325a and the stepwise flat portion 325b, which has the front-to-back surfaces out of coincidence with each other in the lateral direction X of the front-face direction of the multi-layered glass 320, whereby the front-to-back surfaces form the step.

[0109] Here, the position Xb2 of the front-to-back surface of the stepwise protruding shield portion 325a forming part of the reinforcing member 325 of the second front-face direction slidable panel assembly 32 is closer to the X1 side than the position Xa2 of the front-to-back surface of the stepwise protruding shield portion 316a forming part of the reinforcing member 316 of the first front-face direction slidable panel assembly 31. Therefore, the stepwise protruding shield portion 316a of the reinforcing member 316 of the first front-face direction slidable panel assembly 31 overlaps with the stepwise protruding shield portion 325a of the reinforcing member 325 of the second front-face direction slidable panel assembly 32 when viewed in the front-back direction.

[0110] On the front-to-back surface of the stepwise flat portion 325b, the airtight member 328 (sealing member) is disposed adjacent in the front-back direction to the stepwise protruding shield portion 325a. The airtight member 328 is disposed on an outer side surface of the end portion of the multi-layered glass 320 where the stepwise protruding shield portion 325a is provided. On the front-to-back surface of the reinforcing member 325, the airtight member 328 is disposed closer than the stepwise protruding shield portion 325a to the interior-side glass panel 323. In the abutment section 42, the airtight member 328 is disposed between the first front-face direction slidable panel assembly 31 and the second front-face direction slidable panel assembly 32. The airtight member 328 has a slant projection 328a that projects toward the X1 side in the lateral direction X from a portion of the front-to-back surface of the stepwise flat portion 325b, the portion being adjacent in front-back direction to the stepwise protruding shield portion 325a. The slant projection 328a projects while slanting in the direction from the interior side to the exterior side and in the direction from the X2 side to the X1 side of the lateral direction X. In the abutment section 42, the slant projection 328a of the airtight member 328 is pressed by the slant projection 318a of the airtight member 318 of the first front-face direction slidable panel assembly 31 when the first front-face direction slidable panel assembly 31 is abutted against the second front-face direction slidable panel assembly 32.

[0111] The second front-face direction slidable panel assembly 32 has, in the Xl-side end portion in the lateral direction X, the buffer 329b disposed close to the exterior side. The buffer 329b extends in the front-back direction over the front-to-back surface of the stepwise protruding shield portion 325a of the reinforcing member 325 and

the end face 321a of the exterior-side glass panel 321, and is bonded to the front-to-back surface of the stepwise protruding shield portion 325a of the reinforcing member 256 and the end face 321a of the exterior-side glass panel 321. In the abutment section 42, the buffer 329b becomes arranged between the first front-face direction slidable panel assembly 31 and the second front-face direction slidable panel assembly 32 when the first front-face direction slidable panel assembly 31 is abutted against the second front-face direction slidable panel assembly 32.

[0112] When the first front-face direction slidable panel assembly 31 and the second front-face direction slidable panel assembly 32 having the configurations described above are abutted against each other in the abutment section 42, the extension portion 313b of the interior-side glass panel 313 forming part of the multi-layered glass 310 of the first front-face direction slidable panel assembly 31 is positioned close to the interior side, whereas the extension portion 321b of the exterior-side glass panel 321 forming part of the multi-layered glass 320 of the second front-face direction slidable panel assembly 32 is positioned close to the exterior side. Consequently, the extension portion 313b close to the interior side and the extension portion 321b close to the exterior side are matched and abutted in the opposite directions in the abutment section 42, while being oppositely oriented on the interior and exterior sides. The stepwise protruding shield portion 316a of the reinforcing member 316 provided to the multi-layered glass 310 of the first front-face direction slidable panel assembly 31 is positioned close to the interior side, whereas the stepwise protruding shield portion 325a of the reinforcing member 325 provided to the multi-layered glass 320 of the second front-face direction slidable panel assembly 32 is positioned close to the exterior side. Consequently, the stepwise protruding shield portion 316a of the reinforcing member 316 and the stepwise protruding shield portion 325a of the reinforcing member 325 are matched with, and abutted against, each other in the abutment section 42, while being oppositely oriented on the interior and exterior sides.

[0113] Known ribbon widows include glass panels fitted via a mullion. To provide improved viewability to a person in a room who views the outside through such a ribbon window including glass panels fitted via a mullion, the mullion is sometimes designed to have a small width in the front-face direction. In this case, the mullion tends to have a large dimension in the front-back direction to increase the strength of the ribbon window. When the ribbon window with the mullion having a large dimension in the front-back direction is viewed from an oblique direction, a surface in the front-back direction of the mullion is viewed. As a result, the viewability from an oblique direction is not sufficiently ensured in some cases. There has been a demand for a ribbon window to improve viewability not only from front, but also from an oblique direction.

[0114] To meet this demand, according to the present invention, when the first front-face direction slidable panel assembly 31 and the second front-face direction slidable panel assembly 32 are abutted against with each other in the abutment section 42, the X2-side end face 311a of the exterior-side glass panel 311, the X2-side end face 313a of the interior-side glass panel 313, and the reinforcing member 316 of the first front-face direction slidable panel assembly 31 face the Xl-side end face 321a of the exterior-side glass panel 321, the Xl-side end face 323a of the interior-side glass panel 323, and the reinforcing member 325 of the second front-face direction slidable panel assembly 32, respectively in the front-face direction.

[0115] As a result, when the sliding window 1 is in the closed position, the multi-layered glass 310 and the multi-layered glass 320 are arranged adjacent to each other in the lateral direction X without any mullion or stile provided therebetween. Thus, as shown in FIG. 6, the X2-side end face 311a of the exterior-side glass panel 311 of the first front-face direction slidable panel assembly 31 is caused to face the Xl-side end face 321a of the exterior-side glass panel 321 of the second front-face direction slidable panel assembly 32, while the X2-side end face 313a of the interior-side glass panel 313 is caused to face the Xl-side end face 323a of the interior-side glass panel 323. Further, the stepwise protruding shield portion 316a and the stepwise flat portion 316b of the reinforcing member 316 of the first front-face direction slidable panel assembly 31 are positioned with respect to the stepwise flat portion 325b and the stepwise protruding shield portion 325a of the reinforcing member 325 of the second front-face direction slidable panel assembly 32 such that the protrusion of one reinforcing member faces the recess of the other reinforcing member and vice versa. In this state, the end of the first front-face direction slidable panel assembly 31 in the front-face direction and the end of the second front-face direction slidable panel assembly 32 in the front-face direction can be abutted against each other in the abutment section 42.

[0116] Arranging the first front-face direction slidable panel assembly 31 and the second front-face direction slidable panel assembly 32 such that they are abutted against each other in the abutment section 42 removes the need for any mullion or stile between the multi-layered glasses 310 and 320 arranged adjacent to each other in the lateral direction X, and causes the exterior-side front-face surfaces of the exterior-side glass panels 311 and 321 that are close to the exterior side to be coplanar with each other and the interior-side front-face surfaces of the interior-side glass panels 313 and 323 that are close to the interior side to be coplanar with each other in the closed position. Since a frame component, such as a mullion or a stile, is not provided between the multi-layered glasses 310 and 320, the sliding window 1 can ensure viewability when viewed from front and when viewed from an oblique direction. In addition, the absence of a frame component, such as a mullion or a stile, between the multi-layered glasses 310 and 320 contributes to de-

sign improvement of the sliding window 1.

[0117] The X2-side end portion of the interior-side glass panel 313 of the first front-face direction slidable panel assembly 31 overlaps with the Xl-side end portion of the exterior-side glass panel 321 of the second front-face direction slidable panel assembly 32 when viewed in the front-back direction. The stepwise protruding shield portion 316a of the reinforcing member 316 of the first front-face direction slidable panel assembly 31 overlaps with the stepwise protruding shield portion 325a of the reinforcing member 325 of the second front-face direction slidable panel assembly 32 when viewed in the front-back direction. This configuration prevents formation of a through gap in the front-back direction in the abutment section 42 where the first front-face direction slidable panel assembly 31 is abutted against the second front-face direction slidable panel assembly 32. As a result, leakage of light from the abutment section 42 is reduce. In addition, the abutment section 42 having no gap contributes to the design improvement.

[0118] Since the X2-side end portion of the interior-side glass panel 313 of the first front-face direction slidable panel assembly 31 overlaps with the Xl-side end portion of the exterior-side glass panel 321 of the second front-face direction slidable panel assembly 32 when viewed in the front-back direction, even if there is a difference in dimension between the interior-side glass panel 313 of the first front-face direction slidable panel assembly 31 and the exterior-side glass panel 321 of the second front-face direction slidable panel assembly 32, formation of a through gap in the front-back direction can be inhibited. Further, even if there is a difference in dimension between the reinforcing members 325 and 316, since they overlap with each other when viewed in the front-back direction, formation of a through gap in the front-back direction can be inhibited.

[0119] The buffer 319b is bonded to the X2-side end portion in the lateral direction X of the first front-face direction slidable panel assembly 31, the buffer 319b being close to the interior side. The buffer 329b is bonded to the Xl-side end portion in the lateral direction X of the second front-face direction slidable panel assembly 32, the buffer 329b being close to the exterior side. When the first front-face direction slidable panel assembly 31 is abutted against the second front-face direction slidable panel assembly 32 in the abutment section 42, the buffers 319b and 329b, which are provided between the first front-face direction slidable panel assembly 31 and the second front-face direction slidable panel assembly 32 and close to the interior side and the exterior side, respectively, absorb impact acting on the glass panels due to closure of the sliding window 1, thereby making it less likely for the glass panels to be broken.

[0120] In the abutment section 42, the slant projection 318a of the airtight member 318 of the first front-face direction slidable panel assembly 31 and the slant projection 328a of the airtight member 328 of the second front-face direction slidable panel assembly 32 contact with, and are pressed onto, each other when the first front-face direction slidable panel assembly 31 is abutted against the second front-face direction slidable panel assembly 32, thereby increasing airtightness.

[0121] Next, support structures for supporting the upper and lower end portions of the front-back direction slidable panel assemblies 21 and 22 will be described. As shown in FIG. 7, the first movable lower-end supports 201 are each disposed at the lower end of the associated one of the pair of front-back direction slidable panel assemblies 21 and 22, and support the pair of front-back direction slidable panel assemblies 21 and 22 movably in the front-back direction Y. The first movable lower-end support 201 is disposed below the airtight member 125b. Thus, the first movable lower-end support 201 is not viewed externally, thereby contributing to the design improvement. Below the first movable lower-end support 201, the front-back direction movement mechanism 5 is provided. Each of the pair of front-back direction slidable panel assemblies 21 and 22 can be moved in the front-back direction Y by means of the front-back direction movement mechanisms 5 (to be described later).

[0122] As shown in FIG. 7, the first movable lower-end support 201 has a first support flat plate 202 and the front-back direction movable sash roller 203. The first support flat plate 202 has a plate shape having a width in the front-back direction Y and extending in the lateral direction X, and is disposed below the front-back direction slidable panel assembly 21, 22. In the present embodiment, the front-back direction slidable panel assemblies 21 and 22 are each placed on an upper surface of the associated first support flat plate 202. Each of the front-back direction slidable panel assemblies 21 and 22 is not fixed to the first support flat plate 202, but is immovable with respect to the first support flat plate 202 due to its own weight. Thus, the front-back direction slidable panel assemblies 21 and 22 are each configured to move integrally with the associated first movable lower-end support 201, so that movement of the first movable lower-end support 201 causes the associated one of the front-back direction slidable panel assemblies 21 and 22 to move.

[0123] The front-back direction movable sash roller 203 is mounted on the lower surface of the first support flat plate 202, and is movable in the front-back direction Y. As shown in FIG. 7, in the vicinity of the end of the sliding window 1 in the lateral direction X, the front-back direction movable sash roller 203 is movable in the front-back direction Y within the lower frame component 12. Specifically, the front-back direction movable sash roller 203 is placed on the sash roller movement upper surface 120a of the sash roller placement frame 120 that is disposed on the upper surface of the lower frame component body 121. The front-back direction movable sash roller 203 has a mounting frame 203a and a pair of wheels 203b (roller members) that have a disc shape and are rotatable about a rotation axis extending in the lateral direction X.

[0124] In the present embodiment, for example, two or more front-back direction movable sash rollers 203 are arranged in the lateral direction X of the sliding window 1. Specifically, each front-back direction movable sash roller 203 has the pair of wheels 203b that are disposed such that a radial direction thereof extends in the front-back direction Y, and that are arranged in parallel to the lateral direction X. The thus arranged wheels 203b form one set of front-back direction movable sash roller 203, and two or more sets of front-back direction movable sash rollers 203 are arranged in the lateral direction X.

[0125] The front-back direction movable sash roller 203 is movable in the front-back direction Y as far as it is on the sash roller movement upper surface 120a of the sash roller placement frame 120. Specifically, in the case of moving in the front-back direction Y toward the interior side, the front-back direction movable sash roller 203 can move until it reaches a location where the front-back direction slidable panel assembly 20 contacts with the airtight member 125b. In the case of moving in the front-back direction Y toward the exterior side, the front-back direction movable sash roller 203 can move until it reaches a location before the exterior-side end of the sash roller movement upper surface 120a of the sash roller placement frame 120.

[0126] As shown in FIG. 7, the first support flat plate 202 of the first movable lower-end support 201 on which the lower end of the associated one of the front-back direction slidable panel assemblies 21 and 22 is disposed is connected to the front-back direction movement mechanism 5 via an L-shaped bracket 204. The upper surface of the first support flat plate 202 of the first movable lower-end support 201 bears the front-back direction slidable panel assembly 21 or 22 placed thereon.

[0127] As shown in FIG. 7, the first upper end supports 206 support the upper end portions of the front-back direction slidable panel assemblies 21 and 22. The first upper end support 206 has a U-shaped bracket 207, an L-shaped support bracket 208, an airtight member 209a, a pressing member 209b, and a fixing screw 209c.

[0128] As shown in FIG. 7, the U-shaped bracket 207 has a U-shaped cross section having a downward opening. In the front-back direction Y, the opening of the U-shaped bracket 207 has a width larger than the width of the front-back direction slidable panel assemblies 21 and 22. The U-shaped bracket 207 is disposed so as to sandwich the upper end portion of the front-back direction slidable panel assembly 21, 22 in the front-back direction Y. The U-shaped bracket 207 has an upper surface to which a horizontal plate 208a forming part of the L-shaped support bracket 208 is connected by, for example, welding.

[0129] The L-shaped support bracket 208 includes a vertical plate 208b that has a lower end connected to an exterior-side end of the horizontal plate 208a, and an upper end connected to an upright plate 582 (to be described later) of a front-back direction movable member 58 of the front-back direction movement mechanism 5. The vertical plate 208b of the L-shaped support bracket 208 or the upright plate 582 of the front-back direction movement mechanism 5 has a screw-fixing slot (not shown) that extends in the vertical direction. The vertical plate 208b of the L-shaped support bracket 208 is screwed to the upright plate 582 of the front-back direction movable member 58 of the front-back direction movement mechanism 5 via the screw-fixing slot. Since the vertical plate 208b of the L-shaped support bracket 208 or the upright plate 582 of the front-back direction movement mechanism 5 has the screw-fixing slot functioning as a screw hole, when the vertical plate 208b of the L-shaped support bracket 208 and the upright plate 582 of the front-back direction movement mechanism 5 are screwed to each other, positional adjustment can be easily implemented in the vertical direction within the screw-fixing slot.

[0130] The airtight member 209a is disposed between an interior-side vertical part 207b forming part of the U-shaped bracket 207 and the interior-side surface of the upper end portion of the front-back direction slidable panel assembly 21, 22. The pressing member 209b is disposed closer than the U-shaped bracket 207 to the exterior side and is arranged on the exterior-side surface of the upper end portion of the front-back direction slidable panel assembly 21, 22.

[0131] The fixing screw 209c is screwed into, and passes through, a screw hole of an exterior-side vertical part 207a forming part of the U-shaped bracket 207, and can be fastened while allowing adjustment of a screwing position in the front-back direction Y. Thus, by means of the fixing screw 209c, the pressing member 209d is pressed onto the exterior-side surface of the upper end portion of the front-back direction slidable panel assembly 21, 22, while the screwing position is adjusted in the front-face direction, so that the upper end portion of the front-back direction slidable panel assembly 21, 22 can be fastened.

[0132] Next, support structures for supporting the upper and lower end portions of the front-face direction slidable panel assemblies 31 and 32 will be described. As shown in FIG. 9, the second movable lower-end supports 301 are each disposed at the lower end of the associated one of the pair of front-face direction slidable panel assemblies 31 and 32, and support the pair of front-face direction slidable panel assemblies 31 and 32 movably in the lateral direction X of the front-face direction. The second movable lower-end support 301 is disposed below the airtight member 125b. Thus, the second movable lower-end support 301 is not viewed externally, thereby contributing the design improvement. Below the second movable lower-end support 301, the front-face direction movement mechanism 6 is provided. Each of the pair of front-face direction slidable panel assemblies 31 and 32 can be moved in the lateral direction X by means of the front-face direction movement mechanism 6 (to be described later).

[0133] As shown in FIG. 9, the second movable lower-end support 301 has a second support flat plate 302 and

the front-face direction movable sash roller 303. The second support flat plate 302 has a plate shape having a width in the front-back direction Y and extending in the lateral direction X, and is disposed below the front-face direction slidable panel assembly 31, 32. In the present embodiment, the front-face direction slidable panel assemblies 31 and 32 are each placed on an upper surface of the associated second support flat plate 302. Each of the front-face direction slidable panel assemblies 31 and 32 is not fixed to the second support flat plate 302, but is immovable with respect to the second support flat plate 302 due to its own weight. Thus, the front-face direction slidable panel assemblies 31 and 32 are each configured to move integrally with the associated second movable lower-end support 301, so that movement of the second movable lower-end support 301 causes the associated one of the front-face direction slidable panel assemblies 31 and 32 to move.

[0134] The front-face direction movable sash roller 303 is mounted on the lower surface of the second support flat plate 302, and is movable in the lateral direction X of the front-face direction. Specifically, the front-face direction movable sash roller 303, which is movable in the lateral direction X of the front-face direction, is on an upper surface 891a of the vertically-movable lid member 89 when it is positioned in the vicinity of the middle of the sliding window 1. In the vicinity of the end of the sliding window 1, the front-face direction movable sash roller 303 is in the lower frame component 12 and positioned on the sash roller movement upper surface 120a of the sash roller placement frame 120 that is disposed on the upper surface of the lower frame component body 121 (see FIGS. 7 and 8). The front-face direction movable sash roller 303 has a mounting frame 303a and a pair of wheels 303b (roller members) that have a disc shape and are rotatable about a rotation axis extending in the front-back direction Y.

[0135] In the present embodiment, for example, two or more front-face direction movable sash rollers 303 are arranged in the lateral direction X of the sliding window 1. Specifically, each front-face direction movable sash roller 303 has the pair of wheels 303b that are disposed such that a radial direction thereof extends in the lateral direction X, and that are arranged in parallel to the front-back direction Y. The thus arranged wheels 303b form one set of front-face direction movable sash roller 303, and two or more sets of front-face direction movable sash rollers 303 are arranged in the lateral direction X.

[0136] For example, the front-face direction movable sash rollers 303 can be arranged at appropriate locations, as shown in FIG. 11A and 11B. FIG. 11A and 11B show arrangements of the front-face direction movable sash rollers 303. FIG. 11A shows a first arrangement example, and FIG. 11B shows a second arrangement example.

[0137] For example, suppose a case where three sets of front-face direction movable sash rollers 303 are arranged below each of the pair of front-face direction slidable panel assemblies 31 and 32. The three sets of front-face direction movable sash rollers 303 may be aligned with each other along a straight line in the lateral direction X of the second support flat plate 302 as shown in FIG. 11A. Alternatively, the three sets of front-face direction movable sash rollers 303 may be arranged in the lateral direction X of the second support flat plate 302 to be alternately close to one and the other ends in the front-back direction Y, i.e., in a staggered arrangement, as shown in FIG. 11B. The number of the sets of front-face direction movable sash rollers 303 is not limited to three, but may be two or four or more.

[0138] As shown in FIG. 9, the second movable upper-end supports 306 support the upper end portions of the front-face direction slidable panel assemblies 31 and 32. The second movable upper-end support 306 has a crank-shaped connector bracket 307.

[0139] The crank-shaped connector bracket 307 has a lower vertical part 307a, a horizontal connection part 307b, and an upper vertical part 307c.

[0140] The lower vertical part 307a extends in the vertical direction along the exterior-side surface of the upper end portion of the front-face direction slidable panel assembly 31, 32.

[0141] The horizontal connection part 307b is connected to an upper end of the lower vertical part 307a, and extends from the upper end of the lower vertical part 307a along the upper surface of the front-face direction slidable panel assembly 31, 32 toward the interior side in the front-back direction Y.

[0142] The upper vertical part 307c is connected to an interior-side end of the horizontal connection part 307b, and extends upward from the interior-side end of the horizontal connection part 307b.

[0143] The crank-shaped connector bracket 307 having the configuration described above is connected, at the lower vertical part 307a and the horizontal connection part 307b, to the upper end portion of the front-face direction slidable panel assembly 31, 32. An upper portion of the upper vertical part 307c of the crank-shaped connector bracket 307 is connected to a coupling member 64 (to be described later) of the front-face direction movement mechanism 6.

[0144] The upper vertical part 307c of the crank-shaped connector bracket 307 or the coupling member 64 of the front-face direction movement mechanism 6 has a screw-fixing slot (not shown) that extends in the vertical direction. The upper vertical part 307c of the L crank-shaped connector bracket 307 is screwed to the coupling member 64 of the front-face direction movement mechanism 6 via the screw-fixing slot. Since the upper vertical part 307c of the crank-shaped connector bracket 307 or the coupling member 64 of the front-face direction movement mechanism 6 has the screw-fixing slot functioning as a screw hole, when the upper vertical part 307c of the crank-shaped connector bracket 307 and the coupling member 64 of the front-face direction movement mechanism 6 are screwed to each other, positional ad-

justment can be easily implemented in the vertical direction within the screw-fixing slot.

[0145] Next, the front-back direction movement mechanism 5 will be described. FIG. 12A is a perspective view of the front-back direction movement mechanism 5, and shows a state in which the front-back direction slidable panel assembly 21, 22 is at an interior-side position. FIG. 12B is a perspective view of the front-back direction movement mechanism 5, and shows a state in which the front-back direction slidable panel assembly 21, 22 is at an exterior-side position.

[0146] The front-back direction movement mechanisms 5 can move the front-back direction slidable panel assemblies 21 and 22 between the interior-side position shown in FIG. 7 (see FIGS. 2 and 12A) and the exterior-side position (see FIGS. 3 and 12B). As shown in FIG. 1, the front-back direction movement mechanisms 5 are coupled to four peripheral portions of each of the front-back direction slidable panel assemblies 21 and 22, and can move the four peripheral portions of each of the front-back direction slidable panel assemblies 21 and 22 in the front-face direction. Thus, the front-back direction movement mechanisms 5 move the respective four peripheral portions of each of the front-back direction slidable panel assemblies 21 and 22 in the front-back direction Y, thereby moving the front-back direction slidable panel assemblies 21 and 22 exclusively in the front-back direction Y.

[0147] The four peripheral portions of the front-back direction slidable panel assemblies 21 and 22 will be described.

[0148] In the present embodiment, the peripheral portion of the front-back direction slidable panel assembly 21, 22 refers to a portion including an outer end of the front-back direction slidable panel assembly 21, 22 in the in-plane direction and an edge face of the end of the front-back direction slidable panel assembly 21, 22 in the in-plane direction, and a vicinity of the portion. In the present embodiment, the outer end of the front-back direction slidable panel assembly 21, 22 in the in-plane direction is a vertically upper end or a vertically lower end of the front-back direction slidable panel assembly 21, 22. The edge face of the end of the front-back direction slidable panel assembly 21, 22 in the in-plane direction is an upward-facing end face of the vertically upper end or a downward-facing end face of the vertically lower end of the front-back direction slidable panel assembly 21, 22, that is, the upper surface of the vertically upper end or the lower surface of the vertically lower end.

[0149] As shown in FIG. 7, in the present embodiment, the upper peripheral portion of the front-back direction slidable panel assembly 21, 22 is coupled to the front-back direction movement mechanism 5 via the first upper end support 206. In detail, at the outer end of the front-back direction slidable panel assembly 21 or 22 in the in-plane direction (in the vertical direction in this embodiment), the upper peripheral portion of the front-back direction slidable panel assembly 21, 22 is sandwiched in the front-back direction Y by the U-shaped bracket 207 of the first upper end support 206 and fastened by means of the pressing member 209d that is pressed onto the exterior-side surface of the upper end portion of the front-back direction slidable panel assembly 21, 22 with the fixing screw 209c. The first upper end support 206 is coupled to the front-back direction movement mechanism 5.

[0150] As shown in FIG. 7, the lower peripheral portion of the front-back direction slidable panel assembly 21, 22 is coupled to the front-back direction movement mechanism 5 via the first movable lower-end support 201. In detail, at the lower surface the lower end of the front-back direction slidable panel assembly 21, 22, the lower peripheral portion of the front-back direction slidable panel assembly 21, 22 is fixed to the first support flat plate 202 of the first movable lower-end support 201. The first support flat plate 202 of the first movable lower-end support 201 is coupled to the front-back direction movement mechanism 5 via the L-shaped bracket 204.

[0151] Note that among the front-back direction movement mechanisms 5 coupled to the four peripheral portions of each of the front-back direction slidable panel assemblies 21 and 22, those coupled to the upper peripheral portions and those coupled to the lower peripheral portions have the same configuration while being oriented in vertically oppositely. Accordingly, the front-back direction movement mechanism 5 coupled to the lower peripheral portion will be described below.

[0152] As shown in FIGS. 7 and 12A, the front-back direction movement mechanism 5 includes a base plate 51, a motor 52 (drive unit), a mounting member 53, a turning shaft 54, a front-face direction movable member 55, a front-face direction guide rail 56, a turnable member 57, the front-back direction movable member 58, and a front-back direction guide rail 59.

[0153] The base plate 51 has a rectangular plate shape.

[0154] The motor 52 is mounted to an upright end plate 511 that is disposed at one end of the base plate 51 in the lateral direction X of the sliding window 1.

[0155] The turning shaft 54 is connected to a rotary shaft of the motor 52 and extends in the lateral direction X. In the present embodiment, the turning shaft 54 is constituted by, for example, a ball-screw mechanism.

[0156] The front-face direction movable member 55 is mounted to an intermediate portion of the turning shaft 54, and moves along the turning shaft 54 in the lateral direction X of the base plate 51 according to turning movement of the turning shaft 54. The front-face direction movable member 55 has a movable member body 551 and a guide member 552 connected to one side of the movable member body 551 in the lateral direction X. The movable member body 551 has a front-back direction slot opening 551a that is formed in the vertical direction from an upper surface of the movable member body 551, and that extends in the front-back direction Y. The front-back direction slot opening 551a receives a lower projection 573 (to be described later) inserted therein, the

lower projection 573 forming part of the turnable member 57.

[0157] The front-face direction guide rail 56 is disposed in parallel to the turning shaft 54, and extends in the lateral direction X of the front-face direction. The front-face direction guide rail 56 is coupled to a lower end portion of the guide member 552 of the front-face direction movable member 55 so as to allow the guide member 552 to move in the lateral direction X. The front-face direction guide rail 56 guides movement of the front-face direction movable member 55 in the lateral direction X.

[0158] The turnable member 57 has a turnable member body 571, a turning shaft 572, the lower projection 573, and an upper projection 574. The turnable member body 571 is disposed in parallel to the base plate 51, and is constituted by a plate member having a substantially triangular shape in planar view. The turnable member body 571 has a flat upper surface. The turning shaft 572, the lower projection 573, and the upper projection 574 are each arranged in an inward vicinity of an associated one of the apexes of the substantially triangular turnable member body 571.

[0159] The turning shaft 572 extends in the vertical direction and supports the vicinity of one apex of the apexes of the substantially triangular turnable member body 571, the one apex being closer than the front-face direction guide rail 56 to the interior side. The turning shaft 572 has a lower end connected to an upper surface of the base plate 51. The turning shaft 572 is disposed closer than the front-face direction guide rail 56 to the interior side. The turnable member 57 turns around the turning shaft 572.

[0160] The lower projection 573 is provided in the vicinity of one apex of the apexes of the substantially triangular turnable member body 571, the one apex being close to the front-face direction movable member 55. The lower projection 573 projects downward from a lower surface of the turnable member body 571. The lower projection 573 is inserted into the front-back direction slot opening 551a formed in the movable member body 551 and extending in the front-back direction. Thus, the lower projection 573 is movable along the front-back direction slot opening 551a of the movable member body 551.

[0161] The upper projection 574 is provided in the vicinity of one apex of the apexes of the substantially triangular turnable member body 571, the one apex being close to the front-back direction movable member 58. The upper projection 574 projects upward from the upper surface of the turnable member body 571. The upper projection 574 passes through a front-face direction slot opening 581a (to be described later) that is formed in a slidable flat plate 581 of the front-back direction movable member 58, and that extends in the lateral direction X of the front-face direction. Thus, the upper projection 574 is movable along the front-face direction slot opening 581a of the slidable flat plate 581.

[0162] As shown in FIGS. 12A and 12B, the front-back direction movable member 58 moves in the front-back direction Y along with turning of the turnable member 57. The front-back direction movable member 58 is movable in the front-back direction Y. Specifically, when slidable flat plate 581 moves in the front-back direction Y, the guide member 583 fixed to a lower surface of the slidable flat plate 581 moves along the front-back direction guide rail 59.

[0163] The front-back direction movable member 58 has an L-shaped cross section. The front-back direction movable member 58 has the slidable flat plate 581 constituted by a rectangular plate and the upright plate 582 standing at an exterior-side end of the slidable flat plate 581.

[0164] The slidable flat plate 581 has a horizontally-extending flat plate shape with a flat lower surface. The slidable flat plate 581 is disposed on the upper surface of the turnable member body 571, and moves in the front-back direction Y while being in surface-contact with the upper surface of the turnable member body 571 when the turnable member 57 turns around the turning shaft 572. Since the turnable member 57 does not have any sharp edge, the slidable flat plate 581 can smoothly move on the upper surface of the turnable member 57 without being caught at the sides of the turnable member 57.

[0165] As shown in FIG. 12A, the slidable flat plate 581 has the front-face direction slot opening 581a that is formed in the vertical direction from an upper surface of the slidable flat plate 581, and that extends in the front-back direction Y. The front-face direction slot opening 581a receives the upper projection 574 inserted therein, the upper projection 574 forming part of the turnable member 57.

[0166] As shown in FIG. 7, the front-back direction movable member 58 that is disposed in the upper frame component has the upright plate 582 connected to the L-shaped support bracket 208 of the first upper end support 206 that supports the upper end portion of the front-back direction slidable panel assembly 21, 22. The front-back direction movable member 58 that is disposed in the lower frame component has the upright plate 582 connected, via the L-shaped bracket 204, to the first support flat plate 202 of the first movable lower-end support 201, the first support flat plate 202 bearing the lower end portion of the front-back direction slidable panel assembly 21, 22 placed thereon.

[0167] In the upper frame component, two or more front-back direction movement mechanisms 5 and a rotary belt 63 (to be described later) of the front-face direction movement mechanism 6 are arranged. As shown in FIG. 13, in a region where the rotary belt 63 extends, the slidable flat plate 581 of the front-back direction movable member 58 has an interior-side end 58a, which can move in the front-back direction Y so as to come into and go out of a ring formed by the rotary belt 63 of the front-face direction movement mechanism 6. Thus, the interior-side end 58a of the slidable flat plate 581 of the front-back direction movable member 58 is provided such that the interior-side end 58a can move while avoiding interfer-

ence with the movement of the rotary belt 63. As a result, the space in the ring formed by the rotary belt 63 can be effectively used, thereby contributing to space saving of the sliding window 1.

[0168] The front-back direction movement mechanism 5 having the configuration described above turns the turning shaft 54 by driving the motor 52 in the state shown in FIG. 12A or 12B so as to move the front-back direction slidable panel assembly 21, 22 in the front-back direction Y. Then, the front-face direction movable member 55 is moved in the lateral direction X while being guided by the front-face direction guide rail 56. As the front-face direction movable member 55 is moved, the lower projection 573 of the turnable member 57, which passes through the front-back direction slot opening 551a of the front-face direction movable member 55, moves along the front-back direction slot opening 551a of the front-face direction movable member 55, thereby causing the turnable member 57 to turn around the turning shaft 572. The turning of the turnable member 57 around the turning shaft 572 moves the upper projection 574 of the turnable member 57 along the front-face direction slot opening 581a, thereby moving the front-back direction movable member 58 in the front-back direction Y. The movement of the front-back direction movable member 58 in the front-back direction Y can move the front-back direction slidable panel assembly 21, 22 in the front-back direction Y.

[0169] Thus, the front-back direction movement mechanisms 5 can move the front-back direction slidable panel assemblies 21 and 22 connected thereto within the frame assembly 10 (the upper frame component 11 and the lower frame component 12) in the front-back direction Y, by driving the motors 52. Hence, the front-back direction movement mechanisms 5 can move the front-back direction slidable panel assemblies 21 and 22 between the interior-side position shown in FIG. 7 (see FIG. 2) or the position shown in FIG. 5 and the exterior-side position (see FIG. 3). The front-back direction movement mechanisms 5, which are coupled to the four peripheral portions of each of the front-back direction slidable panel assemblies 21 and 22, support each of the front-back direction slidable panel assemblies 21 and 22 at four, i.e., the four peripheral portions, and can stably and reliably move the front-back direction slidable panel assemblies 21 and 22 in the front-back direction Y.

[0170] Next, the front-face direction movement mechanism 6 will be described. The front-face direction movement mechanism 6 can move the front-face direction slidable panel assembly 31, 32 in the front-face direction. The front-face direction movement mechanism 6 is disposed above the associated one of the front-face direction slidable panel assemblies 31 and 32, and is arranged in the upper frame component 11, as shown in FIGS. 9 and 13. Further, the lower frame component 12 is provided with a front-face direction guide mechanism 66 that guides movement of the front-face direction slidable panel assembly 31, 32 when the panel assembly 31, 32 is moved by the front-face direction movement mechanism 6.

[0171] As shown in FIGS. 9 and 13, the front-face direction movement mechanism 6 includes a pair of motors 61, a pair of pulleys 62, the rotary belt 63 wrapped around the pair of pulleys 62, a coupling member 64, and an anti-vibration mechanism 65 (see FIG. 9).

[0172] The motors 61 drive and rotate the pulleys 62. As shown in FIG. 13, the pulleys 62 are disposed above the front-face direction slidable panel assembly 31, 32, and are spaced apart from each other in the lateral direction X. When driven by the motors 61, the pulleys 62 rotate around a rotation axis extending in the front-back direction Y. The rotary belt 63 is constituted by an endless belt and has an annular shape. The rotary belt 63 is wrapped around the pair of pulleys 62 spaced apart from each other in the lateral direction X. The rotary belt 63 rotates when the pulleys 62 rotate.

[0173] The coupling member 64 is coupled to a lower portion of the rotary belt 63. As shown in FIG. 9, the coupling member 64 couples the rotary belt 63 to the crank-shaped connector bracket 307 that is connected to the upper end portion of the front-face direction slidable panel assembly 31, 32. When the rotary belt 63 is rotated to move the coupling member 64 in the lateral direction X, the front-face direction slidable panel assembly 31, 32 is moved in the lateral direction X.

[0174] The anti-vibration mechanism 65 reduces vibration in the front-back direction Y of the front-face direction slidable panel assembly 31, 32. As shown in FIG. 9, the anti-vibration mechanism 65 includes an anti-vibration rail frame 651, a roller member 653, and a roller support 652.

[0175] The anti-vibration rail frame 651 has a U-shaped cross section that opens upward, and extends in the lateral direction X of the front-face direction in a region in which the rotary belt 63 is disposed and which lies in the lateral direction X.

[0176] The roller member 653 is a disc-shaped roller that is disposed such that a radial direction thereof extends substantially horizontally. The roller member 653 is disposed within the anti-vibration rail frame 651, and has a diameter approximately as large as the width of the anti-vibration rail frame 651. The roller member 653 is mounted to the lower surface of the roller support 652 such that the roller member 653 is rotatable around a rotation axis extending in the vertical direction.

[0177] The roller support 652 has an L-shaped cross section, supports the roller member 653, and is connected to the coupling member 64. When the front-face direction slidable panel assembly 31, 32 and the coupling member 64 are moved in the lateral direction X of the front-face direction, the roller support 652 moves in the lateral direction X of the front-face direction, simultaneously with the movement of the coupling member 64 in the lateral direction X.

[0178] As shown in FIG. 9, the front-face direction guide mechanism 66 is provided in the lower frame com-

ponent 12. When the front-face direction slidable panel assembly 31, 32 is moved in the lateral direction X, the front-face direction guide mechanism 66 guides the movement of the front-face direction slidable panel assembly 31, 32 in the lateral direction X, while restraining the slidable panel assembly 31, 32 from moving toward the exterior side in the front-back direction Y.

[0179] The lower frame component 12 includes therein an inner frame 126a, which is hollow and formed in an interior-side end portion above the lower frame component body 121. The inner frame 126a has an upper surface 126b and a projection part 126c projecting upward from an exterior-side end portion of the upper surface 126b. As shown in FIG. 9, the front-face direction guide mechanism 66 has a guide projecting part 661 constituted by the projection part 126c of the lower frame component 12, a guide roller member 662, and a guide roller support 663.

[0180] As shown in FIGS. 8 and 9, the guide projection part 661 extends upward from the inner frame 126a of the lower frame component body 121. The guide projection part 661 extends over an entire region in which the front-face direction slidable panel assembly 31, 32 moves and which lies in the lateral direction X.

[0181] The guide roller member 662 is a disc-shaped roller that is disposed such that a radial direction thereof extends substantially horizontally. The guide roller member 662 is disposed in contact with the interior-side surface of the guide projection part 661. The guide roller member 662 is mounted to the lower surface of the guide roller support 663 such that the guide roller member 662 is rotatable around a rotary shaft 662a extending in the vertical direction.

[0182] The guide roller support 663 has an L-shaped cross section, and has one side supporting the guide roller member 662 and the other side connected to the interior-side surface of the front-face direction movable sash roller 303 of the second movable lower-end support 301. When the front-face direction slidable panel assembly 31, 32 and the second movable lower-end support 301 are moved in the lateral direction X of the front-face direction, the guide roller support 663 moves in the lateral direction X of the front-face direction, simultaneously with the movement of the second movable lower-end support 301 in the lateral direction X.

[0183] In the front-face direction movement mechanism 6 having the configuration described above, the motors 61 rotate the pulleys 62 whereby the rotary belt 63 is rotated. As a result, the front-face direction movement mechanism 6 can move the associated one of the front-face direction slidable panel assemblies 31 and 32 in the lateral direction X, via the coupling member 64.

[0184] The anti-vibration mechanism 65 allows the roller member 653 to move while being guided by the anti-vibration rail frame 651. Thus, in the vicinity of the middle of the sliding window 1 in the lateral direction X, the anti-vibration mechanism 65 can reduce vibration in the front-back direction Y when the front-face direction slidable panel assembly 31, 32 is moved in the lateral direction X.

[0185] As shown in FIG. 9, in the vicinity of the middle of the lower frame component 12 in the lateral direction X, the front-face direction guide mechanism 66 can guide the movement of the front-face direction slidable panel assembly 31, 32 in the lateral direction X, while restraining the slidable panel assembly 31, 32 from moving toward the exterior side in the front-back direction Y. As shown in (D) of FIG. 14, in the vicinity of the end the lower frame component 12 in the lateral direction X, the front-face direction guide mechanism 66 can guide the movement of the front-face direction slidable panel assembly 31, 32 in the lateral direction X, while restraining the slidable panel assembly 31, 32 from moving toward the exterior side in the front-back direction Y.

[0186] Next, the end-positioned lid opening-closing mechanisms 7 will be described. FIG. 14 shows how the lower frame component's exterior-side lid 128 is opened and closed. FIG. 15 shows how the upper frame component's exterior-side lid 118 is opened and closed.

[0187] As shown in FIG. 8, the end-positioned lid opening-closing mechanisms 7 include a lower lid opening-closing mechanism 71 disposed in the lower frame component 12 and an upper lid opening-closing mechanism 72 disposed in the upper frame component 11. When the front-back direction movement mechanisms 5 move the front-back direction slidable panel assembly 21, 22 in the front-back direction Y, the lower lid opening-closing mechanism 71 opens and closes an exterior-side portion of the lower frame component's upward opening 127 with the lower frame component's exterior-side lid 128 so that the lower frame component's space S2 is covered and uncovered. When the front-back direction movement mechanisms 5 move the front-back direction slidable panel assembly 21, 22 in the front-back direction Y, the upper lid opening-closing mechanism 72 opens and closes an exterior-side portion of the upper frame component's downward opening 117 with the upper frame component's exterior-side lid 118.

[0188] In the present embodiment the end-positioned lid opening-closing mechanisms 7 (the lower lid opening-closing mechanism 71, the upper lid opening-closing mechanism 72) are configured to open and close the lower frame component's exterior-side lid 128 and the upper frame component's exterior-side lid 118 when the front-back direction slidable panel assemblies 21 and 22 are moved in the front-back direction Y by driving the motors 52 of the front-back direction movement mechanisms 5. However, this is a non-limiting example. Even without the driver unit such as the motor, the lower frame component's exterior-side lid 128 and the upper frame component's exterior-side lid 118 can be opened and closed by, for example, manually moving the front-back direction slidable panel assemblies 21 and 22.

[0189] The lower lid opening-closing mechanism 71 will be described. As shown in FIG. 8, the lower lid opening-closing mechanism 71 is disposed in the lower frame component 12, and includes the lower frame compo-

nent's exterior-side lid 128, a lower opening-closing turnable member 711 (turnable member), a lower coupling-retaining member 712, and a lower turn-restraining unit 713. The lower frame component's exterior-side lid 128 is provided to the first window assemblies 200.

[0190] The lower coupling-retaining member 712 is coupled to the first movable lower-end support 201 (front-back direction movable sash roller 203) and retains the lower opening-closing turnable member 711 when the lower frame component's exterior-side lid 128 is in a closure position. The lower frame component's exterior-side lid 128 is mounted to the front-back direction movable sash roller 203 of the first window assembly 200 via the first movable lower-end support 201 of the first window assembly 200. The lower coupling-retaining member 712 has a crank-shaped lower coupling member 712a, an L-shaped lower retaining member 712b, and a projection part 712c connected to the lower coupling member 712a.

[0191] The lower coupling member 712a has one end connected to the first movable lower-end support 201 (front-back direction movable sash roller 203) and the other end connected to the lower retaining member 712b and the projection part 712c. The lower retaining member 712b has an L-shape, and retains a retaining roller 711z (to be described later) of the lower opening-closing turnable member 711 when the lower frame component's exterior-side lid 128 is in the closure position.

[0192] The lower opening-closing turnable member 711 supports the lower frame component's exterior-side lid 128 such that the lid 128 can turn in the inside of the lower frame component 12. The lower opening-closing turnable member 711 has a crank shape, and includes an intermediate part 711a that is positioned inside the frame assembly 10 when the lower frame component's exterior-side lid 128 is in the closure position, a first extension part 711b that is disposed close to the exterior side with respect the intermediate part 711a and extends toward the lower frame component's exterior-side lid 128, i.e., toward the lower frame component's upward opening 127 of the frame assembly 10, and a second extension part 711c that is disposed close to the interior side with respect to the intermediate part 711a and extends toward the lower frame component body 121 of the frame assembly 10.

[0193] The lower opening-closing turnable member 711 has a turning shaft 711x provided in one end portion of the second extension part 711c, the one end being opposite to the intermediate part 711a in the vertical direction. The turning shaft 711x is turnably connected to a fixed member 121p fixed to the lower frame component 12. The first extension part 711b is provided with a support roller 711y at its end close to the lower frame component's exterior-side lid 128. The intermediate part 711a is provided with the retaining roller 711z in an interior-side portion thereof.

[0194] The support roller 711y rotates while supporting the back surface (lower surface) of the lower frame component's exterior-side lid 128, the back surface facing the inside of the lower frame component 12.

[0195] When lower frame component's exterior-side lid 128 is in the closure position, the retaining roller 711z is positioned on the interior-side portion of the L-shaped lower retaining member 712b and retained by the L-shaped lower retaining member 712b.

[0196] The lower opening-closing turnable member 711 can be turned around the turning shaft 711x provided in the end portion of the second extension part 711c. The lower opening-closing turnable member 711 has such a weight balance that, under its own weight, the lower opening-closing turnable member 711 turns around the turning shaft 711x so as to fall toward the exterior side.

[0197] When the lower turn-restraining unit 713 (to be described later) stops restraining the lower opening-closing turnable member 711 and the lower retaining member 712b stops applying retaining force to the retaining roller 711z, the lower opening-closing turnable member 711 turns around the turning shaft 711x so as to fall toward the exterior side, under its own weight.

[0198] The lower frame component's exterior-side lid 128 is turnably mounted to the projection part 712c of the lower coupling-retaining member 712. The back surface (lower surface) of the lower frame component's exterior-side lid 128 is supported on the support roller 711y of the lower opening-closing turnable member 711, the back surface facing the inside of the lower frame component 12.

[0199] The lower turn-restraining unit 713 has a drive unit 713a and a restraining rod 713b (lock unit). The restraining rod 713b is configured to reciprocate according to, for example, operation of a solenoid that is incorporated in the drive unit 733a. Thus, the restraining rod 713b can be moved switchably between a locked state (see (A) of FIG. 14) in which the lower opening-closing turnable member 711 is restrained from turning toward the inside of the lower frame component 12 so that the lower frame component's exterior-side lid 128 is restrained from moving, and an unlocked state in which the restraining rod 713b is retracted so that the lower opening-closing turnable member 711 is not restrained from turning and the lower frame component's exterior-side lid 128 is released from the locked state.

[0200] Next, it will be described how the lower lid opening-closing mechanism 71 having the configuration described above opens and closes the lower frame component's exterior-side lid 128.

[0201] First, as shown in (A) of FIG. 14, in the closure position, the lower opening-closing turnable member 711 is maintained in the locked state and is restrained by the restraining rod 713b of the lower turn-restraining unit 713. From this state, the restraining rod 713b is caused to stop retraining the lower opening-closing turnable member 711. In the unlocked state in which the restraining rod 713b does not restrain the lower opening-closing turnable member 711, the front-back direction slidable panel assembly 21, 22 is moved away from the interior side and toward the exterior side in the front-back direction

Y. Consequently, the locked state of the restraining rod 713b is released, and the lower retaining member 712b stops applying the retaining force to the retaining roller 711z. Then, as shown in (B) of FIG. 14, the lower opening-closing turnable member 711 turns around the turning shaft 711x so as to fall toward the exterior side, under its own weight. The lower frame component's exterior-side lid 128 is then inclined so that an exterior-side portion thereof is lowered.

[0202] Subsequently, the front-back direction slidable panel assembly 21, 22 is further moved away from the interior side and toward the exterior side in the front-back direction Y, so that the turning movement of the lower opening-closing turnable member 711 is stopped, as shown in (C) of FIG. 14. As the front-back direction slidable panel assembly 21, 22 is further moved away from the interior side and toward the exterior side in the front-back direction Y, the lower frame component's exterior-side lid 128 turns around its portion mounted to the projection part 712c, so as to be accommodated in an exterior-side end portion of the inside of the lower frame component 12, as shown in (D) of FIG. 14. In this way, the lower frame component's exterior-side lid 128 can be moved from the closure position to the non-closure position. Thereafter, as shown in (D) of FIG. 14, the front-face direction slidable panel assembly 31, 32 is moved toward the end in the lateral direction X of the front-face direction. As a result, the sliding window 1 transitions to the open position (FIG. 4).

[0203] To move the lower frame component's exterior-side lid 128 from the non-closure position to the closure position, the front-back direction slidable panel assembly 21, 22 is moved away from the exterior side and toward the interior side in the front-back direction Y so that the above-described series of movements from the closure position to the non-closure position takes place in inverse order. Thus, the lower frame component's exterior-side lid 128 can be moved from the non-closure position to the closure position.

[0204] The upper lid opening-closing mechanism 72 will be described.

[0205] In the following description of the upper lid opening-closing mechanism 72, differences from the lower lid opening-closing mechanism 71 will be mainly described. The upper lid opening-closing mechanism 72 differs from the lower lid opening-closing mechanism 71 mainly in that the upper lid opening-closing mechanism 72 opens and closes the upper frame component's exterior-side lid 118 and includes a spring member 724. Further, while the lower lid opening-closing mechanism 71 is disposed in the lower frame component 12 and turnably connected to the fixed member 121p, the upper lid opening-closing mechanism 72 is disposed in the upper frame component 11 and turnably connected to a fixed member 111p.

[0206] As shown in FIG. 8, the upper lid opening-closing mechanism 72 is disposed in the upper frame component 11, and includes the upper frame component's exterior-side lid 118, an upper opening-closing turnable member 721 (turnable member), an upper coupling-retaining member 722, an upper turn-restraining unit 723 (restraining member), and the spring member 724. The upper frame component's exterior-side lid 118 is provided to the first window assembly 200.

[0207] Here, the upper lid opening-closing mechanism 72 includes the "upper frame component's exterior-side lid 118", the "upper opening-closing turnable member 721", an "intermediate part 721a", a "first extension part 721b", a "second extension part 721c", a "turning shaft 721x", a "support roller 721y", a "retaining roller 721z", the "upper coupling-retaining member 722", an "upper coupling member 722a", an "upper retaining member 722b" a "projection part 722c", the "upper turn-restraining unit 723", a "drive unit 723a", and a "restraining rod 723b" that correspond to the "lower frame component's exterior-side lid 128", the "lower opening-closing turnable member 711", the "lower opening-closing turnable member 711", the "intermediate part 711a", the "first extension part 711b", the "second extension part 711c", the "turning shaft 711x", the "support roller 711y", the "retaining roller 711z", the "lower coupling member 712a", the "lower retaining member 712b", the "projection part 712c", the "lower turn-restraining unit 713", the "drive unit 713a", and the "restraining rod 713b" of the lower lid opening-closing mechanism 71 described above, respectively. Therefore, a description will be omitted for some of the components of the upper lid opening-closing mechanism 72, to which the above-provided description of the corresponding components of the lower lid opening-closing mechanism 71 applies.

[0208] As shown in FIG. 8, the upper lid opening-closing mechanism 72 includes the spring member 724 disposed between the upper opening-closing turnable member 721 and the fixed member 111p fixed to the upper frame component 11, unlike the lower lid opening-closing mechanism 71. Thus, the spring member 724 urges the upper opening-closing turnable member 721 in a direction in which the upper frame component's exterior-side lid 118 is opened. The upper frame component's exterior-side lid 118 is connected to the upper end portion of the front-back direction slidable panel assembly 21, 22 via the upper coupling-retaining member 722.

[0209] Next, it will be described how the upper lid opening-closing mechanism 72 having the configuration described above opens and closes the upper frame component's exterior-side lid 118.

[0210] First, as shown in (A) of FIG. 15, in a closure position, the upper opening-closing turnable member 721 is maintained in a locked state and is restrained by the restraining rod 723b of the upper turn-restraining unit 723. From this state, the restraining rod 723b is caused to stop retraining the upper opening-closing turnable member 721. In an unlocked state in which the restraining rod 723b does not restrain the upper opening-closing turnable member 721, the front-back direction slidable panel assembly 21, 22 are moved away from the interior side and toward the exterior side in the front-back direc-

tion Y. Consequently, the locked state of the restraining rod 723b is released, and the upper retaining member 722b stops applying retaining force to the retaining roller 721z. Then, as shown in (B) of FIG. 15, the upper opening-closing turnable member 721 turns around the turning shaft 721x so as to fall toward the exterior side, due to the urging force of the spring member 724. The upper frame component's exterior-side lid 118 is then inclined so that an exterior-side portion thereof is raised.

[0211] Subsequently, the front-back direction slidable panel assembly 21, 22 is further moved away from the interior side and toward the exterior side in the front-back direction Y, so that the turning movement of the upper opening-closing turnable member 721 is stopped, as shown in (C) of FIG. 15. As the front-back direction slidable panel assembly 21, 22 is further moved away from the interior side and toward the exterior side in the front-back direction Y, the upper frame component's exterior-side lid 118 turns around its portion mounted to the projection part 722c, so as to be accommodated in an exterior-side end portion of the inside of the upper frame component 11, as shown in (D) of FIG. 15. In this way, the upper frame component's exterior-side lid 118 can be moved from the closure position to the non-closure position.

[0212] To move the upper frame component's exterior-side lid 118 from the non-closure position to the closure position, the front-back direction slidable panel assembly 21, 22 is moved away from the exterior side and toward the interior side in the front-back direction Y so that the above-described series of movements from the closure position to the open position takes place in inverse order. Thus, the upper frame component's exterior-side lid 118 can be moved from the non-closure position to the closure position.

[0213] The end-positioned lid opening-closing mechanism 7 (the upper lid opening-closing mechanism 72, the lower lid opening-closing mechanism 71) having the configuration described above opens and closes the upper frame component's exterior-side lid 118 or the lower frame component's exterior-side lid 128 to uncover and cover the upper frame component's space S1 or the lower frame component's space S2 in accordance with the movement of the front-back direction slidable panel assembly 20 in the front-back direction Y. Thus, with the end-positioned lid opening-closing mechanism 7, the upper frame component's space S1 or the lower frame component's space S2 present in the groove portion of the frame assembly 10 can be easily closed with the upper frame component's exterior-side lid 118 or the lower frame component's exterior-side lid 128 after the front-back direction slidable panel assembly 20 has moved in the front-back direction Y. Simply turning the upper opening-closing turnable member 721 or the lower opening-closing turnable member 711 enables the upper frame component's exterior-side lid 118 or the lower frame component's exterior-side lid 128 to be opened and closed. The front-back direction slidable panel assembly 20 is moved in the front-back direction Y by driving the motors 52, whereby the upper frame component's exterior-side lid 118 or the lower frame component's exterior-side lid 128 can be easily opened and closed.

[0214] In the closure position, the end-positioned lid opening-closing mechanism 7 (the lower lid opening-closing mechanism 71, the upper lid opening-closing mechanism 72) does not allow the front-back direction slidable panel assembly 21, 22 to move in the front-back direction Y. Thus, a function of preventing crime is provided.

[0215] Specifically, in the locked state, the restraining rod 713b of the lower turn-restraining unit 713 and the restraining rod 723b of the upper turn-restraining unit 723 restrain the lower frame component's exterior-side lid 128 and the upper frame component's exterior-side lid 118 from being opened and closed. Thus, the lower frame component's exterior-side lid 128 and the upper frame component's exterior-side lid 118 cannot be moved from the closure position to the non-closure position, which prevents the front-back direction slidable panel assemblies 21 and 22 from moving in the front-face direction. Thus, the sliding window 1 is prevented from transitioning from the closed position to the open position.

[0216] In the present embodiment, the motor 52 (lock unit) of the front-back direction movement mechanism 5 is constituted by a motor that is configured to be braked and locked in the event of a power failure. The motor 52 is switchable between a locked state in which the lower frame component's exterior-side lid 128 or the upper frame component's exterior-side lid 118 is restrained from moving, and an unlocked state in which the lower frame component's exterior-side lid 128 or the upper frame component's exterior-side lid 118 is unlocked. Thus, when power fails, the motor 52 is braked to be brought into the locked state, in which the front-back direction slidable panel assemblies 21 and 22 are not allowed to move in the front-back direction Y. Consequently, the lower frame component's exterior-side lid 128 and the upper frame component's exterior-side lid 118 cannot move to the non-closure position, whereby the sliding window 1 cannot transition from the closed position to the open position. Note that from the viewpoint of cost reduction, a motor configured not to be braked at the time of a power failure may be employed.

[0217] As can be seen, when the sliding window 1 of the present embodiment is in the closed position, the restraining function provided by the restraining rod 713b of the lower turn-restraining unit 713 or the restraining rod 723b of the upper turn-restraining unit 723 and/or the restraining function provided by the braking of the motor 52 lock and restrain the upper frame component's exterior-side lid 118 or the lower frame component's exterior-side lid 128 from moving from the closed position to the open position, thereby making it impossible to open the sliding window 1. This feature can reduce or prevent intrusion into the room. Thus, the sliding window 1 has a crime prevention function.

[0218] Further, the restraining rod 713b of the lower turn-restraining unit 713 or the restraining rod 723b of the upper turn-restraining unit 723 lock and prevent the lower frame component's exterior-side lid 128 or the upper frame component's exterior-side lid 118 from being opened and closed, thereby making the front-back direction slidable panel assemblies 21 and 22 more resistant to wind pressure.

[0219] The front-back direction movement mechanism 5 described above brings the lower opening-closing turnable member 711 or the upper opening-closing turnable member 721 into locked state, whereby the lower frame component's exterior-side lid 128 or the upper frame component's exterior-side lid 118 can be maintained in the closure position. With this feature, a crime prevention function is imparted. In addition, this feature enhances the resistance to window pressure.

[0220] Next, the middle-positioned lid raising-lowering mechanism 8 will be described. FIG. 16A is a perspective view of the middle-positioned lid raising-lowering mechanism 8, and shows a state in which the mechanism 8 is in a descent position. FIG. 16B is a perspective view of the middle-positioned lid raising-lowering mechanism 8, and shows a state in which the mechanism 8 is in an ascent position.

[0221] As shown in FIG. 1, the middle-positioned lid raising-lowering mechanisms 8 are arranged in the vicinity of the middle of in the lateral direction X of the sliding window 1 in the closed position, and are provided in the lower frame component 12 located below the front-face direction slidable panel assemblies 31 and 32.

[0222] After the front-face direction slidable panel assembly 31, 32 is moved toward the end, the middle-positioned lid raising-lowering mechanism 8 is moved from the descent position shown in FIG. 9 (see FIG. 16A) to the ascent position shown in FIG. 10 (see FIG. 16B), so that the vertically-movable lid member 89 can be raised to close the groove portion M present in an interior-side portion in the lower frame component's upward opening 127 located in the vicinity of the middle of the lower frame component 12 in the lateral direction X. The groove portion M can accommodate therein the lower end portions of the front-face direction slidable panel assemblies 31 and 32. The vertically-movable lid member 89 can be raised to become coplanar with the upper end of the groove portion M, thereby covering the groove portion M. Thus, the groove portion M of the lower frame component's upward opening 127 of the lower frame component 12 is closed by the vertically-movable lid member 89 having an upper surface 891a, so that a barrier-free structure is achieved.

[0223] As shown in FIGS. 16A and 16B, the middle-positioned lid raising-lowering mechanism 8 includes a motor 82 (raising-lowering drive unit) that has a motor-side base member 81 and a rotary shaft 83 (drive shaft), a movable member 84 that is movable in the lateral direction X, a guide rail 85, a scissor arm 86, a scissor arm-accommodating base frame 87 that is connected to an interior-side portion of the motor-side base member 81, a scissor arm's movable frame 88, and the vertically-movable lid member 89 (lid member; see FIGS. 9 and 10). The middle-positioned lid raising-lowering mechanism 8 of the present embodiment is of a motor-straight type, and includes the motor 82 and the scissor arm 86 that are aligned with each other along a straight line.

[0224] As shown in FIGS. 9, 10, 16A, and 16B, the motor-side base member 81 has a motor-side base plate 811 placed on a surface of the lower frame component 12 facing the inside, and a motor-side bent part 812.

[0225] The motor-side base plate 811 extends in the lateral direction X. The motor 82 is connected to the other end of the motor-side base member 81. The rotary shaft 83 is disposed above the motor-side base member 81, and extends in a longitudinal direction of the lower frame component 12. The rotary shaft 83 extends from an axis of the motor 82 toward one end in the lateral direction X. The movable member 84 is mounted to an intermediate portion of the rotary shaft 83 in the lateral direction X. When the motor 82 is driven, the rotary shaft 83 is actuated to move the movable member 84 in the lateral direction X. The rotary shaft 83 is connected to an end portion of the scissor arm 86 in the longitudinal direction of the lower frame component 12 via the movable member 84 (to be detailed later), and is constituted by a ball-screw mechanism (screw mechanism) that is driven and rotated to raise and lower the vertically-movable lid member 89.

[0226] The motor-side base plate 811 has, at both ends in the lateral direction X, motor-side bent parts 812a having an L-shaped cross section. Specifically, the motor-side bent parts 812a rise from both ends in the front-back direction Y of the motor-side base plate 811, bend outward in the front-back direction Y, and project substantially horizontally in the front-back direction Y. The motor-side bent part 812a located close to the interior side has an upper surface overlaid on an upper surface of a frame-side rising-bent part 121a (rib) and fixed with a screw 812b moved from above. The frame-side rising-bent part 121a has an L-shaped cross section, includes a portion projecting from a surface of the lower frame component 12 facing the inside of the frame assembly 10 toward the inside of the lower frame component 12 (upward in the present embodiment), and a portion projecting outward in the front-back direction Y from the end of the foregoing portion. The frame-side rising-bent part 121a is a rib via which the middle-positioned lid raising-lowering mechanism 8 is mounted to the lower frame component 12.

[0227] With this configuration, the motor-side bent part 812a is suitably fixed to the frame-side rising-bent part 121a of the lower frame component 12 with the screw, thereby contributing to improvement of workability. Since the upper surface of the motor-side bent part 812a is overlaid on the upper surface of the frame-side rising-bent part 121a (rib) and fixed with the screw 812b moved from above, the fixing position is easily accessible, thereby achieving satisfactory work efficiency. In addition, the

above configuration eliminates the need for forming a screw hole in the lower frame component 12 for mounting of the middle-positioned lid raising-lowering mechanism 8, thereby improving the watertightness. Since there is the possibility that water flows along the frame-side rising-bent part 121a, it is preferable to form a water drainage hole (not shown) at an end of a portion of the lower frame component 12 in the lateral direction X, the portion being provided with the frame-side rising-bent part 121a.

[0228] The scissor arm-accommodating base frame 87 extends in the lateral direction X, and is disposed offset from the motor-side base member 81 toward the interior side in the front-back direction Y, and toward one end in the lateral direction. The scissor arm-accommodating base frame 87 has an arm frame body 871 disposed close to one end in the lateral direction X, a guide rail placement plate 872 disposed close to the other end in the lateral direction, and arm accommodation-side bent parts 873. The arm frame body 871 and the guide rail placement plate 872 are aligned with each other along a straight line in the lateral direction X.

[0229] The guide rail placement plate 872 bears the guide rail 85 placed thereon. The guide rail 85 extends in the lateral direction X. The guide rail 85 is coupled to the movable member 84 that is movable in the lateral direction X.

[0230] The movable member 84 extends in the front-back direction Y, and is coupled to, and disposed between, the rotary shaft 83 disposed at the motor-side base plate 811 and the guide rail 85 placed on the guide rail placement plate 872. The movable member 84 is guided by the guide rail 85 such that the movable member 84 can move in the lateral direction X. The movable member 84 has a movable member body 841 that has an L-shaped cross section and extends in the front-back direction Y, and a projection plate 842 that extends from an interior-side portion toward the scissor arm 86. The projection plate 842 has a leading end connected to the scissor arm 86. When the movable member 84 moves in the lateral direction X, the scissor arm 86 connected to the leading end of the projection plate 842 of the movable member 84 extends upward or contacts downward.

[0231] In the vertical direction, the scissor arm 86 is disposed between the arm frame body 871 and the scissor arm's movable frame 88.

[0232] The arm frame body 871 has a U-shaped cross section that opens upward. The scissor arm 86 is disposed in an upper portion of an inside of the arm frame body 871.

[0233] The scissor arm's movable frame 88 has a U-shaped cross section that opens downward. The scissor arm 86 is disposed in a lower portion of an inside of the scissor arm's movable frame 88.

[0234] The scissor arm 86 has a pair of dual arm parts 861, a coupling turn shaft 862 that turnably couples the pair of dual arm parts 861 to each other while maintaining the dual arm parts 861 crossing each other, an accommodation-side pivot shaft 863, a movement-side non-slidable shaft 864, an accommodation-side slidable shaft 865, and a movement-side slidable shaft 866. The scissor arm 86 can extend and contact in the direction in which the vertically-movable lid member 89 is raised and lowered, according to the movement in the lateral direction X of the projection plate 842 of the movable member 84.

[0235] The dual arm parts 861 each have a plate shape extending in a predetermined direction and cross each other. The pair of dual arm parts 861 are turnably coupled to each other by means of the coupling turn shaft 862 disposed at substantially the longitudinally middle of the arm parts 861. In the pair of dual arm parts 861, two arm parts 861 facing and connected to each other form one set of arm parts.

[0236] The pair of dual arm parts 861 are turnably connected to one end in the lateral direction X of the arm frame body 871 by the accommodation-side pivot shaft 863, and to the other end in the lateral direction X of the arm frame body 871 by the accommodation-side slidable shaft 865 such that the pair of dual arm parts 861 can slide along an accommodation-side slide slot 871b formed in the arm frame body 871. The accommodation-side slide slot 871b is formed adjacent to the other end in the lateral direction X of a side plate 871a of the arm frame body 871, passes through the side plate 871a in the front-back direction Y, and extends in the lateral direction X.

[0237] The pair of dual arm parts 861 are turnably connected to one end in the lateral direction X of the scissor arm's movable frame 88 (to be detailed later) by the movement-side non-slidable shaft 864, and to the other end in the lateral direction X of the scissor arm's movable frame 88 by the movement-side slidable shaft 866 such that the pair of dual arm parts 861 can slide along a movement-side slide slot 881a formed in the scissor arm's movable frame 88. The movement-side slide slot 881a is formed adjacent to the other end in the lateral direction X of a side wall 881 of the scissor arm's movable frame 88, passes through a side wall of the motor-side base plate 811 in the front-back direction Y, and extends in the lateral direction X.

[0238] The arm accommodation-side bent parts 873 are disposed at both ends in the lateral direction X of the scissor arm-accommodating base frame 87 and have an L-shaped cross section. Specifically, the arm accommodation-side bent parts 873 rise from both ends in the front-back direction Y of the scissor arm-accommodating base frame 87, bend outward in the front-back direction Y, and project substantially horizontally in the front-back direction Y. The arm accommodation-side bent part 873a located close to the exterior side has an upper surface overlaid on the upper surface of the frame-side rising-bent part 121a (rib) and fixed with a screw 873b moved from above.

[0239] With this configuration, the arm accommodation-side bent part 873a is suitably fixed to the frame-side rising-bent part 121a of the lower frame component 12

with the screw, thereby contributing improvement of workability. Since the upper surface of the arm accommodation-side bent part 873a is overlaid on the upper surface of the frame-side rising-bent part 121a (rib) and fixed with the screw 873b moved from above, the fixing position is easily accessible, thereby achieving satisfactory work efficiency. In addition, the above configuration eliminates the need for forming a screw hole in the lower frame component 12 for mounting of the middle-positioned lid raising-lowering mechanism 8, thereby improving the watertightness.

[0240] As shown in FIGS. 9 and 10, the vertically-movable lid member 89 is connected to an upper portion of the scissor arm's movable frame 88. The vertically-movable lid member 89 has a lid body 891 having a U-shaped cross section, and a pair of vertical positioning ribs 892. The vertically-movable lid member 89 can be raised to become coplanar with the upper end of the groove portion M to cover the groove portion M. The lid body 891 has the planar upper surface 891a. In the closure position, the upper surface 891a of the lid body 891 is arranged coplanarly with an upper surface 125c (interior-side surface; see FIG. 10) of the lower frame component 12.

[0241] Each of the vertical positioning ribs 892 is disposed close to the upper end of the lid body 891, and projects from a side wall of the lid body 891 outward in the front-back direction Y. When the vertically-movable lid member 89 of the middle-positioned lid raising-lowering mechanism 8 is being raised, the vertical positioning rib 892 comes into contact with the lower end of the downward projection part 129b of the lower frame component's exterior-side fixed lid 129 at the time when the upper surface 891a of the lid body 891 of the vertically-movable lid member 89 becomes coplanar with the sash roller movement upper surface 120a of the sash roller placement frame 120 of the lower frame component 12. The vertically-movable lid member 89 is raised and stopped at a position corresponding to the contact of the vertical positioning rib 892 with the lower end of the downward projection part 129b of the lower frame component's exterior-side fixed lid 129. In this way, the vertical positioning ribs 892 limits the upward movement of the vertically-movable lid member 89, enabling control of the ascent position of the vertically-movable lid member 89.

[0242] In the middle-positioned lid raising-lowering mechanism 8 having the configuration described above, the motor 82 is driven so that a rotational drive force of the rotary shaft 83 constituted by a ball-screw mechanism moves the movable member 84 in the lateral direction X, and the movement of the movable member 84 in the lateral direction X causes the scissor arm 86 to extend upward and contract downward. In this manner, the middle-positioned lid raising-lowering mechanism 8 can raise and lower the vertically-movable lid member 89. Thus, when the vertically-movable lid member 89 is in the non-closure position, in the vicinity of the middle in the lateral direction X, the middle-positioned lid raising-lowering mechanism 8 causes the vertically-movable lid member 89 to cover the interior-side portion of the lower frame component's upward opening 127, thereby achieving a barrier-free structure in which the upper surface 891a of the lid body 891 of the lid body 891 of the vertically-movable lid member 89 is coplanar with the sash roller movement upper surface 120a of the sash roller placement frame 120 of the lower frame component 12.

[0243] In addition, the rotary shaft 83 can be arranged in the longitudinal direction of the frame assembly 10, instead of the width direction or the vertical direction of the frame assembly 10. Thus, a space for installation of the rotary shaft 83 can be ensured along the longitudinal direction of the lower frame component 12. As a result, the lower frame component 12 can be designed to have a reduced dimension in the width and vertical directions, enabling achievement of a compact sash frame.

[0244] The middle-positioned lid raising-lowering mechanism 8 includes the scissor arm 86 that is constituted by the crossing pair of dual arm parts 861 and that can extend and contract in the direction in which the vertically-movable lid member 89 is raised and lowered. Thus, since the scissor arm 86 is configured to be disposed in the longitudinal direction of the lower frame component 12, the lower frame component 12 can be designed to have a reduced dimension in the width and vertical directions, while being capable of performing the raising and lowering operation. As a result, the middle-positioned lid raising-lowering mechanism 8 is compact in size, enabling achievement of a compact sash frame. In addition, the scissor arm 86 can be extended and contracted by means of the rotary shaft 83 constituted by a ball-screw mechanism. Thus, the barrier-free structure can be achieved which has a simple configuration.

[0245] When the vertically-movable lid member 89 is at the descent position, the upper surface 891a of the vertically-movable lid member 89 is configured to become coplanar with the sash roller movement upper surface 120a of the sash roller placement frame 120 in the vertical direction such that the front-face direction movable sash roller 303 of the second movable lower-end support 301 can move between the upper surface 891a of the vertically-movable lid member 89 and the sash roller movement upper surface 120a of the sash roller placement frame 120. The upper surface 891a of the vertically-movable lid member 89 and the sash roller movement upper surface 120a of the sash roller placement frame 120 are arranged in the lateral direction X with no gap or a smallest possible gap left therebetween such that the front-face direction movable sash roller 303 of the second movable lower-end support 301 can move between the upper surface 891a of the vertically-movable lid member 89 and the sash roller movement upper surface 120a of the sash roller placement frame 120.

[0246] In the present embodiment, the boundary in the lateral direction X between the upper surface 891a of the vertically-movable lid member 89 and the sash roller movement upper surface 120a of the sash roller placement frame 120 may have an appropriate one of shapes

indicated by 80A, 80B, and 80C shown in FIG. 17A, 17B and 17C. FIG. 17A, 17B and 17C show boundaries 80A, 80B, and 80C at a lower rail. FIG. 17A shows the boundary 80A of a first example. FIG. 17B shows the boundary 80B of a second example. FIG. 17C shows the boundary 80C of a third example.

[0247] For example, as shown in FIG. 17A, the boundary 80A between the upper surface 891a of a vertically-movable lid member 89A and the sash roller movement upper surface 120a of a sash roller placement frame 120A may be linear in the front-back direction Y. As shown in FIG. 17B, the boundary 80B between the upper surface 891a of a vertically-movable lid member 89B and the sash roller movement upper surface 120a of a sash roller placement frame 120B may be oblique. As shown in FIG. 17C, the boundary 80C between the upper surface 891a of a vertically-movable lid member 89C and the sash roller movement upper surface 120a of a sash roller placement frame 120C may be stepwise.

[0248] For example, in the case where the boundary 80B or 80C is employed which is oblique as shown in FIG. 17B or stepwise as shown in FIG. 17C and where the two wheels 303b of the front-face direction movable sash roller 303 arranged side-by-side in the front-back direction Y are configured to move in the lateral direction X, when the front-face direction movable sash roller 303 passes across the boundary 80B or 80C, the two wheels 303b pass across the boundary 80B or 80C at timings out of coincidence with each other. Thus, noise generated when the two wheels 303b pass across the boundary 80B or 80C can be diffused.

[0249] In the case where the boundary 80A is employed which is linear in the front-back direction Y as shown in FIG. 17A and where the two wheels 303b of the front-face direction movable sash rollers 303 are arranged side-by-side in the front-back direction Y but mounted to positions offset from each other in the lateral direction X, the two wheels 303b can pass across the boundary 80A at timings out of coincidence with each other. Thus, noise generated when the two wheels 303b pass across the boundary 80A can be diffused.

[0250] Next, a method of mounting the front-back direction slidable panel assemblies 20 to the frame assembly 10 and a method of mounting the front-face direction slidable panel assemblies 30 to the frame assembly 10 will be described.

[0251] The method of mounting the front-back direction slidable panel assemblies 20 to the frame assembly 10 is described first.

[0252] As shown in FIG. 7, the first movable lower-end supports 201 having the first support flat plates 202 disposed on top thereof are inserted into the lower frame component 12 through the lower frame component's upward opening 127, and then, are placed on the sash roller movement upper surface 120a of the sash roller placement frame 120 disposed in the lower frame component 12. Next, each first movable lower-end support 201 is connected to the upright plate 582 of the front-back direction movable member 58 of the associated front-back direction movement mechanism 5 via the L-shaped bracket 204. Here, the first support flat plates 202 of the first movable lower-end supports 201 have the plurality of front-back direction movable sash rollers 203 fixed thereto, the plurality of front-back direction movable sash rollers 203 having the plurality of wheels 203b orientated in the same direction. Thus, the first movable lower-end supports 201 can be mounted while having the plurality of wheels 203b of the plurality of front-back direction movable sash rollers 203 oriented in the same direction.

[0253] Next, the lower ends of the front-back direction slidable panel assemblies 20 are placed on the upper surfaces of the first support flat plates 202. The front-back direction slidable panel assemblies 21 and 22 are configured not to move with respect to the first support flat plates 202 due to their own weight. The front-back direction slidable panel assemblies 21 and 22 on the first support flat plates 202 move in the front-back direction Y, integrally with the first support flat plates 202.

[0254] Subsequently, the upper end portions of the front-back direction slidable panel assemblies 20 are mounted to the first upper end supports 206. The upper end portion of each of the front-back direction slidable panel assemblies 21 and 22 is fitted into the opening of the U-shaped bracket 207 of the associated first upper end support 206 such that the upper portion is sandwiched by the U-shaped bracket 207 in the front-back direction Y. In this state, the fixing screw 209c is screwed, while the screwing position is adjusted in the front-back direction Y, so that the pressing member 209d is pressed onto the exterior-side surface of the upper end portion of the associated one of the front-back direction slidable panel assemblies 21 and 22. Thus, the upper end portion of each of the front-back direction slidable panel assemblies 21 and 22 can be fastened to the associated L-shaped support bracket 208 with the screw, while the screwing position is adjusted in the front-face direction.

[0255] Next, the vertical plate 208b of the L-shaped support bracket 208 of the first upper end support 206 is connected to the upright plate 582 of the front-back direction movable member 58 of the front-back direction movement mechanism 5. Here, either one of the screw hole of the L-shaped support bracket 208 and the screw hole of the upright plate 582 of the front-back direction movement mechanism 5 is configured as the screw-fixing slot. Therefore, while the position where the screw is fixed is easily adjusted in the vertical direction in the screw-fixing slot, the vertical plate 208b of the L-shaped support bracket 208 can be connected to the upright plate 582 of the movable member 58 of the front-back direction movement mechanism 5. Subsequently, the upper frame component's interior-side cover 116 is mounted to the interior-side portion of the upper frame component's downward opening 117 of the upper frame component 11. In this way, the front-back direction slidable panel assemblies 20 can be mounted to the frame assembly 10.

[0256] Next, the method of mounting the front-face di-

rection slidable panel assemblies 30 to the frame assembly 10 will be described. As shown in FIG. 9, in the vicinity of the middle of the frame assembly 10 in the lateral direction X, the second movable lower-end supports 301 having the second support flat plates 302 disposed on top thereof are inserted into the lower frame component 12 through the lower frame component's upward opening 127, and then, are placed on the upper surfaces 891a of the vertically-movable lid members 89 of the middle-positioned lid raising-lowering mechanisms 8 disposed in the lower frame component 12. Here, the second support flat plates 302 of the second movable lower-end supports 301 have the plurality of front-face direction movable sash rollers 303 fixed thereto, the plurality of front-face direction movable sash rollers 303 having the plurality of wheels 303b orientated in the same direction. Thus, the second movable lower-end supports 301 can be mounted while having the plurality of wheels 303b of the plurality of front-face direction movable sash rollers 303 oriented in the same direction.

[0257] Next, the lower ends of the front-face direction slidable panel assemblies 30 are placed on the upper surfaces of the second support flat plates 302. The front-face direction slidable panel assemblies 30 are configured not to move with respect to the second support flat plates 302 due to their own weight. The front-face direction slidable panel assemblies 30 on the second support flat plates 302 move in the lateral direction X, integrally with the second support flat plates 302.

[0258] Next, the coupling members 64 of the front-face direction movement mechanisms 6 are each connected to the upper vertical part 307c of the crank-shaped connector bracket 307 having the lower vertical part 307a connected to the upper end portion of associated one of the front-face direction slidable panel assemblies 30. Here, either one of the screw hole of the upper vertical part 307c of the crank-shaped connector bracket 307 and the screw hole of the coupling member 64 of the front-face direction movement mechanism 6 is configured as the screw-fixing slot. Therefore, while the position where the screw is fixed is easily adjusted in the vertical direction in the screw-fixing slot, the upper vertical part 307c of the crank-shaped connector bracket 307 can be connected to the coupling member 64 of the front-face direction movement mechanism 6. Subsequently, the upper frame component's interior-side cover 116 is mounted such that it covers the interior-side portion of the upper frame component's downward opening 117 of the upper frame component 11. In this way, the front-face direction slidable panel assemblies 30 can be mounted to the frame assembly 10.

[0259] The configuration of the above-described embodiment exerts the following effects.

[0260] The multi-layered glasses 310 and 320 are provided. The multi-layered glass 310 includes the exterior-side glass panel 311, the interior-side glass panel 313, and the reinforcing member 316 disposed between the exterior-side glass panel 311 and the interior-side glass panel 313. In at least one end portion of the multi-layered glass 310, the interior-side glass panel 313 has the extension portion 313b at one end of thereof, the extension portion 313b protruding outward in comparison with the end face 311a of the exterior-side glass panel 311 in an in-plane direction of a glass surface of the interior-side glass panel 313. The multi-layered glass 310 is provided with the stepwise protruding shield portion 316a that is disposed in a portion corresponding to an interior-side glass surface or an exterior-side glass surface of at least the extension portion 313b.

[0261] The multi-layered glass 320 includes the interior-side glass panel 323, the exterior-side glass panel 321, and the reinforcing member 325 disposed between the interior-side glass panel 323 and the exterior-side glass panel 321. In at least one end portion of the multi-layered glass 320, the exterior-side glass panel 321 has the extension portion 321b at one end of thereof, the extension portion 321b protruding outward in comparison with the end face 323a of the interior-side glass panel 323 in an in-plane direction of a glass surface of the exterior-side glass panel 321. The multi-layered glass 320 is provided with the stepwise protruding shield portion 325a that is disposed in a portion corresponding to an interior-side glass surface or an exterior-side glass surface of at least the extension portion 321b.

[0262] The extension portions 313b and 321 are configured to prevent formation of a gap that allows communication between the interior and exterior of the room. The stepwise protruding shield portion 316a of the reinforcing member 316 and the stepwise protruding shield portion 325a of the reinforcing member 325, which are provided at the extension portions 313b and 321b, respectively, can reduce leakage of light.

[0263] When the slidable panel assemblies 20 and 30 are arranged adjacent to each other in the front-face direction, one end of the multi-layered glass 310 becomes adjacent to one end of the multi-layered glass 320 in the front-face direction. In these ends, the stepwise protruding shield portion 316a of the reinforcing member 316 and the stepwise protruding shield portion 325a of the reinforcing member 325 are matched with, and abutted against, each other, while being oppositely oriented on the interior and exterior sides. This configuration eliminates the need for providing a frame component, such as a mullion and a stile, between adjacent multi-layered panels. The absence of the mullion and the stile leads to a decrease in obstacles to a field of view, thereby improving the viewability from front and from an oblique direction.

[0264] In the present embodiment, the multi-layered glass 310, 320 further includes the airtight member 318, 328 in the one end portion thereof where the stepwise protruding shield portion 316a, 325a is provided, the airtight member 318, 328 being disposed on an outer side surface of the multi-layered glass 310, 320. With this configuration, when the slidable panel assemblies 20 and 30 are arranged adjacent to each other in the front-face di-

rection, the airtight members 318 and 328 are positioned in the abutment section 42, thereby ensuring airtightness even without a mullion or a stile.

[0265] In the present embodiment, the reinforcing member 316 includes the reinforcing portion 316c that is disposed between the exterior-side glass panel 311 and the interior-side glass panel 313, and the stepwise protruding shield portion 316a that protrudes outward in comparison with the end face 311a of the exterior-side glass panel 311 in the direction in which the extension portion 313b of the interior-side glass panel 313 protrudes along the extension portion 313b. With this configuration, the stepwise protruding shield portion 316a of the reinforcing member 316 can reinforce the extension portion 313b of the interior-side glass panel 313, while being arranged along the interior-side glass panel 313. The reinforcing member 325 includes the reinforcing portion 325c that is disposed between the exterior-side glass panel 321 and the interior-side glass panel 323, and the stepwise protruding shield portion 316a that protrudes outward in comparison with the end face 321a of the exterior-side glass panel 321 in the direction in which the extension portion 321b of the exterior-side glass panel 321 protrudes, and extends along the extension portion 321b. With this configuration, the stepwise protruding shield portion 325a of the reinforcing member 325 can reinforce the extension portion 321b of the exterior-side glass panel 321, while being arranged along the exterior-side glass panel 321.

[0266] In the present embodiment, the stepwise protruding shield portion 316a of the reinforcing member 316 and the stepwise protruding shield portion 325a of the reinforcing member 325 extend in the direction in which the extension portion 313b of the interior-side glass panel 313 protrudes and the direction in which the extension portion 312b of the exterior-side glass panel 321 extends, along the entire length of the extension portions 313b and 321b, respectively. Thus, the stepwise protruding shield portion 316a of the reinforcing member 316 and the stepwise protruding shield portion 325a of the reinforcing member 325 can firmly reinforce the extension portion 313b of the interior-side glass panel 313 and the extension portion 312b of the exterior-side glass panel 321, respectively.

[0267] In the present embodiment, the reinforcing member 316 has the stepwise flat portion 316b that is located between the stepwise protruding shield portion 316a of the reinforcing member 316 and the exterior-side glass panel 311, the stepwise flat portion 316b being coplanar with the end face 311a of the exterior-side glass panel 311. The reinforcing member 325 has the stepwise flat portion 325b that is located between the stepwise protruding shield portion 325a of the reinforcing member 325 and the interior-side glass panel 323, and is coplanar with the end face 323a of the interior-side glass panel 323. With this configuration, a space for receiving the stepwise protruding shield portion 316a of the reinforcing member 316 and a space for receiving the stepwise protruding shield portion 325a of the reinforcing member 325 can be formed at the respective counterpart to which the multi-layered glass 310, 320 is abutted.

[0268] The sliding window 1 includes the frame assembly 10 fittable to an opening of a building, and the plurality of slidable panel assemblies including the first front-face direction slidable panel assembly 31 and the second front-face direction slidable panel assembly 32 that are aligned within the frame assembly 10. The first front-face direction slidable panel assembly 31 and the second front-face direction slidable panel assembly 32 include the multi-layered glasses 210, 220, 310, and 320. The interior-side glass panel 313 of the multi-layered glass 310 of the first front-face direction slidable panel assembly 31 has the extension portion 313b located close to the interior side, while the exterior-side glass panel 321 of the multi-layered glass 320 of the second front-face direction slidable panel assembly 32 has the extension portion 321b located close to the exterior side. The adjacent exterior-side glass panels 311 and 321 have exterior-side front-face surfaces that are coplanar with each other. The adjacent interior-side glass panels 313 and 323 have interior-side front-face surfaces that are coplanar with each other.

[0269] With this configuration, in the abutment section 42, the stepwise protruding shield portion 316a of the reinforcing member 316 and the stepwise protruding shield portion 325a of the reinforcing member 325 are matched with, and abutted against, each other to be placed on a plane, while being oppositely oriented on the interior and exterior sides. As a result, when the slidable panel assemblies 20 and 30 are arranged adjacent to each other in the front-face direction, there is a small difference in depth between the adjacent slidable panel assemblies 20 and 30. The small difference in depth leads to a decrease in obstacles to the field of view, thereby contributing to viewability improvement. The small difference in depth between the adjacent slidable panel assemblies 20 and 30 also contributes to design improvement.

[0270] In the present embodiment, in the abutment sections 41, 42, and 43, the stepwise protruding shield portion 316a of the reinforcing member 316 provided to the first front-face direction slidable panel assembly 31 overlaps with the stepwise protruding shield portion 325a of the reinforcing member 325 provided to the second front-face direction slidable panel assembly 32. With this configuration, when the pair of front-back direction slidable panel assemblies 20 and the pair of front-face direction slidable panel assemblies 30 are arranged adjacent to each other in the front-face direction, the abutment sections 41, 42, and 43 are free from a gap passing through the sliding window 1 in the front-back direction. The gap-free abutment sections 41, 42, and 43 contribute to design improvement.

[0271] The configuration of the first embodiment described above further exerts the following effects.

[0272] The sliding window 1 according to the present

embodiment includes the front-back direction slidable panel assemblies 20 and the front-face direction slidable panel assemblies 30 that are disposed within the frame assembly 10. The front-back direction slidable panel assemblies 20 and the front-face direction slidable panel assemblies 30 are movable, within the frame assembly 10, between the closed position in which the front-back direction slidable panel assemblies 20 and the front-face direction slidable panel assemblies 30 are aligned along a straight line in the front-back direction Y and the open position in which the front-back direction slidable panel assemblies 20 overlap with the front-face direction slidable panel assemblies 30 when viewed in the front-back direction Y. The front-back direction slidable panel assemblies 20 are movable exclusively in the front-back direction Y within in the frame assembly 10. With this configuration, moving the front-back direction slidable panel assemblies 20 exclusively in the front-back direction Y within the frame assembly 10 allows the front-face direction slidable panel assemblies 30 to be opened and closed. Thus, the sliding window 1 is achieved which can be opened and closed while maintaining the viewability.

[0273] In the present embodiment, the front-face direction slidable panel assemblies 30 are movable exclusively in the front-face direction within the frame assembly 10. Thus, in a state where the front-back direction slidable panel assemblies 20 have been moved exclusively in the front-back direction Y within the frame assembly 10, the front-face direction slidable panel assemblies 30 can be moved exclusively in the lateral direction X of the front-face direction. As a result, the sliding window 1 is easy to open and close.

[0274] In the present embodiment, the front-back direction movement mechanisms 5 are coupled to peripheral portions of the front-back direction slidable panel assemblies 20, the front-back direction movement mechanisms 5 being configured to move the front-back direction slidable panel assemblies 20 exclusively in the front-back direction Y. This configuration allows the front-back direction slidable panel assemblies 21 and 22 to be supported at the peripheral portions thereof and to be stably and reliably moved in the front-back direction Y.

[0275] In the present embodiment, to move the front-back direction slidable panel assemblies 20 and the front-face direction slidable panel assemblies 30 from the closed position to the open position, the front-back direction slidable panel assemblies 20 are moved in the front-back direction Y, and thereafter, the front-face direction slidable panel assemblies 30 are moved in the lateral direction X of the front-face direction. The front-back direction slidable panel assemblies 20 and the front-face direction slidable panel assemblies 30 are configured to move from the closed position to the open position in this way. This configuration makes opening and closing operation of the sliding window 1 easy.

[0276] In the present embodiment, when the front-back direction slidable panel assemblies 20 and the front-face direction slidable panel assemblies 30 are in the closed position, the airtight members 116b, 125b, 133b are disposed between the front-back direction slidable panel assemblies 20 and the frame assembly 10, while the airtight member 116b, 125b, and 133b are disposed between the front-face direction slidable panel assemblies 30 and the frame assembly 10. This configuration can ensure watertightness and airtightness even when the sliding window 1 is opened and closed.

[0277] The configuration of the first embodiment described above further exerts the following effects. The sliding window 1 according to the present embodiment includes the frame assembly 10 fittable to an opening of a building, and the front-back direction slidable panel assembly 20 disposed within the frame assembly 10. The frame assembly 10 (the upper frame component 11, the lower frame component 12) has the exterior-side part (the upper frame component's exterior-side extension portion 112, the lower frame component's exterior-side extension portion 122) that faces the exterior-side surface of the front-back direction slidable panel assembly 20, the interior-side part (the upper frame component's interior-side extension portion 114, the lower frame component's interior-side extension portion 124) that faces the interior-side surface of the front-back direction slidable panel assembly 20, and the bottom part (the lower part 111t, the upper part 121t) that continuously extends from an end of the exterior-side part to an end of the interior-side part. The front-back direction slidable panel assembly 20 has a cover member (the upper frame component's exterior-side lid 118, the lower frame component's exterior-side lid 128) for covering the space (the upper frame component's space S1, the lower frame component's space S2) that is formed between the front-back direction slidable panel assembly 20 and the exterior-side part when the front-back direction slidable panel assembly 20 has moved in the front-back direction Y. Thus, moving the front-back direction slidable panel assembly 20 in the front-back direction Y opens and closes the upper frame component's exterior-side lid 118 or the lower frame component's exterior-side lid 128. After the front-back direction slidable panel assembly 20 has been moved in the front-back direction Y, the upper frame component's space S1 or the lower frame component's space S2 of the frame assembly 10 can be easily closed with the upper frame component's exterior-side lid 118 or the lower frame component's exterior-side lid 128.

[0278] The present embodiment further includes the lower opening-closing turnable member 711 that supports the upper frame component's exterior-side lid 118 such that the lid 118 can turn in the inside of the lower frame component 12, or the upper opening-closing turnable member 721 that supports the lower frame component's exterior-side lid 128 such that the lid 128 can turn in the inside of the upper frame component 11. With this configuration, the upper frame component's exterior-side lid 118 or the lower frame component's exterior-side lid 128 can be opened and closed by simply turning the lower opening-closing turnable member 711 or the upper open-

ing-closing turnable member 721.

[0279] The present embodiment further includes the restraining rod 713b or the restraining rod 723b and the motor 52 that are switchable between the locked state in which the lower opening-closing turnable member 711 or the upper opening-closing turnable member 721 is restrained from moving and the unlocked state in which the lower opening-closing turnable member 711 or the upper opening-closing turnable member 721 is released from the locked state. Thus, locking the turn movement of the lower opening-closing turnable member 711 or the upper opening-closing turnable member 721 enables the upper frame component's exterior-side lid 118 or the lower frame component's exterior-side lid 128 to be maintained in the closure position. With this configuration, a crime prevention function is imparted. In addition, this configuration enhances the resistance to window pressure.

[0280] In the present embodiment, driving the motor 52 causes the front-back direction slidable panel assembly 20 to move in the front-back direction Y within the frame assembly 10. Thus, the upper frame component's exterior-side lid 118 or the lower frame component's exterior-side lid 128 can be easily opened and closed by moving the front-back direction slidable panel assembly 20 in the front-back direction Y by means of driving of the motor 52.

[0281] The configuration of the first embodiment described above further exerts the following effects.

[0282] The sash frame of the present embodiment includes the frame assembly 10 fittable to an opening of a building, the frame assembly 10 having the groove portion M that can receive the front-face direction slidable panel assemblies 30 configured to close the opening, and the middle-positioned lid raising-lowering mechanisms 8 that are disposed in the frame assembly 10 and can raise and lower the vertically-movable lid member 89 in the groove portion M of the frame assembly 10. The vertically-movable lid member 89 can cover the groove portion M when it is raised to become coplanar with the upper end of the groove portion M. The middle-positioned lid raising-lowering mechanism 8 includes the motor 82 having the rotary shaft 83, and can raise and lower the vertically-movable lid member 89 by means of the rotational drive force of the rotary shaft 83. The rotary shaft 83 extends in the longitudinal direction of the lower frame component 12 of the frame assembly 10. With this configuration, the rotary shaft 83 can be arranged in the longitudinal direction of the frame assembly 10, instead of the width direction or the vertical direction of the frame assembly 10. Thus, a space for installation of the rotary shaft 83 can be ensured along the longitudinal direction of the lower frame component 12. As a result, the lower frame component 12 can be designed to have a reduced dimension in the width and vertical directions, enabling achievement of the sash frame that is compact in size.

[0283] In the present embodiment, the middle-positioned lid raising-lowering mechanism 8 includes the scissor arm 86 that is constituted by the crossing pair of arm parts 861 and can extend and contract in the direction in which the vertically-movable lid member 89 is raised and lowered. Thus, since the scissor arm 86 is configured to be disposed in the longitudinal direction of the lower frame component 12, the lower frame component 12 can be designed to have a reduced dimension in the width and vertical directions, while allowing the raising and lowering operation to be performed. As a result, the middle-positioned lid raising-lowering mechanism 8 is compact in size, thereby enabling achievement of the sash frame that is compact.

[0284] In the present embodiment, the rotary shaft 83 is constituted by a ball-screw mechanism that is connected to an end of the scissor arm 86 in the longitudinal direction of the frame assembly 10 and that is driven and rotated to raise and lower the vertically-movable lid member 89. With this configuration, the scissor arm 86 can be extended and contracted by means of the rotary shaft 83 constituted by the ball-screw mechanism. Thus, a barrier-free structure can be achieved by way of a simple configuration.

[0285] In the present embodiment the frame assembly 10 is provided with the frame-side rising-bent part 121a that projects from the frame assembly 10 toward the inside of the frame assembly 10, and that is intended for mounting of the middle-positioned lid raising-lowering mechanism 8 to the frame assembly 10. With this configuration, the middle-positioned lid raising-lowering mechanism 8 can be mounted to the frame assembly 10 via the frame-side rising-bent part 121a, thereby contributing to improvement of workability. In addition, the frame-side rising-bent part 121a provided to the lower frame component 12 eliminates the need for a screw hole formed in the lower frame component 12 for the purpose of mounting the middle-positioned lid raising-lowering mechanism 8, thereby contributing to improvement of watertightness.

Second Embodiment

[0286] A second embodiment will be described below. The second embodiment includes a lower lid opening-closing mechanism 73 instead of the lower lid opening-closing mechanism 71 of the end-positioned lid opening-closing mechanisms 7 of the first embodiment. FIG. 18 shows the lower lid opening-closing mechanism 73 according to the second embodiment of the present invention. FIG. 19 shows how the lower lid opening-closing mechanism 73 according to the second embodiment of the present invention opens and closes a lid. In the following description of the second embodiment, differences from the first embodiment will be mainly described. In the description of the second embodiment, the same components as those of the first embodiment are denoted by the same reference characters, and a description of the same components will be omitted as appropriate.

[0287] The lower lid opening-closing mechanism 73 is now described. As shown in FIG. 18, the lower lid open-

ing-closing mechanism 73 is disposed in a lower frame component 12, and includes a lower frame component's exterior-side lid 128, a lower opening-closing turnable member 731 (turnable member), a lower coupling member 732, and a lower turn-restraining unit 733.

[0288] The lower coupling member 732 is coupled to a first movable lower-end support 201 (front-back direction movable sash roller 203) and is connected to the lower frame component's exterior-side lid 128. The lower frame component's exterior-side lid 128 is mounted to a lower end portion of a front-back direction slidable panel assembly 20, via the first movable lower-end support 201.

[0289] The lower coupling member 732 has a lower coupling plate 732a and a projection part 732b connected to a lower coupling member 712a. The lower coupling plate 732a has one end connected to the first movable lower-end support 201 (front-back direction movable sash roller 203) and the other end connected to the projection part 732b.

[0290] The lower opening-closing turnable member 731 supports the lower frame component's exterior-side lid 128 such that the lid 128 can turn in the inside of the lower frame component 12. The lower opening-closing turnable member 731 has a U-shaped cross section. When the lower frame component's exterior-side lid 128 is in a closure position, the lower opening-closing turnable member 731 has a closure part 731a forming closed portion of the U-shape in the frame assembly 10, a first extension part 731b extending from an exterior-side end of the closure part 731a toward a lower frame component's upward opening 127, and a second extension part 731c extending from an interior-side end of the closure part 731a toward the lower frame component's upward opening 127.

[0291] The second extension part 731c has a lower end provided with a turning shaft 731x. The turning shaft 731x is turnably connected to a fixed member 121q fixed to the lower frame component 12. The second extension part 731c has an upper end provided with a retaining roller 731z. The retaining roller 731z retains a retaining block 735 mounted on the first movable lower-end support 201. The first extension part 731b has a support roller 731y at its end close to the lower frame component's exterior-side lid 128. The closure part 731a has a retaining roller 711z in its interior-side portion.

[0292] The lower turn-restraining unit 733 has a drive unit 733a and a restraining rod 733b (lock unit). The lower turn-restraining unit 733 has the same or similar configuration to that of the lower turn restraining-unit 713 described above. A description of the lower turn-restraining unit 733 is omitted here.

[0293] It will be described how the lower lid opening-closing mechanism 73 having the configuration described above opens and closes the lower frame component's exterior-side lid 128. As shown in FIG. 18, in the closure position, the lower opening-closing turnable member 731 is maintained in a locked state in which it is restrained by the restraining rod 733b of the lower turn-restraining unit 733. From this state, the restraining rod 733b is caused to stop retraining the lower opening-closing turnable member 731. In an unlocked state in which the restraining rod 733b does not restrain the lower opening-closing turnable member 731, the front-back direction slidable panel assembly 21, 22 is moved away from the interior side and toward the exterior side in the front-back direction Y. Consequently, the locked state of the restraining rod 733b is released, and the retaining block 735 stops applying a retaining force to the retaining roller 731z. Then, as shown in (A) of FIG. 19, the lower opening-closing turnable member 731 turns around the turning shaft 731x so as to fall toward the exterior side, under its own weight. The lower frame component's exterior-side lid 128 is then inclined so that an exterior-side portion thereof is lowered.

[0294] Subsequently, the front-back direction slidable panel assembly 21, 22 is further moved away from the interior side and toward the exterior side in the front-back direction Y, so that the turning movement of the lower opening-closing turnable member 731 is stopped, as shown in (B) of FIG. 19. As the front-back direction slidable panel assembly 21, 22 is further moved away from the interior side and toward the exterior side in the front-back direction Y, the lower frame component's exterior-side lid 128 turns around its portion mounted to the projection part 732b, so as to be accommodated in an exterior-side end portion of the inside of the lower frame component 12, as shown in (C) of FIG. 19. In this way, the lower frame component's exterior-side lid 128 can be moved from the closure position to the non-closure position.

[0295] To move the lower frame component's exterior-side lid 128 from the non-closure position to the closure position, the front-back direction slidable panel assembly 21, 22 is moved away from the exterior side and toward the interior side in the front-back direction Y so that the above-described series of movements from the closure position to the open position takes place in inverse order. Thus, the lower frame component's exterior-side lid 128 can be moved from the open position to the closure position.

[0296] The lower lid opening-closing mechanism 73 of the second embodiment having the configuration described above exerts the same effects as those of the lower lid opening-closing mechanism 71 of the first embodiment. The second embodiment has been described based on the case where the lower lid opening-closing mechanism 73 is disposed in the lower frame component 12. However, this is a non-limiting example. The lower lid opening-closing mechanism 73 can be oriented upside down to be disposed in the upper frame component 11.

Third Embodiment

[0297] A third embodiment will be described below.

The third embodiment includes end-positioned lid raising-lowering mechanisms 8A and front-back direction movement mechanisms 5A disposed in a vicinity of an end of a lower frame component 12A in the lateral direction X. FIG. 20 shows a lower portion of a sliding window 1 according to the third embodiment of the present invention, when viewed from the exterior side. FIG. 21 is an exploded perspective view of the portion shown in FIG. 20. FIG. 22 is a perspective view showing the end-positioned lid raising-lowering mechanism 8A and the front-back direction movement mechanism 5A of the third embodiment that are disposed on the lower frame component 12A. FIG. 23A shows a state in which a vertically-movable lid member 90 has been lowered from the state shown in FIG. 20. FIG. 23B shows a state in which a front-back direction slidable panel assembly 20 has been moved toward the exterior side, from the state shown in FIG. 23A. In the following description of the third embodiment, differences from the first embodiment will be mainly described. In the description of the third embodiment, the same components as those of the first embodiment are denoted by the same reference characters, and a description of the same components will be omitted as appropriate.

[0298] As shown in FIGS. 20 to 22, in the third embodiment, the end-positioned lid raising-lowering mechanisms 8A and the front-back direction movement mechanisms 5A are disposed in the vicinity of the end of the lower frame component 12A in the lateral direction X.

[0299] As shown in FIGS. 20 and 21, the end-positioned lid raising-lowering mechanisms 8A are arranged in the vicinity of the end of the lower frame component 12A in the lateral direction X to be disposed below the front-back direction slidable panel assembly 20. As shown in FIG. 22, the end-positioned lid raising-lowering mechanism 8A is mounted to the upper surface of a lower frame component body 121 of the lower frame component 12A. The end-positioned lid raising-lowering mechanism 8A raises and lowers the vertically-movable lid member 90 (see FIGS. 20 and 21) so that a recessed portion K (groove portion) of the lower frame component 12A is covered when the front-back direction slidable panel assembly 20 has been moved in the front-back direction Y, thereby achieving a barrier-free structure. The vertically-movable lid member 90 can be raised to become coplanar with the upper end of the recessed portion K to cover the recessed portion K. The recessed portion K can receive the front-back direction slidable panel assembly 20, and is formed as a portion recessed with respect to an upper surface 91a of a fixed lid member 91 disposed inward in the lateral direction X of the front-face direction. The recessed portion K constitutes a groove portion. Note that in the first embodiment described above, the end-positioned lid opening-closing mechanisms 7 (see FIG. 8), which are provided in the vicinities of the ends of the frame assembly 10 in the lateral direction X, enable the groove portion M of the lower frame component 12 to be covered when the front-back direction slidable panel assembly 20 has been moved in the front-back direction Y, thereby achieving the barrier-free structure.

[0300] The end-positioned lid raising-lowering mechanism 8A of the third embodiment has a configuration partially different from that of the middle-positioned lid raising-lowering mechanism 8, which is disposed in the vicinity of the middle of the frame assembly 10 of the first embodiment.

[0301] Specifically, a main difference between the middle-positioned lid raising-lowering mechanism 8 of the first embodiment and the end-positioned lid raising-lowering mechanism 8A of the third embodiment lies in that the mechanism 8 of the first embodiment is of a motor-offset type in which the motor 82 and the scissor arm 86 are offset from each other in the front-back direction Y (see FIG. 16A), whereas the mechanism 8A of the third embodiment is of a motor-straight type in which a motor 82 and a scissor arm 86 are aligned with each other along a straight line (see FIG. 22). The end-positioned lid raising-lowering mechanism 8A of the third embodiment has the same configuration as that of the middle-positioned lid raising-lowering mechanism 8 of the first embodiment except that the motor 82 and the scissor arm 86 are aligned with each other along a straight line. The description of the middle-positioned lid raising-lowering mechanism 8 of the first embodiment applies to the end-positioned lid raising-lowering mechanism 8A of the third embodiment, of which a description is omitted here.

[0302] In the present embodiment, since the end-positioned lid raising-lowering mechanisms 8A are disposed in the vicinity of the end of the frame assembly 10 in the lateral direction X, the front-back direction movement mechanism 5A of the third embodiment differs in configuration from the front-back direction movement mechanism 5 of the first embodiment. Specifically, a main difference between the front-back direction movement mechanism 5A of the third embodiment and the front-back direction movement mechanism 5 of the first embodiment lies in that an upright plate 582a of a front-back direction movable member 58A of the front-back direction movement mechanism 5 has a cutout 582b (see FIG. 22). Like the front-back direction movement mechanisms 5 of the first embodiment, the front-back direction movement mechanisms 5A of the third embodiment move four peripheral portions of the front-back direction slidable panel assembly 20 in the front-back direction Y, thereby moving the front-back direction slidable panel assembly 20 exclusively in the front-back direction Y.

[0303] Next, it will be described why the upright plate 582a of the front-back direction movable member 58A of the front-back direction movement mechanism 5 has the cutout 582b. If the front-back direction movement mechanism 5A has the same configuration as that of the front-back direction movement mechanism 5 of the first embodiment, when the vertically-movable lid member 90 is raised or lowered by the end-positioned lid raising-lowering mechanism 8A, the upright plate 582 of the front-

back direction movable member 58 will come in contact with the vertically-movable lid member 90, and accordingly, the vertically-movable lid member 90 will need to be machined, such that, for example, a cutout is formed in the surface thereof. However, such machining of the upper surface of the vertically-movable lid member 90 is not preferable from the viewpoint of design.

[0304] For this reason, in the front-back direction movement mechanism 5 of the third embodiment, the upright plate 582a of the front-back direction movable member 58A has the cutout 582b, as shown in FIG. 22. In the present embodiment, the cutout 582b is formed in an inward portion in the lateral direction X of the upright plate 582a and has a rectangular shape such that the front-back direction movable member 58A of the front-back direction movement mechanism 5 can move in the front-back direction Y while avoiding the vertically-movable lid member 90.

[0305] Since the rest of the configuration of the front-back direction movement mechanism 5A of the third embodiment is the same as the configuration of the front-back direction movement mechanism 5 of the first embodiment, a description of the rest of the configuration is omitted here.

[0306] Operation associated with the configuration of the third embodiment will be described.

[0307] In the state shown in FIG. 20, the end-positioned lid raising-lowering mechanisms 8A are actuated, so that the vertically-movable lid member 90 is moved from an ascent position shown in FIG. 20 to a descent position shown in FIG. 23A.

[0308] Next, from the position shown in FIG. 23A, the front-back direction slidable panel assembly 20 is moved away from the interior side and toward the exterior side in the front-back direction Y. At this time, the four peripheral portions of the front-back direction slidable panel assembly 20 are respectively moved in the front-back direction Y.

[0309] In this case, due to the cutout 582b formed in the upright plate 582a forming part of the front-back direction movable member 58A of the front-back direction movement mechanism 5, the front-back direction movable member 58A of the front-back direction movement mechanism 5 can be moved in the front-back direction Y while avoiding the vertically-movable lid member 90.

[0310] Thus, the upper surface of the vertically-movable lid member 90 does not need to be subjected to machining, such as formation of a cutout, thereby ensuring design quality.

Fourth to Seventh Embodiments

[0311] Next, fourth to seventh embodiments will be described.

[0312] In the following description of the fourth to seventh embodiments, differences from the first embodiment or from each of the fourth to sixth embodiments will be mainly described. In the description of the fourth to seventh embodiments, the same components as those of the first embodiment or each of the fourth to sixth embodiments are denoted by the same reference characters, and a description of the same components will be omitted as appropriate.

Fourth Embodiment

[0313] A configuration of a ribbon window 1A as a fitting according to the fourth embodiment will be described. FIG. 24 is a transverse cross-sectional view of the ribbon window 1A including FIX panels according to the fourth embodiment of the present invention.

[0314] A main difference between the ribbon window 1A of the fourth embodiment and the sliding window 1 of the first embodiment lies in that the ribbon window 1A of the fourth embodiment includes the FIX panels, as shown in FIG. 24.

[0315] The ribbon window 1A of the fourth embodiment includes a frame assembly 10A, and a pair of front-back direction slidable panel assemblies 20 and a pair of front-face direction slidable panel assemblies 30 of the first embodiment that are aligned with each other along a straight line in the lateral direction X within the frame assembly 10A. The frame assembly 10A of the fourth embodiment differs in configuration from the frame assembly 10 of the first embodiment. Multi-layered glasses of the ribbon window 1A of the fourth embodiment include the same number of layers of glass panels as the multi-layered glasses of the sliding window 1 of the first embodiment.

[0316] The frame assembly 10A has a pair of vertical frame components 13A, 13A. The vertical frame component 13A includes a vertical frame component body 131 that is shorter in the front-back direction than the vertical frame component 13 of the first embodiment, and further has a vertical frame component's exterior-side extension portion 134 that extends inwardly in the front-face direction from an exterior-side end of the vertical frame component body 131. The vertical frame component's exterior-side extension portion 134 is provided with an engaging portion 134a on an interior-side front-face surface of an inward end thereof. A cushion member 134b is attached to the engaging portion 134a.

[0317] The ribbon window 1A of the fourth embodiment is the same as the sliding window 1 of the first embodiment except that the ribbon window 1A includes the FIX panels, and exerts the same effects as those of the first embodiment.

Fifth Embodiment

[0318] A configuration of a ribbon window 1B as a fitting according to the fifth embodiment will be described. FIG. 25 is a transverse cross-sectional view of the ribbon window 1B including FIX panels according to the fifth embodiment of the present invention.

[0319] A main difference between the ribbon window

1B of the third embodiment and the ribbon window 1A of the fourth embodiment lies in that airtight members 227, 318, 327, and 328 and exterior-side buffers 329b and 229 that are included in the ribbon window 1A of the fourth embodiment are not provided to the ribbon window 1B. Like the ribbon window 1A of the fourth embodiment, the ribbon window 1B of the fifth embodiment is a ribbon window including the FIX panels. Multi-layered glasses of the ribbon window 1B of the fifth embodiment include the same number of layers of glass panels as the multi-layered glasses of the sliding window 1 of the first embodiment and the multi-layered glasses of the ribbon window 1A of the fourth embodiment.

[0320] The ribbon window 1B of the fifth embodiment, which include the FIX panels, cannot be opened. Therefore, the airtight members 227, 318, 327, and 328 and the exterior-side buffers 329b and 229 that are included in the sliding window 1 of the first embodiment are not provided to the ribbon window 1B of the fifth embodiment.

[0321] The ribbon window 1B of the fifth embodiment exerts the same effects as those of the ribbon window 1A of the fourth embodiment, except for the effects associated with the airtight members 217, 227, 317, 318, 327, and 328 and the exterior-side buffers 329b and 229.

Sixth Embodiment

[0322] A configuration of a ribbon window 1C as a fitting according to the sixth embodiment will be described. FIG. 26 is a transverse cross-sectional view of the ribbon window 1C including FIX panels according to the sixth embodiment of the present invention. As shown in FIG. 26, the ribbon window 1C of the sixth embodiment differs in the number of layers of glass panels included in the multi-layered glass from the sliding window 1 of the first embodiment and the ribbon window 1A of the fourth embodiment. Like the ribbon window 1A of the fourth embodiment and the ribbon window 1B of the fifth embodiment, the ribbon window 1C of the sixth embodiment is a ribbon window including the FIX panels.

[0323] The multi-layered glasses 210A, 220A, 310A, 320A of the sixth embodiment do not include the intermediate glass panels 212, 222, 312, and 322, which are provided to the first embodiment, but include the exterior-side glass panels 211, 221, 311, and 321, and the interior-side glass panels 213, 223, 313, and 323. A pair of glass panel spacers 214A, a pair of glass panel spacers 224A, a pair of glass panel spacers 314A, and a pair of glass panel spacers 324A are provided. Each spacer is disposed on an inner side of an associated one of reinforcing members 215, 225, 226, 316, 325, and 326 in the lateral direction X, and disposed between an associated pair of exterior-side glass panels 211, 221, 311, 321 and interior-side glass panels 213, 223, 313, 323.

[0324] Except this, the configuration of the ribbon window 1C of the sixth embodiment is the same as that of the ribbon window 1A of the fourth embodiment.

[0325] The ribbon window 1C of the sixth embodiment exerts the same effect as those of the ribbon window 1A of the fourth embodiment.

Seventh Embodiment

[0326] A configuration of a ribbon window 1D as a fitting according to the seventh embodiment will be described. FIG. 27 is a transverse cross-sectional view of the ribbon window 1D including FIX panels according to the seventh embodiment.

[0327] As shown in FIG. 27, a main difference between the ribbon window 1D according to the seventh embodiment and the ribbon window 1C according to the sixth embodiment lies in that the airtight member 227, 318, 327, and 328 and the exterior-side buffers 329b and 229 that are included in the ribbon window 1C according to the sixth embodiment are not provided to the ribbon window 1D according to the seventh embodiment. Like the ribbon window 1C of the sixth embodiment, the ribbon window 1D of the seventh embodiment is a ribbon window including the FIX panels. Multi-layered glasses of the ribbon window 1D of the seventh embodiment include the same number of layers of glass panels as the multi-layered glasses of the ribbon window 1C of the sixth embodiment.

[0328] The ribbon window 1D of the seventh embodiment, which include the FIX panels, cannot be opened. Therefore, the airtight members 227, 318, 327, and 328 and the exterior-side buffers 329b and 229 that are included in the sliding window 1 of the first embodiment are not provided to the ribbon window 1D of the seventh embodiment.

[0329] The ribbon window 1D of the seventh embodiment exerts the same effects as those of the ribbon window 1C of the sixth embodiment, except for the effects associated with the airtight members 217, 227, 317, 318, 327, and 328 and the exterior-side buffers 329b and 229.

Eighth Embodiment

[0330] A sliding window 1E of an eighth embodiment will be described. The eighth embodiment is a modification of the first embodiment. As will be detailed in the following description of the eighth embodiment, the front-back direction slidable panel assemblies 21 and 22 and the front-face direction slidable panel assembles 31 and 32 of the first embodiment may be replaced with front-back direction slidable panel assemblies 21E and 22E and front-face direction slidable panel assemblies 31E and 32E, respectively. Except for the slidable panel assemblies, the configuration of the eighth embodiment is the same as the configuration of the first embodiment. In the following description of the eighth embodiment, the differences from the first embodiment will be described.

[0331] FIG. 28 is a transverse cross-sectional view of the sliding window 1E according to the eighth embodiment, taken along a line corresponding to the line A-A in FIG. 1, and shows the sliding window 1E in a closed

position. FIG. 29 is a transverse cross-sectional view showing the sliding window 1E that has transitioned to an intermediate position from the closed position shown in FIG. 28, with the front-back direction slidable panel assemblies 20E moved toward the exterior side. FIG. 30 is a vertical cross-sectional view showing the sliding window 1E that has transitioned to the closed position from the intermediate position shown in FIG. 29, with the front-face direction slidable panel assemblies 30E moved outwardly away from each other in the lateral direction. FIG. 31 is a cross-sectional view taken along a line corresponding to the line B-B in FIG. 1. FIG. 32 is a cross-sectional view taken along a line corresponding to the line C-C in FIG. 1. FIG. 33 is a cross-sectional view taken along a line corresponding to the line D-D in FIG. 1.

[0332] As shown in FIGS. 28 to 30, the sliding window 1E includes the front-back direction slidable panel assemblies 21E and 22E and the front-face direction slidable panel assemblies 31E and 32E.

[0333] The pair of front-back direction slidable panel assemblies 21E and 22E are constituted by multi-layered glasses 210E and 220E, respectively. The multi-layered glasses 210E and 220E each include two glass panels (an exterior-side glass panel 211E, 221E, and an interior-side glass panel 213E, 223E). The pair of front-face direction slidable panel assemblies 31E and 32E are constituted by multi-layered glasses 310E and 320E, respectively. The multi-layered glasses 310E and 320E each include two glass panels (an exterior-side glass panel 311E, 321E, and an interior-side glass panel 313E, 323E).

[0334] As shown in FIGS. 28 to 30, the multi-layered glasses 210E, 220E, 310E, and 320E, have a pair of glass panel spacers 214E, a pair of glass panel spacers 224E, a pair of glass panel spacers 314E, a pair of glass panel spacers 324E, respectively. Each pair of glass panel spacers are disposed at both ends of the associated multi-layered glass in the lateral direction X of the front-face direction. The pair of front-back direction slidable panel assemblies 21E and 22E and the pair of front-face direction slidable panel assembles 31E and 32E have reinforcing members 216E, 226E, 315E, 316E, 325E, 326E and buffers 219E, 229E, 319E, 319F, 329E, and 329F.

[0335] Each of the glass panel spacers 214E, 224E, 314E, and 324E is disposed close to an end of the pair of front-back direction slidable panel assemblies 21E and 22E and the pair of front-face direction slidable panel assemblies 31E and 32E in the lateral direction X. Each of the glass panel spacers 214E, 224E, 314E, and 324E is disposed between an associated pair of the glass panels (the exterior-side glass panels 211E, 221E, 311E, 321E, and the interior-side glass panels 213E, 223E, 313E, 323E) in the front-back direction Y.

[0336] As shown in FIGS. 28 to 30, the reinforcing members 216E, 226E, 315E, 316E, 325E, and 326E are each disposed on the outer side of an associated one of the glass panel spacers 214E, 224E, 314E, and 324E in the lateral direction X, the glass panel spacers 214E, 224E, 314E, and 324E being disposed in an abutment section 41E, 42E, or 43E. The reinforcing members 216E, 226E, 315E, 316E, 325E, and 326E have a rectangular parallelepiped shape.

[0337] The reinforcing members 216E, 226E, 315E, 316E, 325E, and 326E are each disposed at an end portion in the lateral direction X of the associated one the exterior-side glass panels 211E, 221E, 311E, and 321E and the interior-side glass panels 213E, 223E, 313E, and 323E, the end portion being close to the abutment section 41E, 42E, or 43E. Each of the reinforcing members 216E, 226E, 315E, 316E, 325E, and 326E is disposed close to the interior side or the exterior side so as to form stepwise portions. Consequently, when the reinforcing members are abutted against each other in the abutment sections 41E, 42E, and 43E, the mutually abutted ones of the reinforcing members overlap with each other when viewed in the front-back direction Y.

[0338] The reinforcing members 216E, 226E, 315E, 316E, 325E, and 326E in the abutment sections 41E, 42E, and 43E are configured as follows. When the front-back direction slidable panel assembly 20E is moved away from the exterior side and toward the interior side, the reinforcing member 216E of the front-back direction slidable panel assembly 20E is abutted against the reinforcing member 315E of the front-face direction slidable panel assembly 30E in the abutment section 41E, while the reinforcing member 226E of the front-back direction slidable panel assembly 20E is abutted against the reinforcing member 325E of the front-face direction slidable panel assembly 30E in the abutment section 43E.

[0339] In the present embodiment, as shown in FIG. 28, in the abutment section 41E where the front-back direction slidable panel assembly 21E is abutted against the front-face direction slidable panel assembly 31E, the reinforcing member 216E at the end of the front-back direction slidable panel assembly 21E is positioned close to the exterior side whereas the reinforcing member 315E at the end of the front-face direction slidable panel assembly 31E is positioned close to the interior side. Therefore, when the reinforcing member 216E of the front-back direction slidable panel assembly 21E is positioned close to the exterior side while the reinforcing member 315E of the front-face direction slidable panel assembly 31E is positioned close to the interior side in the abutment section 41E, the reinforcing members 216E and 315E overlap with each other when viewed in the front-back direction Y. Accordingly, when the front-back direction slidable panel assembly 21E is moved away from the exterior side and toward the interior side, the reinforcing member 216E of the front-back direction slidable panel assembly 21E is pressed onto the reinforcing member 315E of the front-face direction slidable panel assembly 31E.

[0340] In the abutment section 43E where the front-back direction slidable panel assembly 22E is abutted against the front-face direction slidable panel assembly

32E, the reinforcing member 226E at the end of the front-back direction slidable panel assembly 22E is positioned close to the exterior side whereas the reinforcing member 325E at the end of the front-face direction slidable panel assembly 32E is positioned close to the interior side. Therefore, when the reinforcing member 226E of the front-back direction slidable panel assembly 22E is positioned close to the exterior side while the reinforcing member 325E of the front-face direction slidable panel assembly 32E is positioned close to the interior side in the abutment section 43E, the reinforcing members 226E and 325E overlap with each other when viewed in the front-back direction Y. Accordingly, when the front-back direction slidable panel assembly 22E is moved away from the exterior side and toward the interior side, the reinforcing member 226E of the front-back direction slidable panel assembly 22E is pressed onto the reinforcing member 325E of the front-face direction slidable panel assembly 31E.

[0341] In the abutment section 42E where the front-face direction slidable panel assemblies 31E and 32E are abutted against each other, the reinforcing member 316E of one of the mutually abutted slidable panel assemblies, i.e., the front-face direction slidable panel assembly 31E is positioned close to the exterior side whereas the reinforcing member 326E of the other, i.e., the front-face direction slidable panel assembly 32E is positioned close to the interior side. In this state, the reinforcing members 316E and 326E are arranged in the abutment section 42E such that they overlap with each other when viewed in the front-back direction Y. As a result, when the front-face direction slidable panel assemblies 31E and 32E are moved inward toward each other in the lateral direction X of the front-face direction, the reinforcing member 316E of the front-face direction slidable panel assembly 31 is matched with the reinforcing member 326E of the front-face direction slidable panel assembly 32E.

[0342] As shown in FIGS. 31 to 33, the pair of front-back direction slidable panel assemblies 21E and 22E and the pair of front-face direction slidable panel assemblies 31E and 32E have, in respective upper and lower end portions, a pair of glass panel spaces 231E and a pair of glass panel spacers 331E, respectively.

[0343] The pair of glass panel spacers 231E are disposed between the glass panels in the upper and lower end portions of each of the pair of front-back direction slidable panel assemblies 21E and 22E. The pair of glass panel spacers 331E are disposed between the glass panels in the upper and lower end portions of each of the pair of front-face direction slidable panel assemblies 31E and 32E.

[0344] As shown in FIG. 31, the lower end portion of each of the pair of front-back direction slidable panel assemblies 21E and 22E is supported on a first movable lower-end support 201E, whereas the upper end portion is supported on a first upper end support 206E. As shown in FIG. 33, the lower end portion of each of the pair of front-face direction slidable panel assemblies 31E and 32E is supported on a second movable lower-end support 301E, whereas the upper end portion is supported on a second movable upper-end support 306E.

[0345] The sliding window 1E of the eighth embodiment exerts the same effects as those of the sliding window 1 of the first embodiment.

[0346] In the foregoing, preferred embodiments of the present invention have been described. However, the present invention is not limited to the above-described embodiment, and modification can be made as appropriate. In the above embodiment, the airtight members 318 and 328 are respectively provided to the first front-face direction slidable panel assembly 31 and the second front-face direction slidable panel assembly 32 that are adjacent to each other. However, this is a non-limiting example. The airtight member may be provided to only one of the adjacent slidable panel assemblies.

[0347] In the embodiment described above, the airtight members 318 and 328 are each provided at the middle of the associated one of the first front-face direction slidable panel assembly 31 and the second front-face direction slidable panel assembly 32 in the front-back direction. However, this is a non-limiting example. For example, the airtight members 318 and 328 may be provided close to the interior side or the exterior side in the front-back direction. For example, the airtight and watertight sealing members may be provided at the locations where the buffers 219, 229, 319a, 319b, 329a, and 329b of the above-described embodiment are disposed. Alternatively, the buffers 219, 229, 319a, 319b, 329a, and 329b of the above embodiment may be configured to function as airtight and watertight sealing members as well.

[0348] The above embodiments include the multi-layered glasses having two or three layers of air spaces. However, this is a non-limiting example. The multi-layered glasses may have four or more layers of air spaces.

[0349] In the above embodiment, the shield portions are constituted by the stepwise protruding shield portions 316a and 325a as the protrusions of the reinforcing members 316 and 325. However, this is a non-limiting example. The shield portion may be constituted by a film or a plate bonded to the interior-side or exterior-side glass surface of the extension portion 313b of the interior-side glass panel 313, or a film or a plate bonded to the interior-side or exterior-side glass surface of the extension portion 321b of the exterior-side glass panel 321. Alternatively, the shield portion may be formed by coloring the extension portion 313b of the interior-side glass panels 313 or the extension portion 321b of the exterior-side glass panels 321.

[0350] In the above-described embodiment, in the case where the adjacent multi-layered glasses 310 and 320 are configured to be abutted against each other, the reinforcing members 316 and 325 are both provided with the stepwise protruding shield portions 316a and 325a. However, this is a non-limiting example. The stepwise

protruding shield portion may be provided to either one of the reinforcing members 316 and 325.

[0351] In the embodiment described above, the front-back direction movement mechanisms 5 are coupled to the four peripheral portions of the front-back direction slidable panel assembly 20. However, this is a non-limiting example. For instance, it is conceivable that one front-back direction movement mechanism 5 is coupled to the middle of the upper side of the front-back direction slidable panel assembly 20 in the lateral direction X while two front-back direction movement mechanisms 5 are coupled to two peripheral portions of the lower side of the front-back direction slidable panel assembly 20. It is also conceivable that two front-back direction movement mechanisms 5 are coupled to two peripheral portions of the upper side of the front-back direction slidable panel assembly 20 while one front-back direction movement mechanism 5 is coupled to the middle of the lower side of the front-back direction slidable panel assembly 20 in the lateral direction X.

[0352] In the above-described embodiment, the case where the middle-positioned lid raising-lowering mechanism 8 is employed in the sliding window has been described, as a non-limiting example. For example, any mechanism may be used which is configured to close an opening formed when a slidable panel assembly is moved. Such a mechanism is usable in a double sliding window.

[0353] In the above-described embodiment, the middle-positioned lid raising-lowering mechanism 8 is disposed in the lower frame component 12. However, this is a non-limiting example. For example, the middle-positioned lid raising-lowering mechanism 8 may be disposed in the upper frame component 11.

[0354] In the above-described embodiment, the frame-side rising-bent part 121a for mounting of the middle-positioned lid raising-lowering mechanism 8 is provided to the lower frame component 12. However, this is a non-limiting example. The frame-side rising-bent part 121a may be provided to, for example, the upper frame component 11. The frame-side rising-bent part 121a, the motor-side bent part 812a, or the arm accommodation-side bent part 873a has an L-shaped cross section. However, this is a non-limiting example. The frame-side rising-bent part 121a, the motor-side bent part 812a, or the arm accommodation-side bent part 873a may have a T-shaped cross section. The frame-side rising-bent part 121a, the motor-side bent part 812a, or the arm accommodation-side bent part 873a has a horizontal surface at its leading end portion adjacent to the bend. However, this is a non-limiting example. The horizontal surface may be replaced with a vertical surface or an inclined surface.

[0355] The middle-positioned lid raising-lowering mechanism 8 of the first embodiment, which is of the motor-offset type may be replaced with the end-positioned lid raising-lowering mechanism 8A of the third embodiment, which is of the motor-straight type, and vice versa.

[0356] In the first embodiment described above, the case where the rotary shaft 83 is constituted by a ball-screw mechanism has been described as a non-limiting example. The rotary shaft 83 may be constituted by, for example, a slide screw mechanism.

[0357] In the first and second embodiments described above, the upper frame component's exterior-side lid 118 (cover member) is configured to cover the upper frame component's space S1

[0358] (space) located between the front-back direction slidable panel assembly 20 and the upper frame component's exterior-side extension portion 112 (exterior-side part) when the front-back direction slidable panel assembly 20 is moved in the front-back direction Y. The lower frame component's exterior-side lid 128 (cover member) is configured to cover the lower frame component's space S2 (space) located between the front-back direction slidable panel assembly 20 and the lower frame component's exterior-side extension portion 122 (exterior-side part) when the front-back direction slidable panel assembly 20 is moved in the front-back direction Y. However, these are non-limiting examples. The cover member may be configured to cover a space formed between the front-back direction slidable panel assembly 20 and the interior-side part.

EXPLANATION OF REFERENCE NUMERALS

[0359]

1, 1E: Sliding Window (fitting)
1A, 1B, 1C, 1D: Ribbon Window (fitting)
5: Front-back direction Movement Mechanism (Interior-Exterior Direction Movement Mechanism)
8: Middle-Positioned Lid Raising-Lowering Mechanism (Raising-Lowering Device)
10: Frame Assembly
20, 20A, 20E: Front-Back direction Slidable Panel Assembly (Sash, First Sash)
21, 21A, 21E: First Front-back direction Slidable Panel Assembly (Sash)
22, 22A, 22E: Second Front-back direction Slidable Panel Assembly (Sash)
30, 30A, 30E: Front-Face Direction Slidable Panel Assembly (Sash, Second Sash)
31, 31A, 31E: First Front-Face Direction Slidable Panel Assembly (Sash, One Sash)
32, 32A, 32E: Second Front-Face Direction Slidable Panel Assembly (Sash, the Other Sash)
41, 42, 43: Abutment Section
52: Motor (Drive Unit, Lock Unit)
82: Motor (Raising-Lowering Drive Unit)
83: Rotary Shaft (Drive Shaft)
86: Scissor Arm
89: Vertically-Movable Lid Member (Lid Member)
112: Upper Frame Component's Exterior-Side Extension Portion (Exterior-Side Part)
114: Upper Frame Component's Interior-Side Exten-

sion Portion (Interior-Side Part)
116b: Airtight Member (First Airtight Member, Second Airtight Member)
118: Upper Frame Component's Exterior-Side Lid (Cover Member)
121a: Frame-Side Rising-Bent Part
122: Lower Frame Component's Exterior-Side Extension Portion (Exterior-Side Part)
124: Lower Frame Component's Interior-Side Extension Portion (Interior-Side Part)
125b: Airtight Member (First Airtight Member, Second Airtight Member)
128: Lower Frame Component's Exterior-Side Lid (Cover Member)
133b: Airtight Member (First Airtight Member, Second Airtight Member)
200: First Window Assembly (Sash)
210, 220, 310, 320: Multi-Layered Glass
210E, 220E, 310E, 320E: Multi-Layered Glasses
311, 311E: Exterior-Side Glass Panel (First Glass)
313, 313E: Interior-Side Glass Panel (Second Glass)
321, 321E: Exterior-Side Glass Panel (Second Glass)
323, 323E: Interior-Side Glass Panel (First Glass)
216, 226, 315, 316, 325, 326: Reinforcing Member
217, 227, 317, 318, 327, 328: Airtight Member (Sealing Member)
311a: End Face of Interior-Side Glass Panel (End Face of First Glass)
313b: Extension Portion (Protruding portion)
316a: Stepwise Protruding Shield Portion (Shield Portion)
316b: Stepwise Flat Portion (Flat Portion)
316c: Reinforcing Portion
321b: Extension Portion (Protruding portion)
323a: End Face of Exterior-Side Glass Panel (End Face of Second Glass)
325a: Stepwise Protruding Shield Portion (Shield Portion)
325b: Stepwise Flat Portion (Flat Surface)
325c: Reinforcing Portion
711: Lower Opening-Closing Turnable Member (Turnable Member)
713b: Restraining Rod (Lock Unit)
721: Upper Opening-Closing Turnable Member (Turnable Member)
723b: Restraining Rod (Restraining Member)
861: Arm Part
K: Recessed Portion (Groove Portion)
M: Groove Portion
S1: Upper Frame Component's Space (Space)
S2: Lower Frame Component's Space (Space)

Claims

1. A multi-layered glass comprising: a first glass; a second glass; and a reinforcing member disposed between the first glass and the second glass, wherein

in at least one end portion of the multi-layered glass, the second glass has a protruding portion at one end thereof, the protruding portion protruding outward in comparison with an end face of the first glass in an in-plane direction of a glass surface of the second glass, and
the multi-layered glass is provided with a shield portion that is disposed in a portion corresponding to an interior-side glass surface or an exterior-side glass surface of at least the protruding portion.

2. The multi-layered glass according to claim 1, further comprising:
a sealing member in the one end portion thereof where the protruding portion is provided, the sealing member being disposed on an outer side surface of the multi-layered glass.

3. The multi-layered glass according to claim 1 or 2, wherein
the reinforcing member comprises a reinforcing portion disposed between the first glass and the second glass, and the shield portion protruding outward in comparison with the end face of the first glass in a direction in which the protruding portion of the second glass protrudes, and extending along the protruding portion.

4. The multi-layered glass according to any one of claims 1 to 3, wherein
the shield portion of the reinforcing member extends in a direction in which the protruding portion of the second glass protrudes and lies over an entire length of the protruding portion.

5. The multi-layered glass according to any one of claims 1 to 4, wherein
the reinforcing member has a flat surface that is located between the shield portion of the reinforcing member and the first glass, the flat surface being coplanar with the end face of the first glass.

6. A fitting comprising: a frame assembly fittable to an opening of a building; and a plurality of sashes aligned within the frame assembly, wherein

adjacent sashes of the plurality of sashes each comprise a multi-layered glass including a first glass, a second glass, and a reinforcing member disposed between the first glass and the second glass,
in at least one end portion of the multi-layered glass, the second glass has a protruding portion at one end thereof, the protruding portion pro-

truding outward in comparison with an end face of the first glass in an in-plane direction of a glass surface of the second glass,
the multi-layered glasses of the adjacent sashes are adjacent to each other, at least one of the multi-layered glasses adjacent to each other is provided with a shield portion that is disposed in a portion corresponding to an interior-side glass surface or an exterior-side glass surface of at least the protruding portion,
one sash of the adjacent sashes is abutted against the other sash in an abutment section,
in the abutment section, the protruding portion provided to the second glass of the multi-layered glass of the one sash is disposed close to one of an interior side and an exterior side, whereas the protruding portion provided to the second glass of the multi-layered glass of the other sash is disposed close to the other of the interior side and the exterior side, and
the multi-layered glasses adjacent to each other have interior-side front-face surfaces that are coplanar with each other and exterior-side front-face surfaces that are coplanar with each other.

7. The fitting according claim 6, further comprising:
a sealing member in the one end portion of the multi-layered glass where the protruding portion is provided, the sealing member being disposed on an outer side surface of the multi-layered glass.

8. The fitting according claim 6 or 7, wherein
the reinforcing member comprises a reinforcing portion disposed between the first glass and the second glass, and the shield portion protruding outward in comparison with the end face of the first glass in a direction in which the protruding portion of the second glass protrudes, and extending along the protruding portion.

9. The fitting according to any one of claims 6 to 8, wherein
the shield portion of the reinforcing member extends in a direction in which the protruding portion of the second glass protrudes and lies over an entire length of the protruding portion.

10. The fitting according to any one of claims 6 to 9, wherein
the reinforcing member has a flat surface that is located between the shield portion of the reinforcing member and the first glass, the flat surface being coplanar with the end face of the first glass.

11. The fitting according to any one of claims 6 to 10, wherein
each of the multi-layered glasses adjacent to each other is provided with the shield portion, and
in the abutment section where the one sash of the adjacent sashes of the plurality of sashes is abutted against the other sash of the adjacent sashes, the shield portion of the reinforcing member of the one sash overlaps with the shield portion of the reinforcing member of the other sash.

12. A fitting comprising: a frame assembly fittable to an opening of a building; and a first sash and a second sash disposed within the frame assembly, wherein

the first sash and the second sash are movable, within the frame assembly, between a closed position in which the first sash and the second sash are aligned along a straight line in a front-face direction and an open position in which the first sash overlaps with the second sash when viewed in an interior-exterior direction of a room, and
the first sash is movable exclusively in the interior-exterior direction within the frame assembly.

13. The fitting according to claim 12, wherein
the second sash is movable exclusively in the front-face direction within the frame assembly.

14. The fitting according to claim 12 or 13, further comprising:
an interior-exterior direction movement mechanism coupled to a peripheral portion of the first sash, the interior-exterior direction movement mechanism being configured to move the first sash exclusively in the interior-exterior direction.

15. The fitting according to any one of claims 12 to 14, the fitting being configured to move the first sash and the second sash from the closed position to the open position by moving the first sash in the interior-exterior direction, and thereafter, by moving the second sash in the front-face direction.

16. The fitting according to any one of claims 12 to 15, further comprising: a first airtight member and a second airtight member, wherein
when the first sash and the second sash are in the closed position, the first airtight member is disposed between the first sash and the frame assembly while the second airtight member is disposed between the second sash and the frame assembly.

17. A fitting comprising: a frame assembly fittable to an opening of a building; and a sash disposed within the frame assembly, wherein

the frame assembly has an exterior-side part that faces an exterior-side surface of the sash, an interior-side part that faces an interior-side surface of the sash, and a bottom part that con-

tinuously extends from an end of the exterior-side part to an end of the interior-side part, and the sash includes a cover member for covering a space that is formed between the sash and the exterior-side part or a space that is formed between the sash and the interior-side part when the sash has moved in an interior-exterior direction of a room.

18. The fitting according to claim 17, further comprising: a turnable member that supports the cover member such that the cover member is turnable in an inside of the frame assembly.

19. The fitting according to claim 17 or 18, further comprising:
a lock unit that is switchable between a locked state in which the cover member is restrained from moving and an unlocked state in which the cover member is released from the locked state.

20. The fitting according to any one of claims 17 to 19, further comprising:
a drive unit, wherein driving the drive unit causes the sash to move in the interior-exterior direction within the frame assembly.

21. A sash frame comprising: a frame assembly fittable to an opening of a building, wherein

the frame assembly has a groove portion capable of receiving a sash configured to close the opening,
the frame assembly includes a raising-lowering device that is disposed in the frame assembly and is capable of raising and lowering a lid member in the groove portion of the frame assembly,
the lid member is capable of covering the groove portion when the lid member is raised to become coplanar with an upper end of the groove portion,
the raising-lowering device includes a raising-lowering drive unit having a drive shaft, and is capable of raising and lowering the lid member by means of a rotational drive force of the drive shaft, and
the drive shaft extends in a longitudinal direction of the frame assembly.

22. The sash frame according to claim 21, wherein
the raising-lowering device comprises a scissor arm that includes a pair of crossing arm parts and is capable of extending and contracting in a direction in which the lid member is raised and lowered.

23. The sash frame according to claim 22, wherein
the drive shaft comprises a screw mechanism that is connected to an end of the scissor arm in the longitudinal direction of the frame assembly, the screw mechanism being driven and rotated to raise and lower the lid member.

24. The sash frame according to any one of claims 21 to 23, wherein
the frame assembly is provided with a rib that projects from the frame assembly toward an inside of the frame assembly, the rib being intended for mounting of the raising-lowering device to the frame assembly.

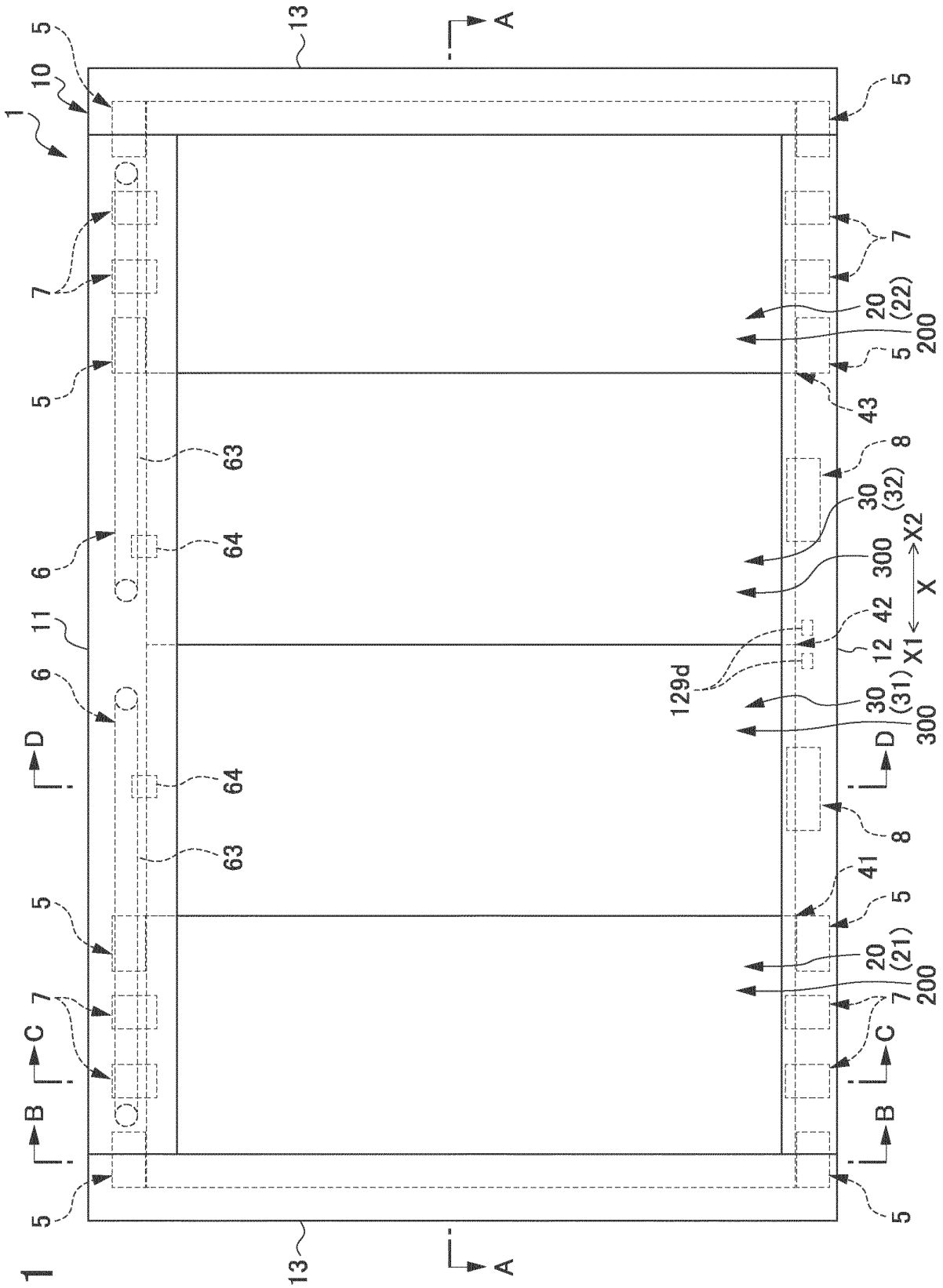

1
5
10
13
A
7
20
(22)
200
43
8
30
(32)
300
X2
X
X1
42
12
129d
11
6
D
64
63
B
C
41
(21)

FIG. 1

FIG. 2

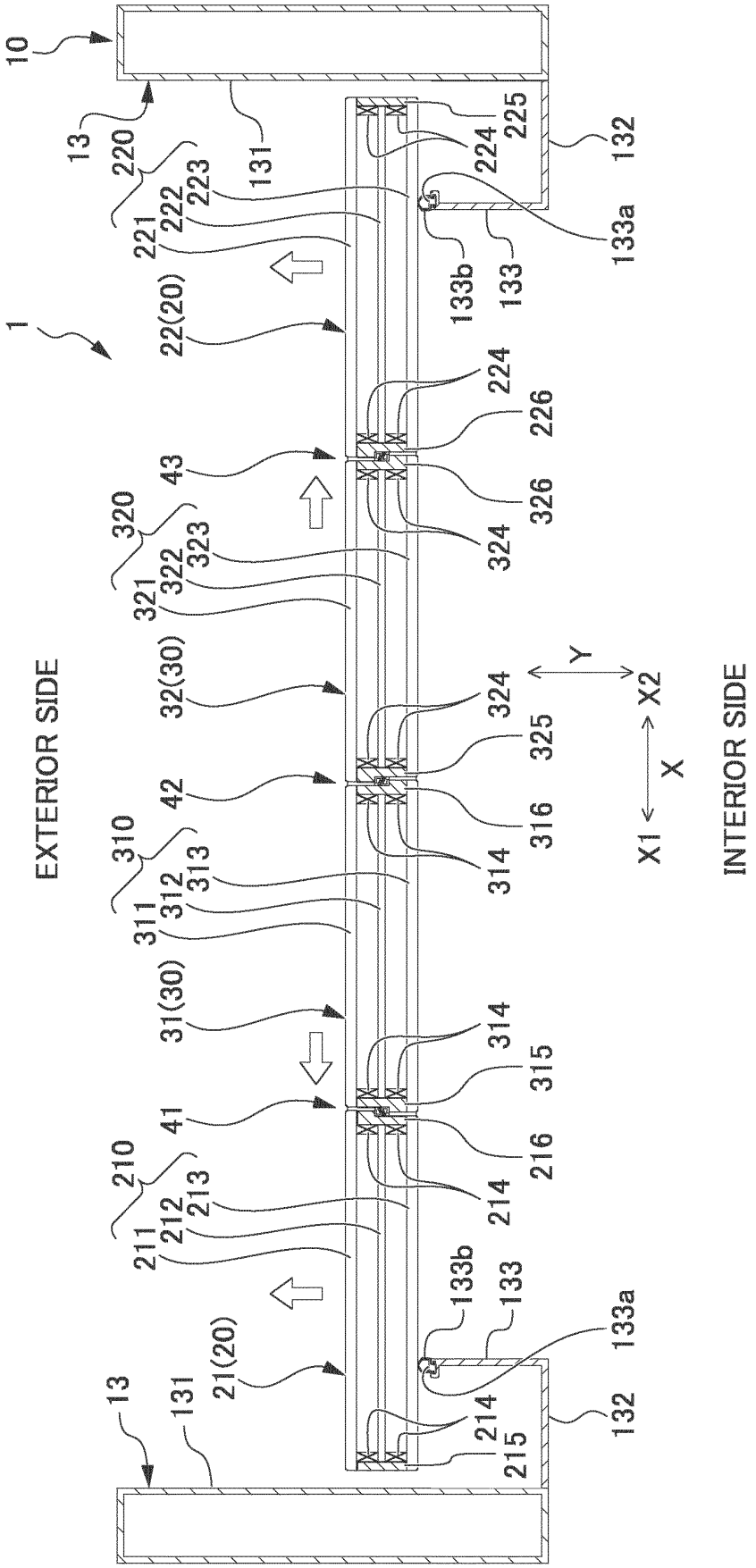

10
13
220
131
221
222
223
224
225
132
133a
133b
133
1
22(20)
224
226
43
320
321
322
323
326
324
32(30)
324
325
Y
X2
X
X1
42
310
311
312
313
316
314
31(30)
314
315
41
210
211
212
213
216
214
133b
133
133a
21(20)
13
131
214
215
132
EXTERIOR SIDE
INTERIOR SIDE

FIG. 3

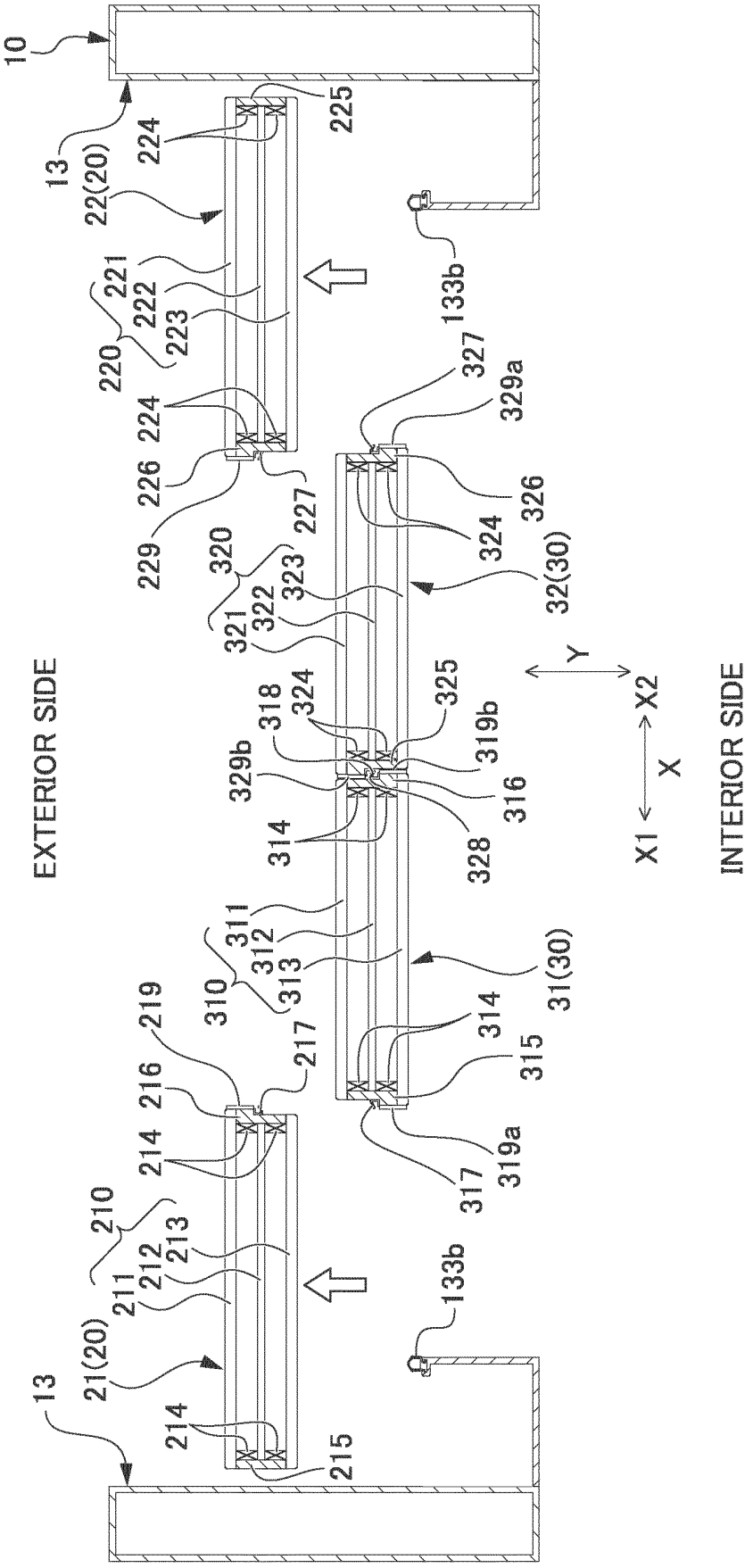

EXTERIOR SIDE
INTERIOR SIDE
10
13
22(20)
21(20)
32(30)
31(30)
133b
Y
X
X1
X2

FIG. 4

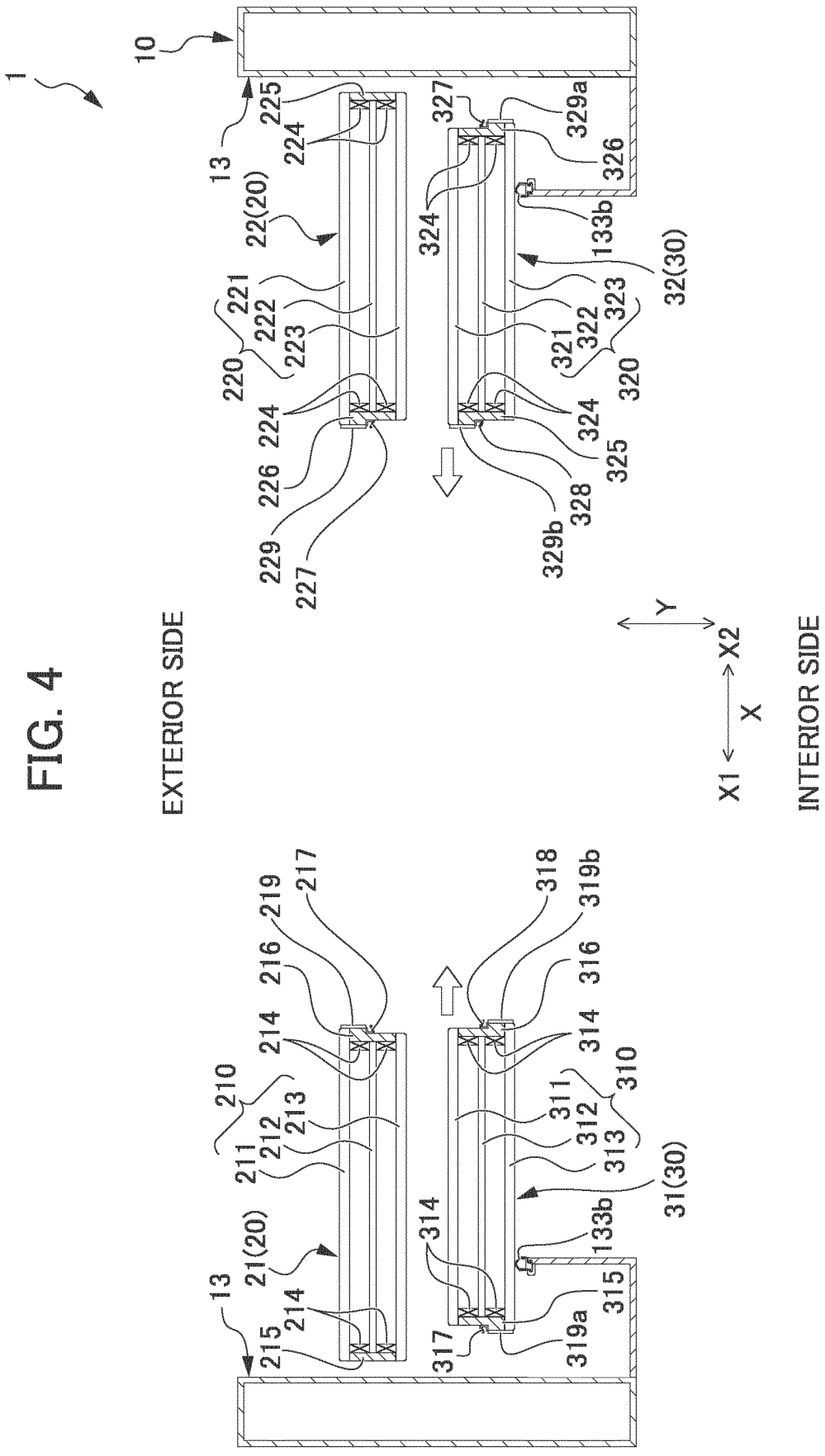
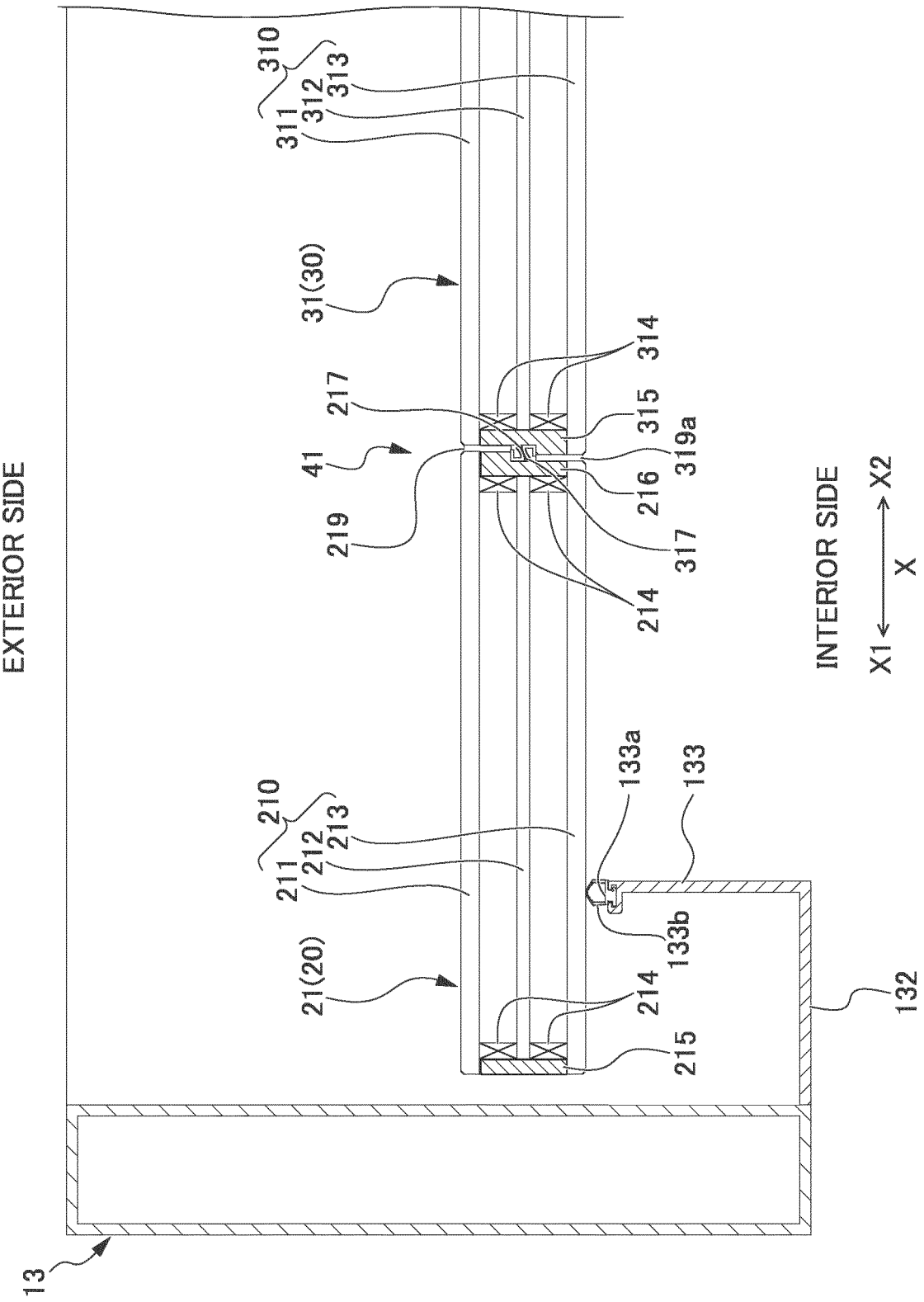

1
10
13
225
224
22(20)
221
222
223
220
224
226
229
227
327
329a
326
133b
324
32(30)
323
322
321
320
324
325
328
329b
EXTERIOR SIDE
INTERIOR SIDE
Y
X2
X
X1
217
219
216
214
210
211
212
213
214
215
13
21(20)
318
319b
316
314
310
311
312
313
31(30)
314
133b
315
319a
317

FIG. 5


EXTERIOR SIDE
INTERIOR SIDE
X1
X2
X
13
21(20)
210
211
212
213
214
215
216
217
219
31(30)
310
311
312
313
314
315
317
319a
41
132
133
133a
133b

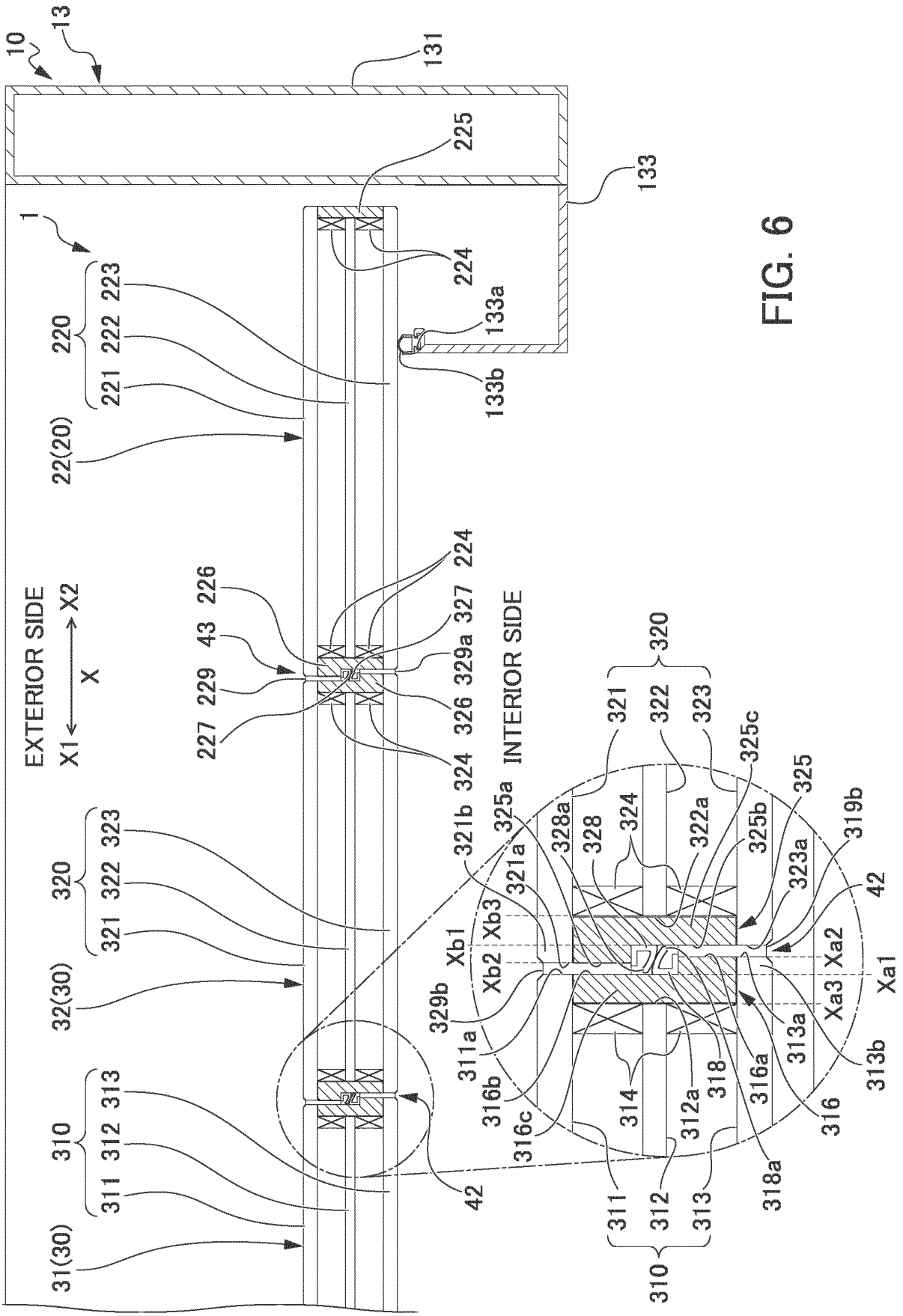

10
13
131
225
133
1
224
133a
133b
220
221
222
223
22(20)
EXTERIOR SIDE
X1
X2
X
INTERIOR SIDE
226
43
227
229
224
327
329a
326
324
320
321
322
323
325c
325
321b
325a
321a
328a
328
324
322a
325b
323a
319b
42
Xb1
Xb3
Xb2
Xa2
Xa3
Xa1
329b
311a
316b
316c
314
312a
318
316a
313a
316
313b
311
312
313
318a
310
32(30)
31(30)
42

FIG. 6

FIG. 7

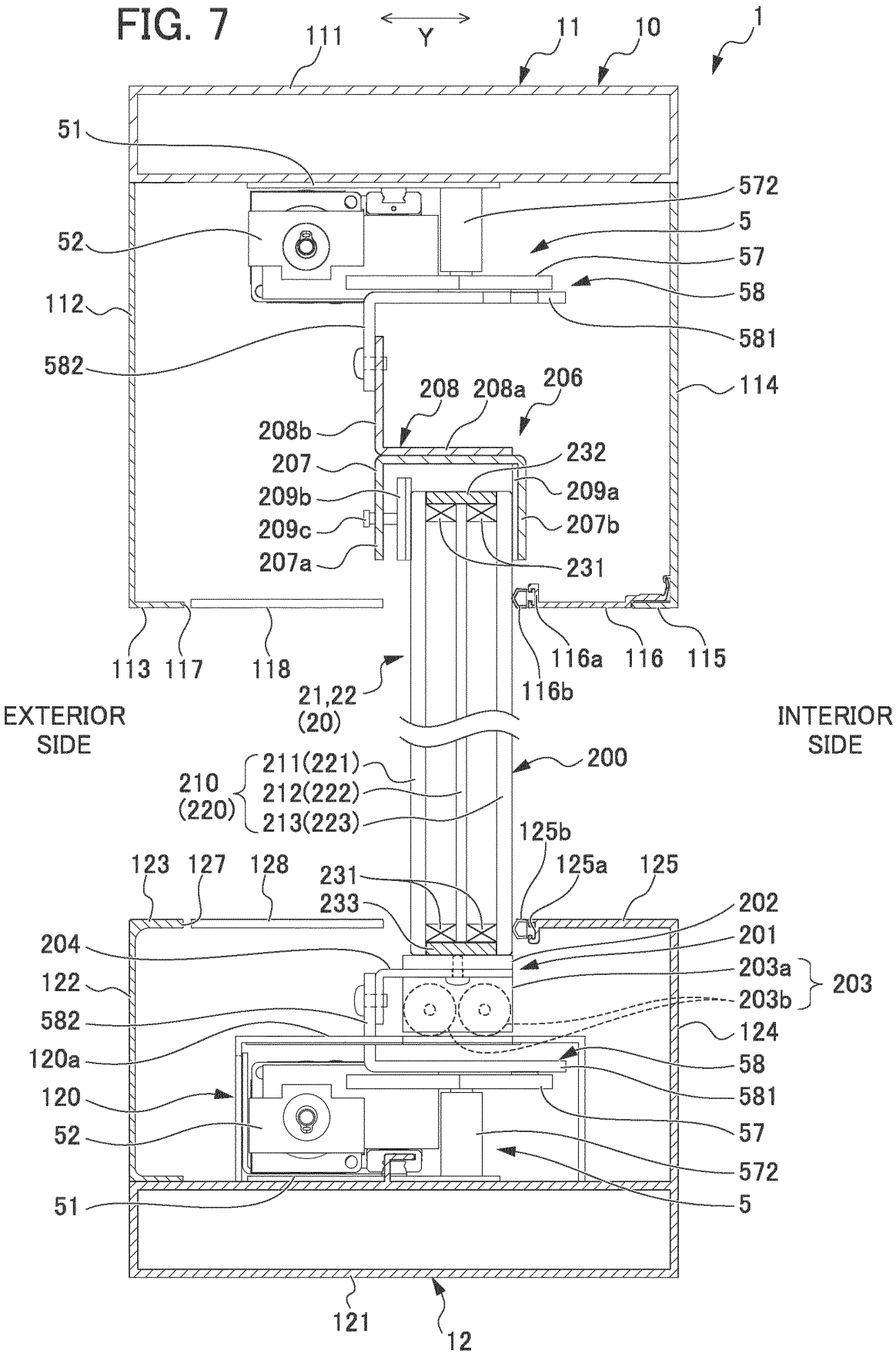

111
Y
11
10
1
51
572
52
5
57
58
112
581
582
114
208
208a
206
208b
207
232
209b
209a
209c
207b
207a
231
113
117
118
116a
116
115
21,22
(20)
116b
EXTERIOR SIDE
INTERIOR SIDE
200
210
(220)
211(221)
212(222)
213(223)
125b
123
127
128
231
125a
125
233
202
204
201
203a
203
122
203b
582
124
120a
58
120
581
52
57
572
51
5
121
12

FIG. 8

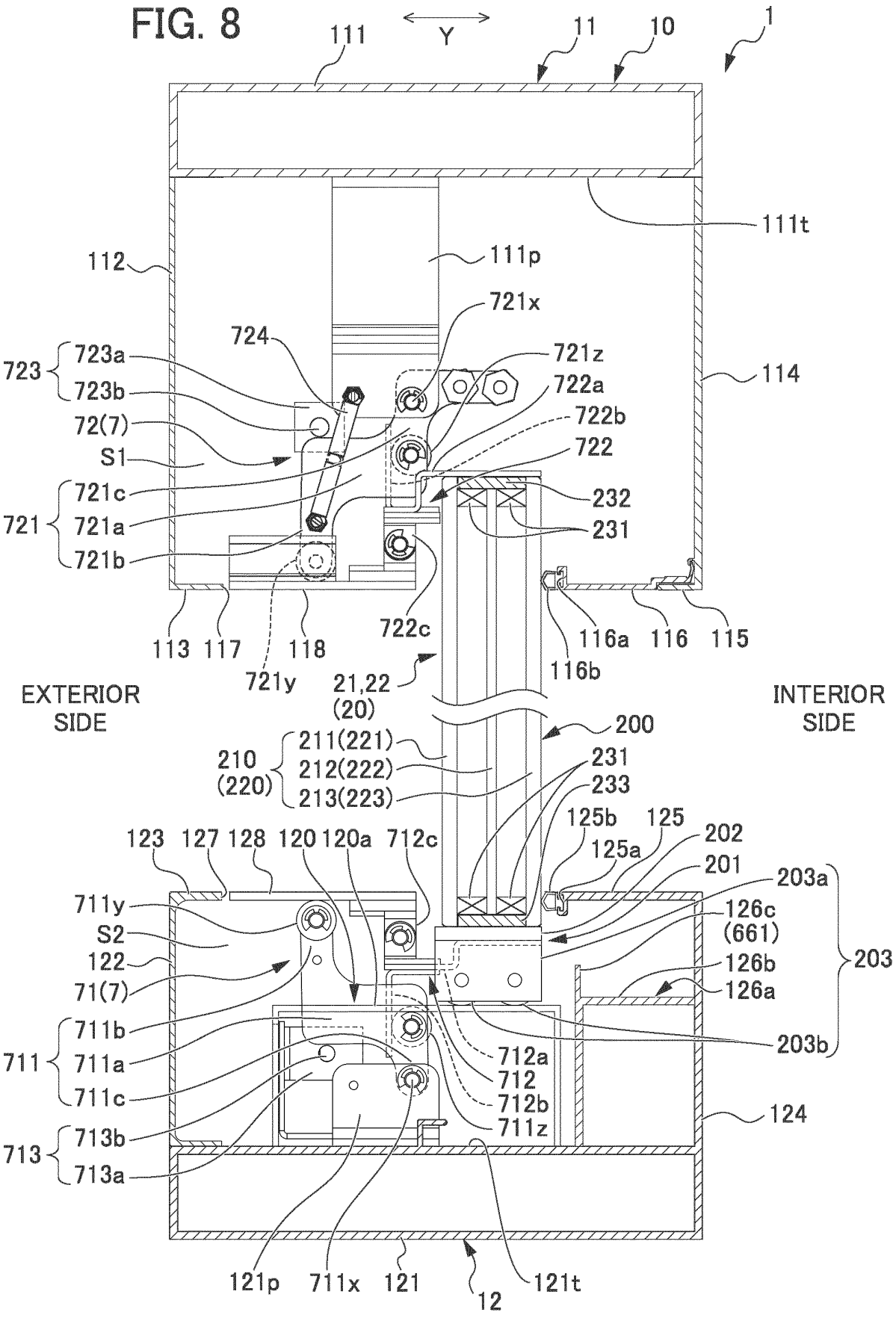

111
Y
11
10
1
111t
112
111p
721x
724
721z
723
723a
723b
722a
114
72(7)
722b
S1
722
721c
232
721
721a
231
721b
722c
116a
116
115
113
117
118
116b
721y
21,22
(20)
EXTERIOR SIDE
INTERIOR SIDE
200
211(221)
210
212(222)
231
(220)
213(223)
233
125b
125
202
123
127
128
120
120a
712c
125a
201
203a
711y
126c
(661)
S2
122
126b
203
71(7)
126a
711b
203b
711
711a
712a
712
711c
712b
711z
713
713b
124
713a
121p
711x
121
12
121t

FIG. 9

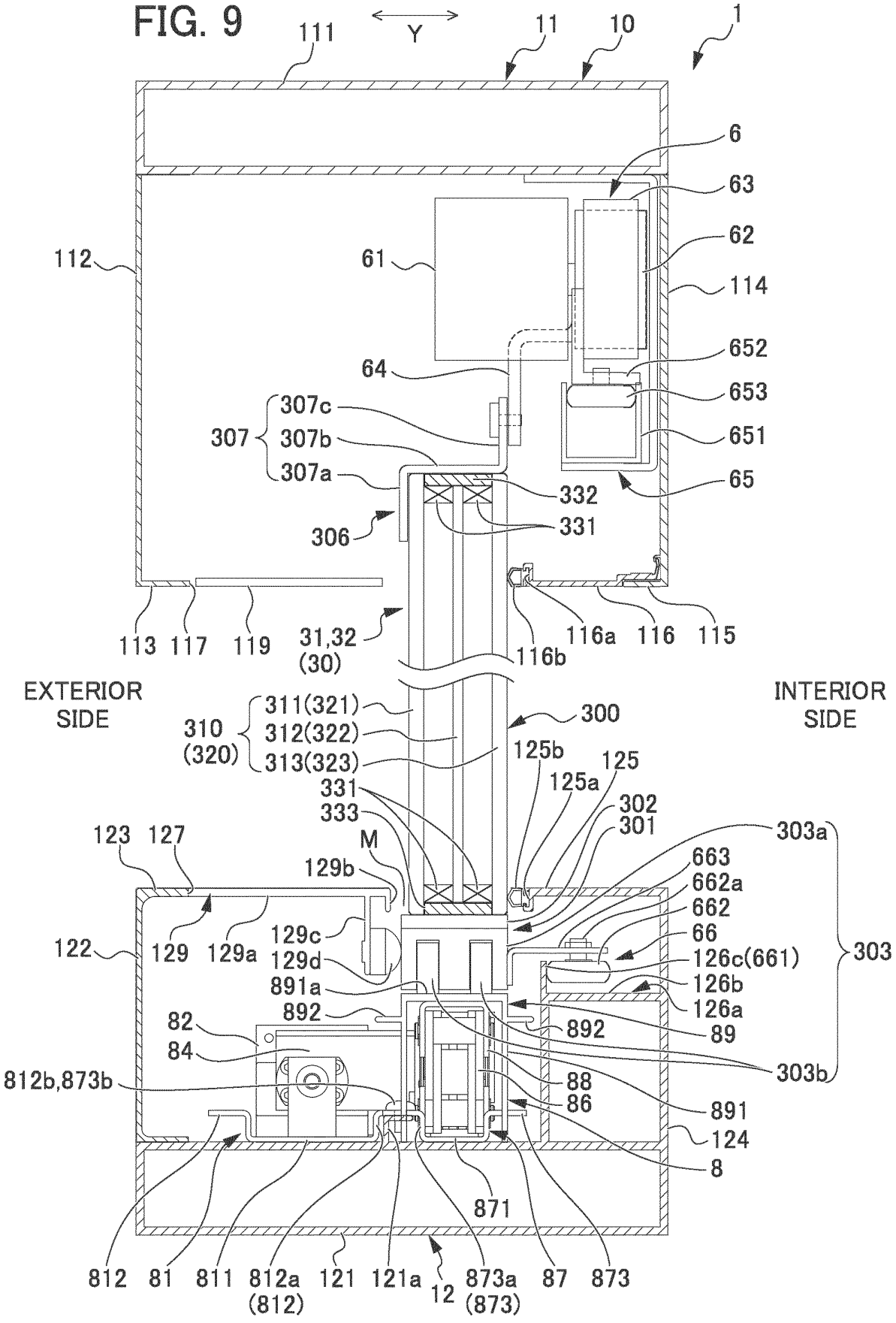

111
Y
11
10
1
6
63
62
114
652
653
651
65
112
61
64
307c
307
307b
307a
332
331
306
113
117
119
31,32
(30)
116b
116a
116
115
EXTERIOR
SIDE
INTERIOR
SIDE
311(321)
310
(320)
312(322)
313(323)
300
125b
125a
125
331
333
302
301
303a
123
127
M
129b
663
662a
662
66
129
129a
129c
129d
122
126c(661)
303
126b
126a
891a
892
82
84
892
89
812b,873b
303b
88
86
891
124
8
871
812
81
811
812a
(812)
121
121a
12
873a
(873)
87
873

FIG. 10

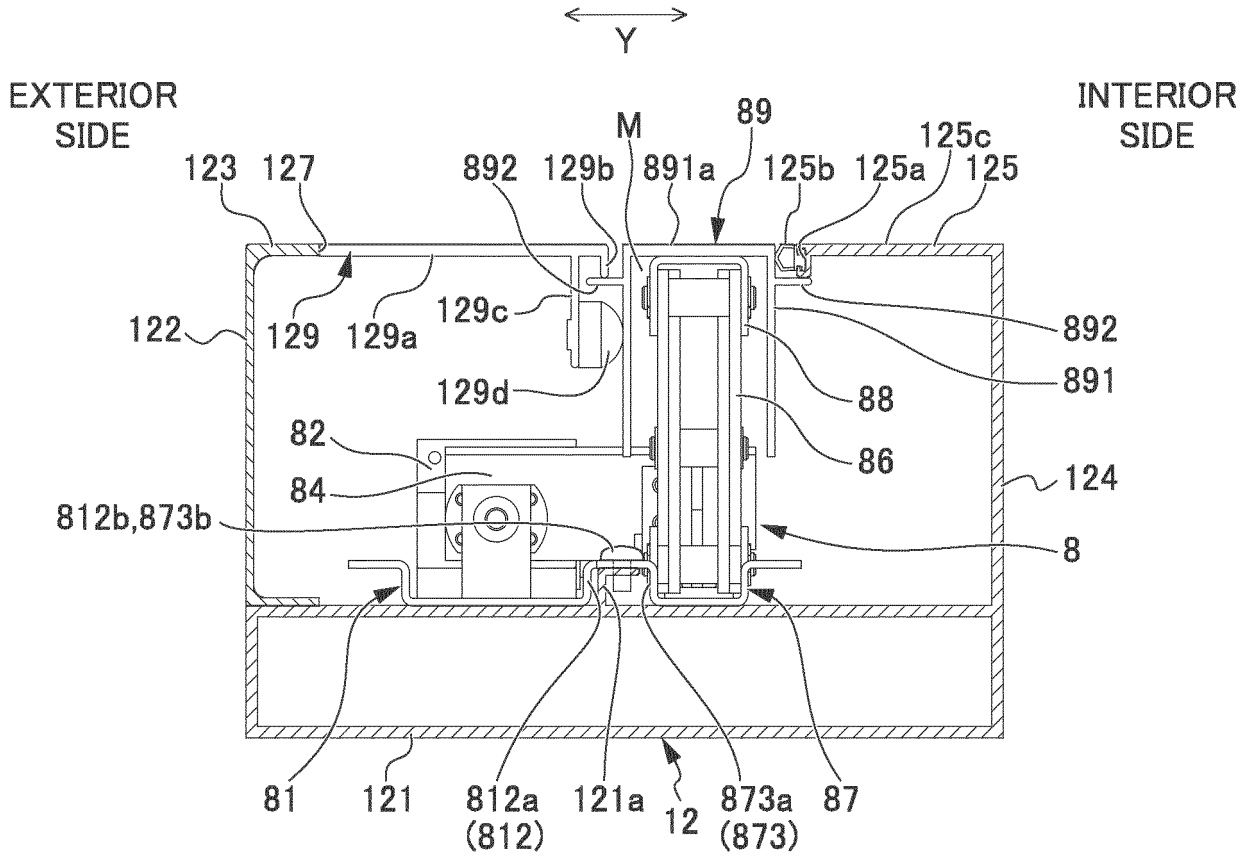

Y
EXTERIOR SIDE
INTERIOR SIDE
123
127
892
129b
M
891a
89
125b
125a
125c
125
122
129
129a
129c
892
129d
891
88
82
86
84
124
812b,873b
8
81
121
812a (812)
121a
12
873a (873)
87

FIG. 11A

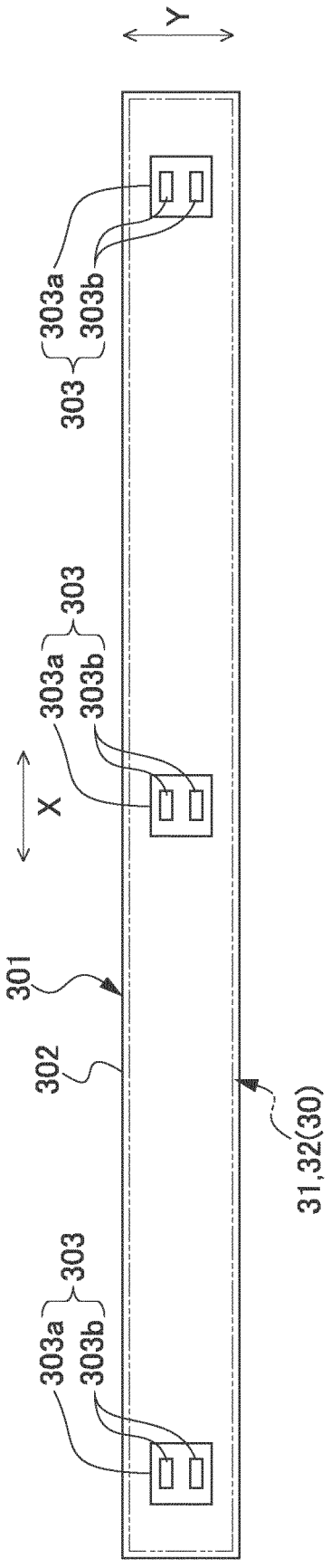


FIG. 11B

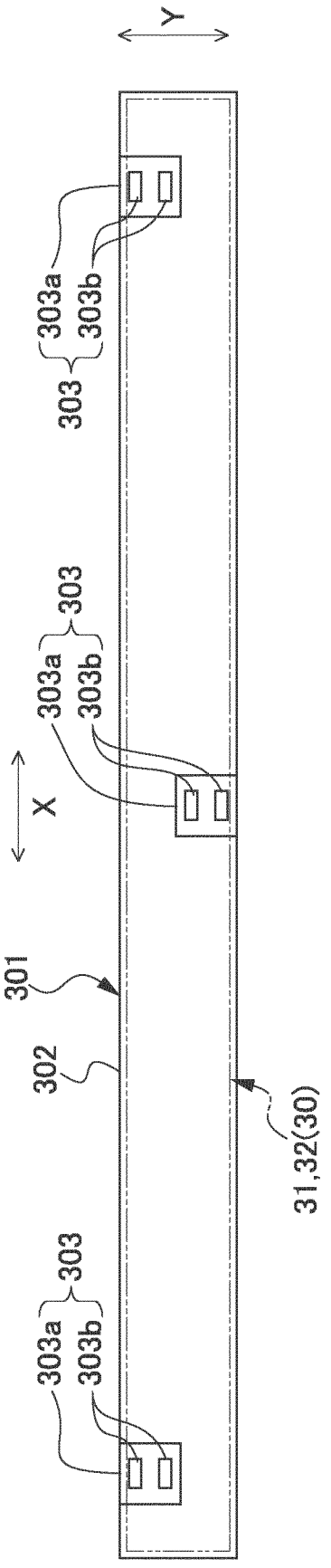


FIG. 12A

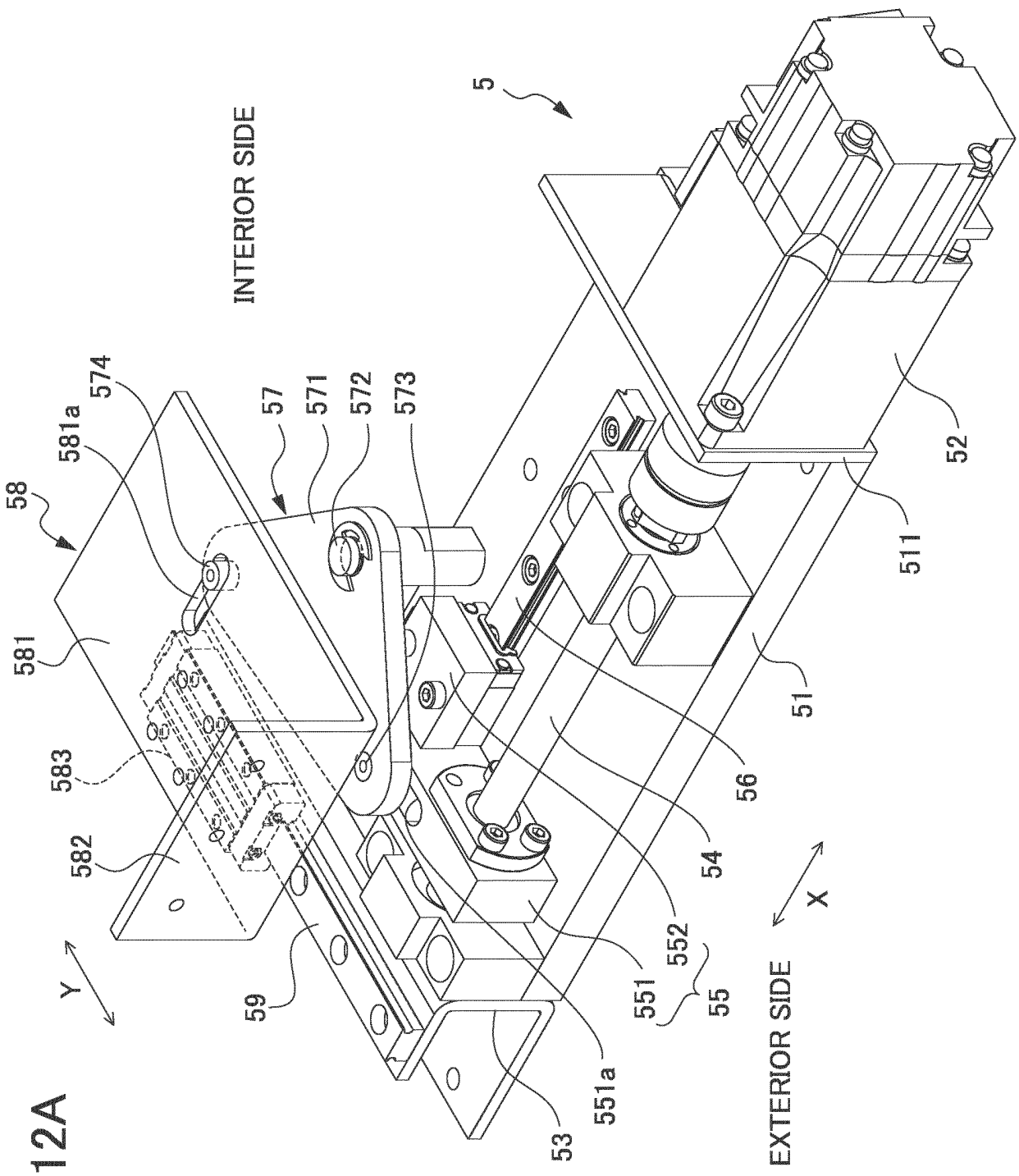

INTERIOR SIDE
EXTERIOR SIDE
5
51
511
52
53
54
55
551
551a
552
56
57
571
572
573
574
58
581
581a
582
583
59
X
Y

FIG. 12B

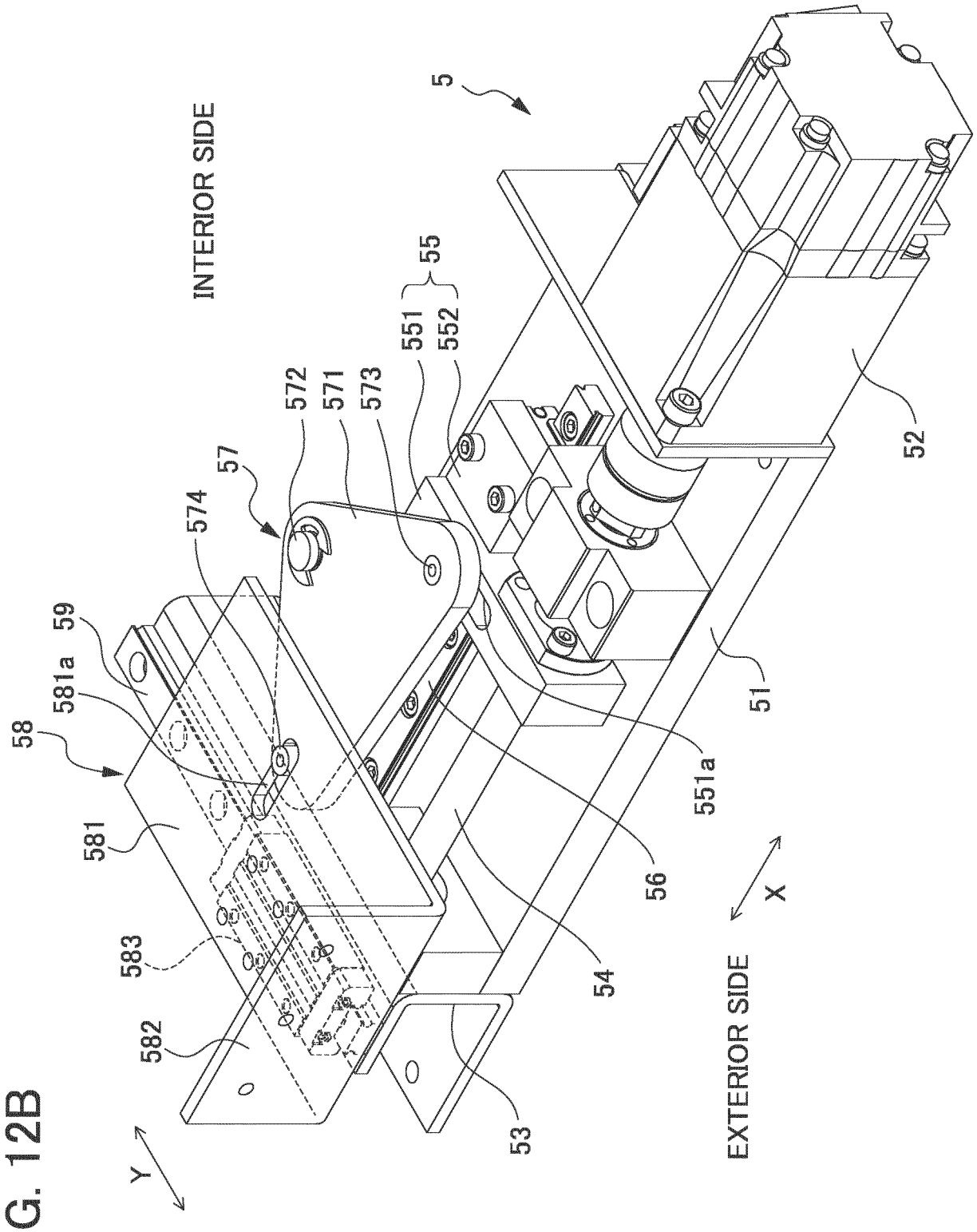

5
INTERIOR SIDE
55
551
552
572
571
573
57
574
59
581a
58
581
583
582
Y
53
54
56
551a
51
52
X
EXTERIOR SIDE

FIG. 13

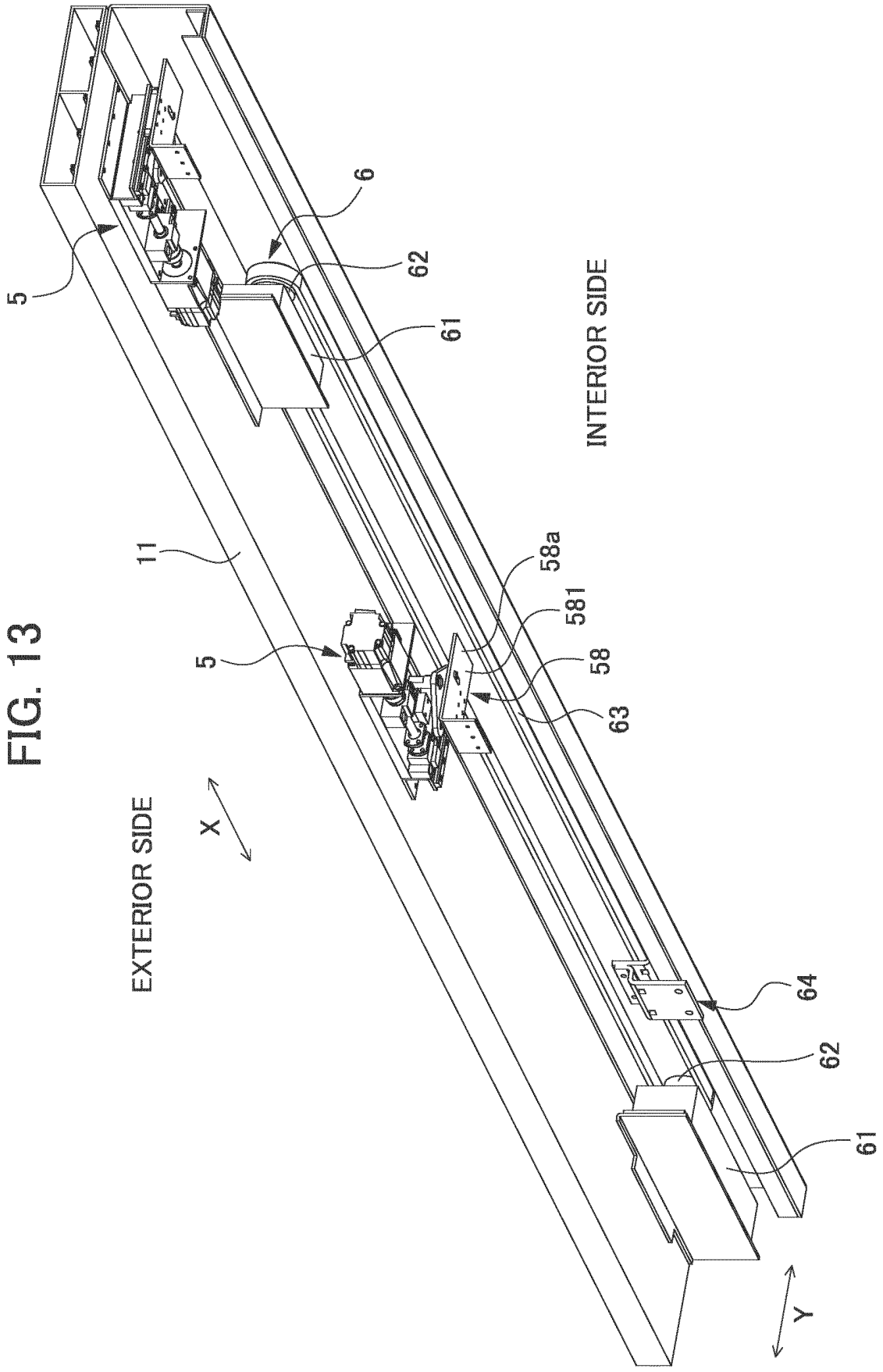

5
6
62
61
INTERIOR SIDE
11
5
58a
581
58
63
EXTERIOR SIDE
X
64
62
61
Y

FIG. 14

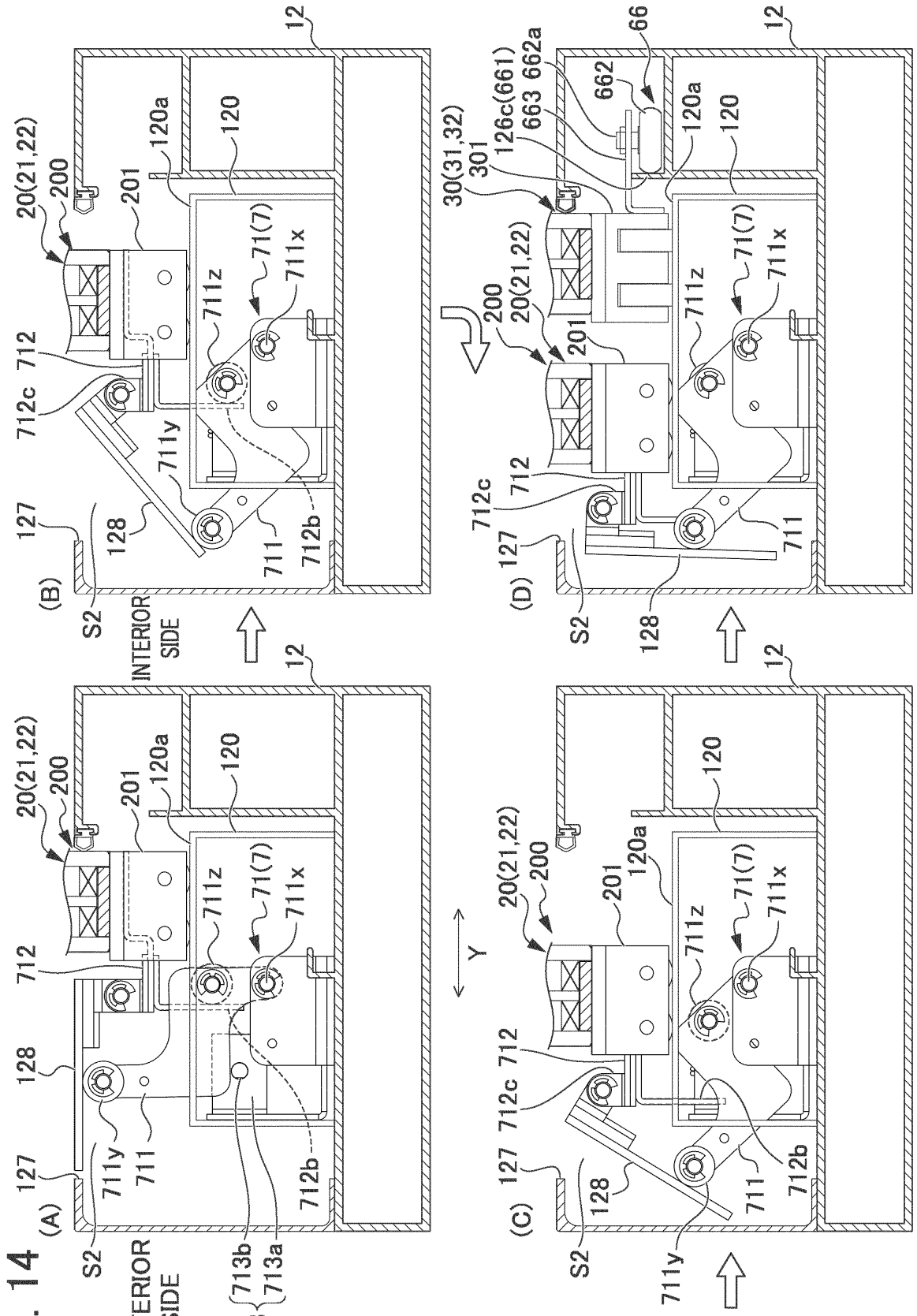

(A)
(B)
(C)
(D)
EXTERIOR SIDE
INTERIOR SIDE
Y
S2
127
128
711y
711
712b
713
713b
713a
712
712c
711x
71(7)
711z
120
120a
201
200
20(21,22)
12
66
662
662a
663
126c(661)
301
30(31,32)

FIG. 15

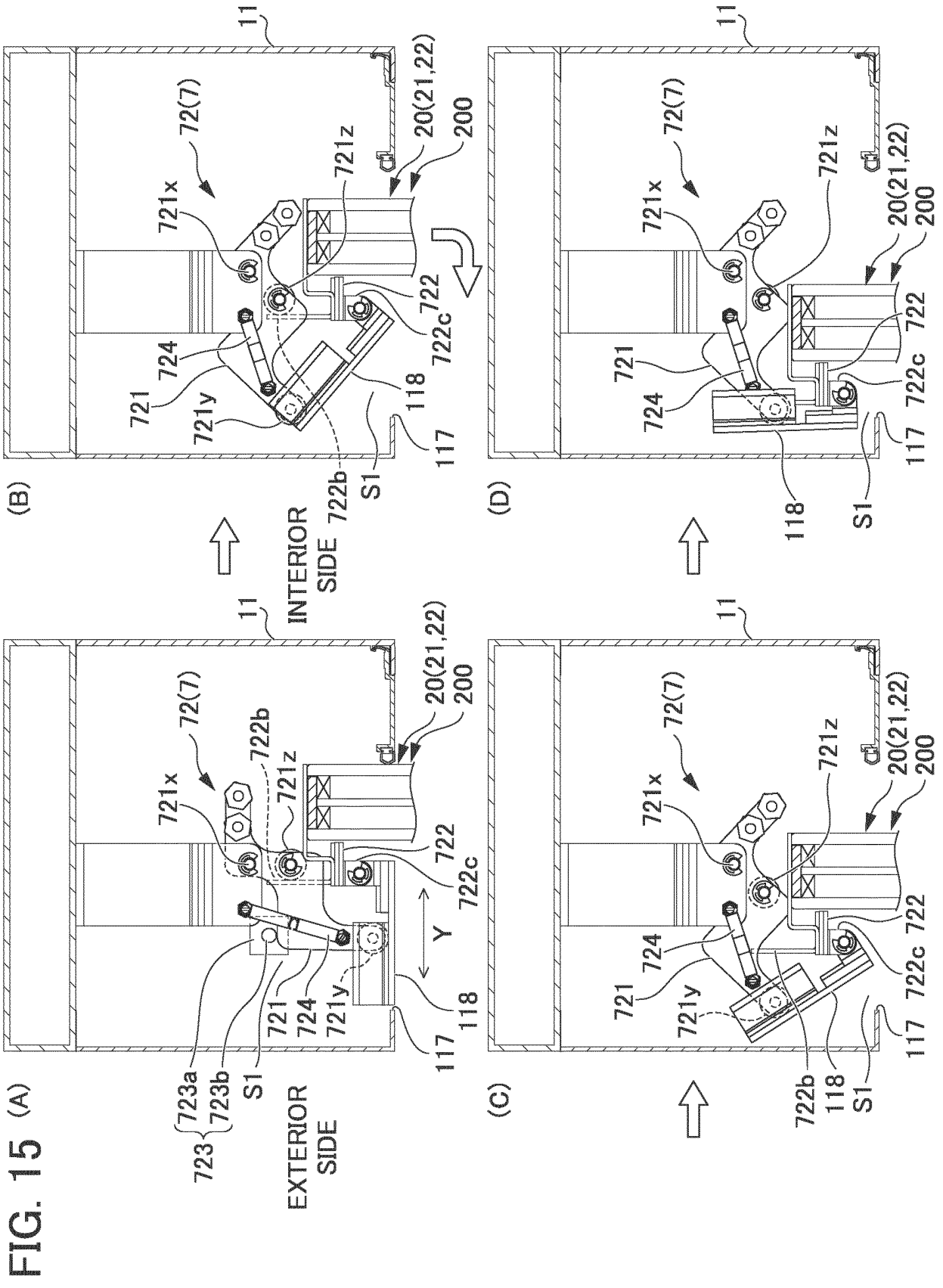

(A)
(B)
(C)
(D)
11
72(7)
721x
721z
722b
722
722c
20(21,22)
200
723
723a
723b
721
721y
724
S1
118
117
Y
EXTERIOR SIDE
INTERIOR SIDE

FIG. 16A

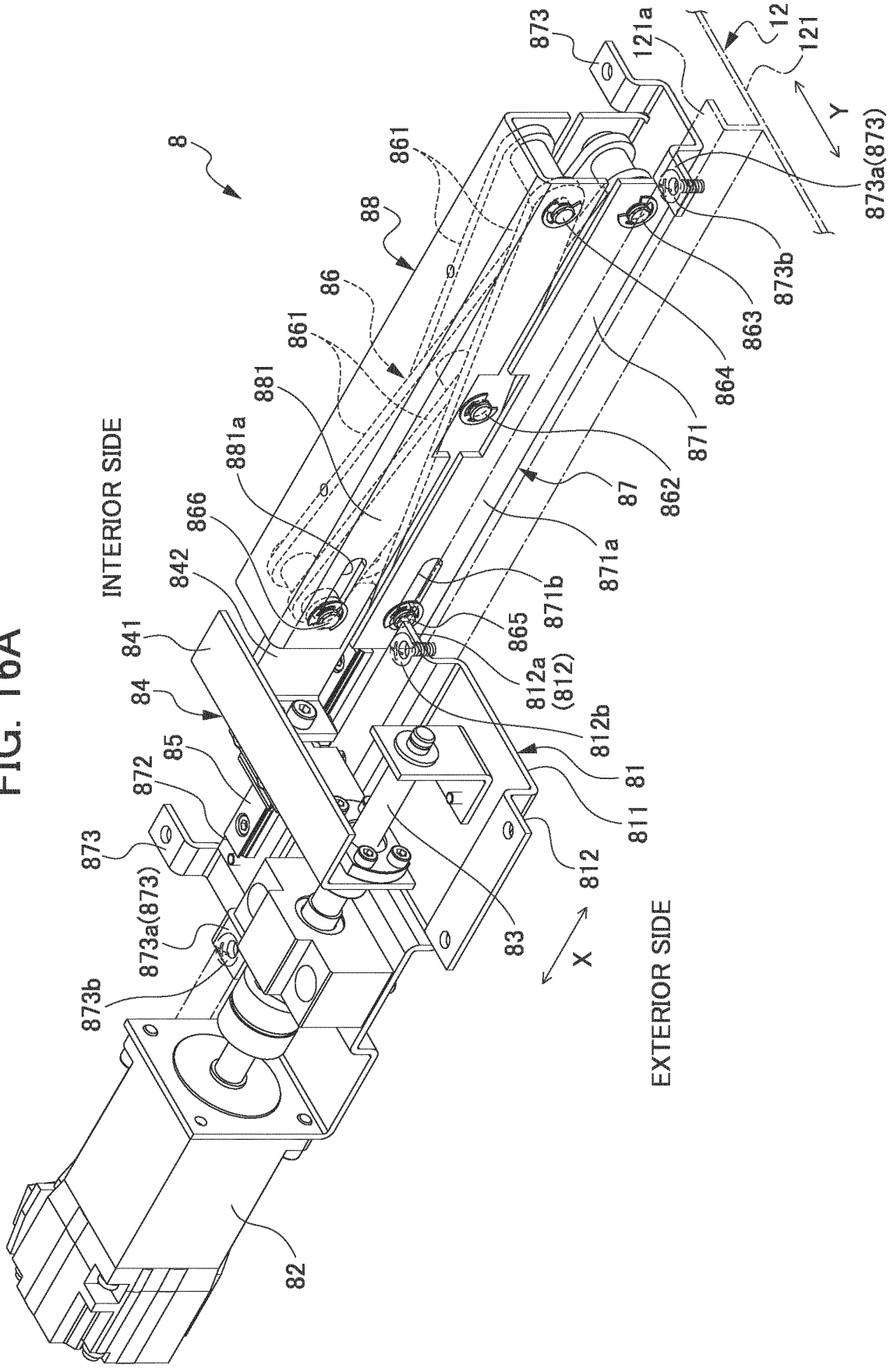

8
88
86
861
881
881a
866
842
841
84
85
872
873
873a(873)
873b
82
83
812
811
81
812b
812a
(812)
865
871b
871a
87
862
871
864
863
873b
873a(873)
121
121a
12
Y
X
INTERIOR SIDE
EXTERIOR SIDE

FIG. 16B

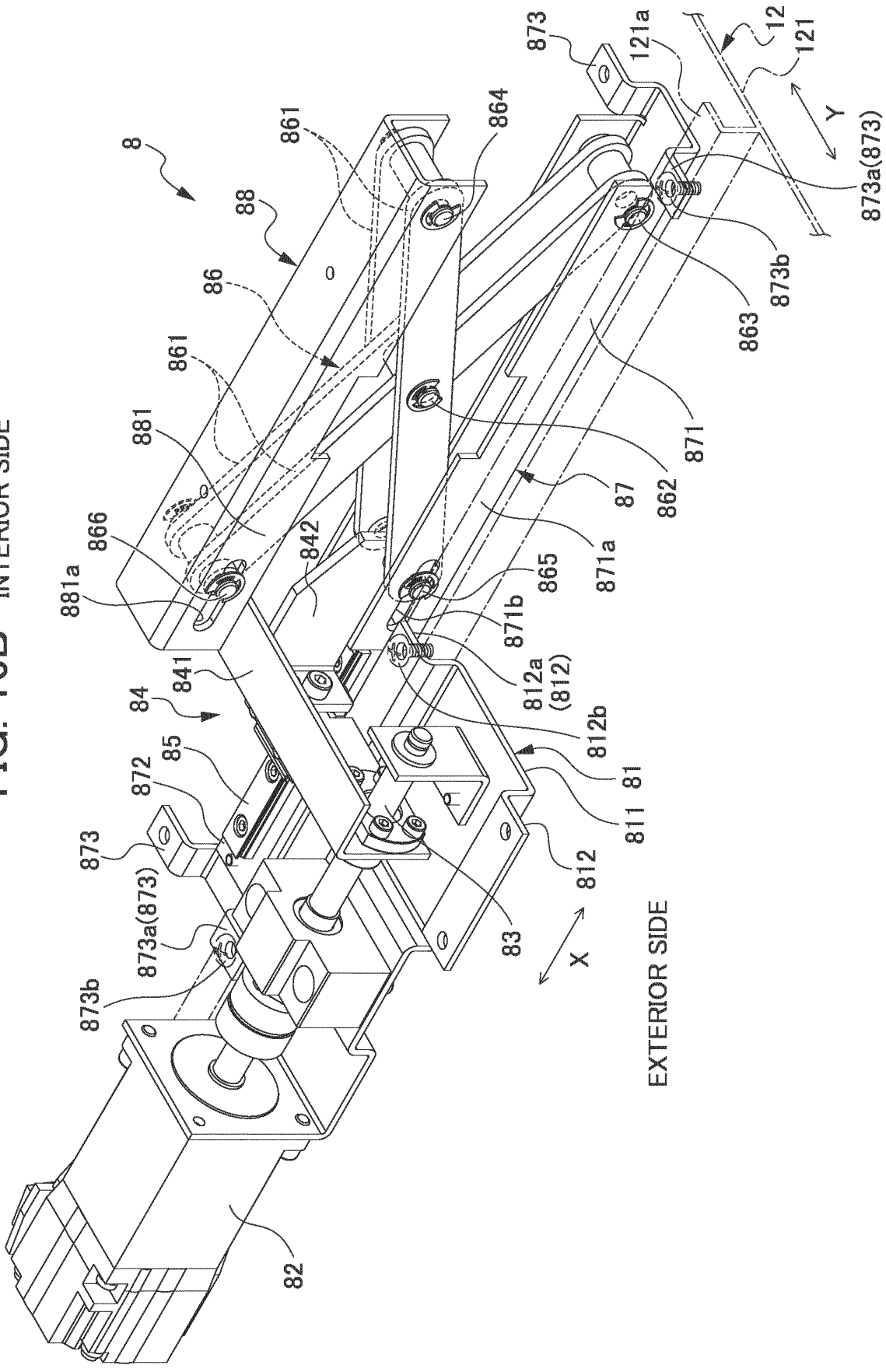

INTERIOR SIDE
EXTERIOR SIDE
8
88
86
861
881
881a
866
842
841
84
85
872
873
873a(873)
873b
82
83
812
811
81
812b
812a
(812)
871b
865
871a
87
862
871
863
873b
873a(873)
121
12
121a
873
864
X
Y

FIG. 17A

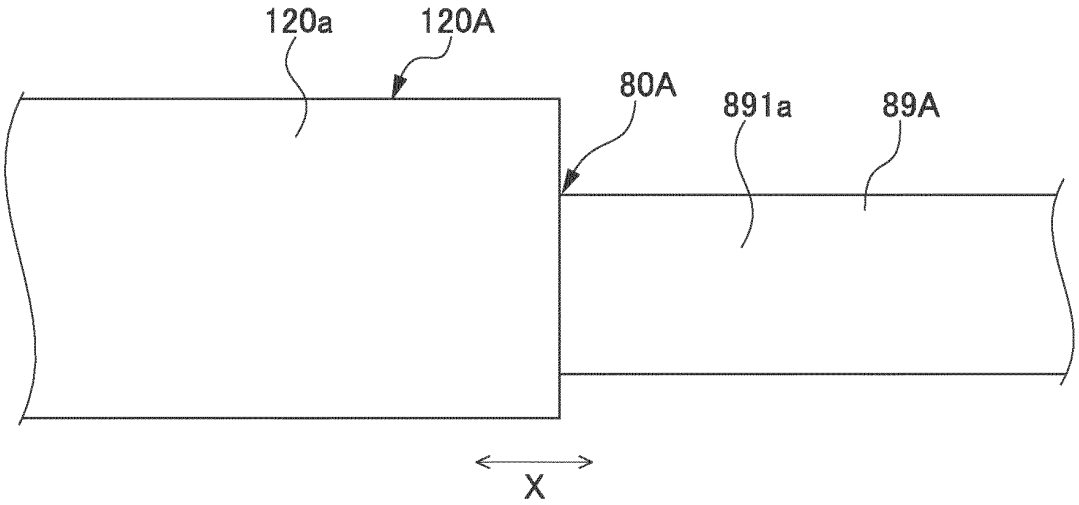


FIG. 17B

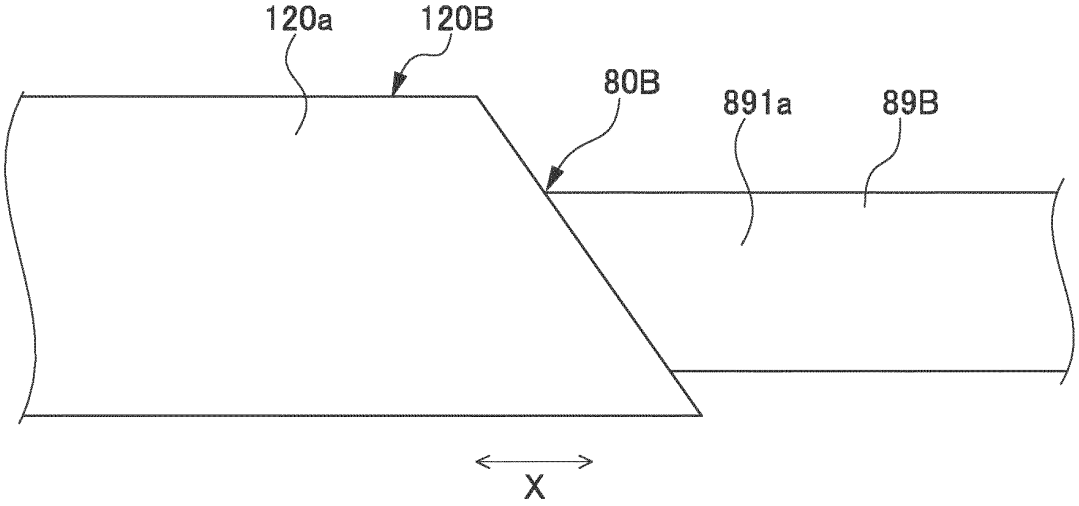


FIG. 17C

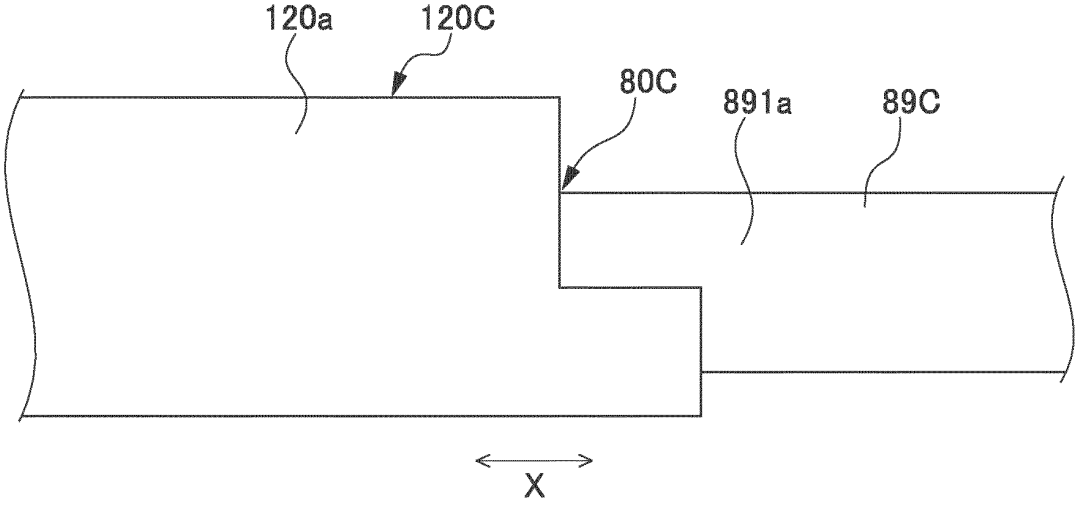
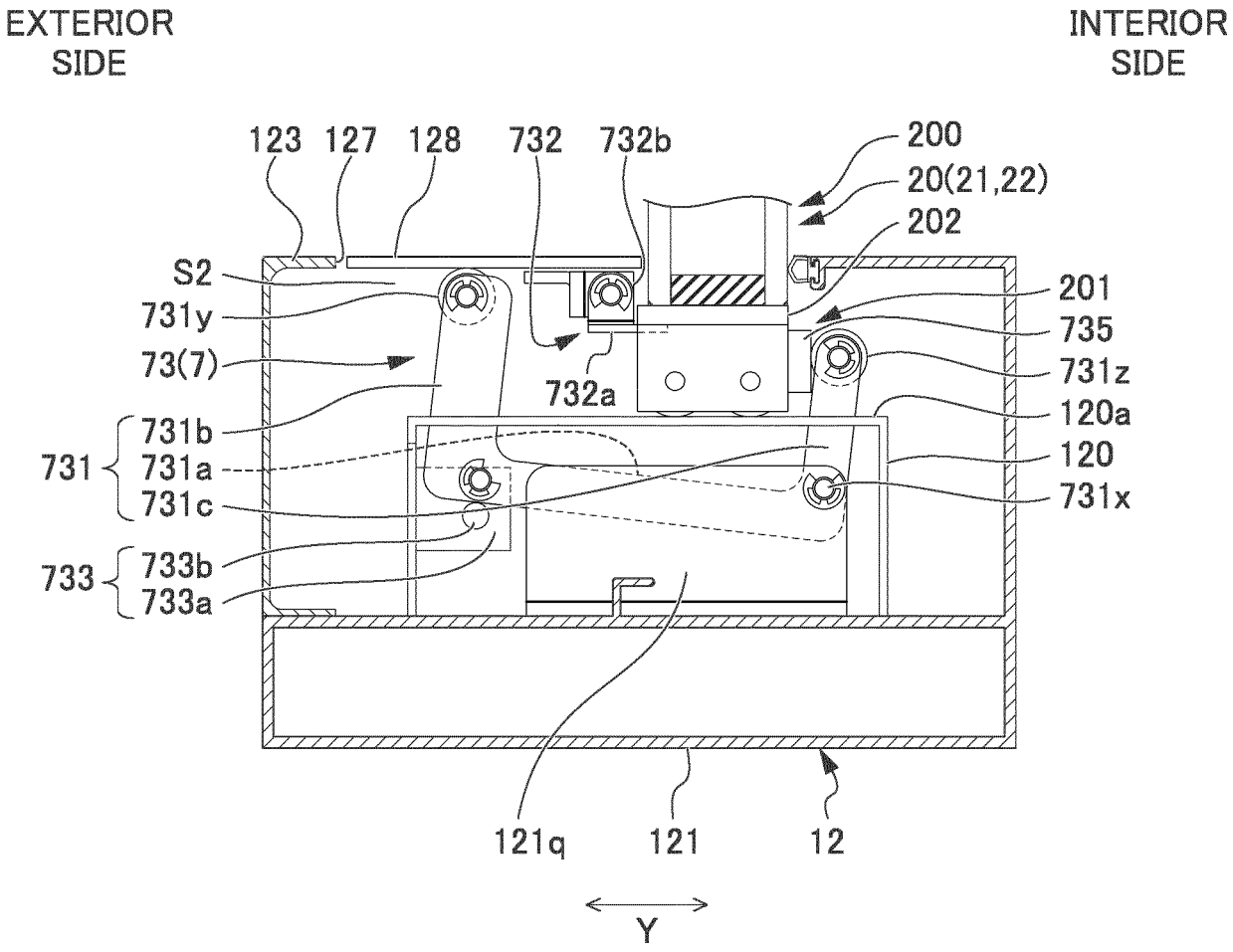


FIG. 18


EXTERIOR SIDE
INTERIOR SIDE
123
127
128
732
732b
200
20(21,22)
202
S2
731y
73(7)
732a
201
735
731z
120a
120
731x
731
731b
731a
731c
733
733b
733a
121q
121
12
Y

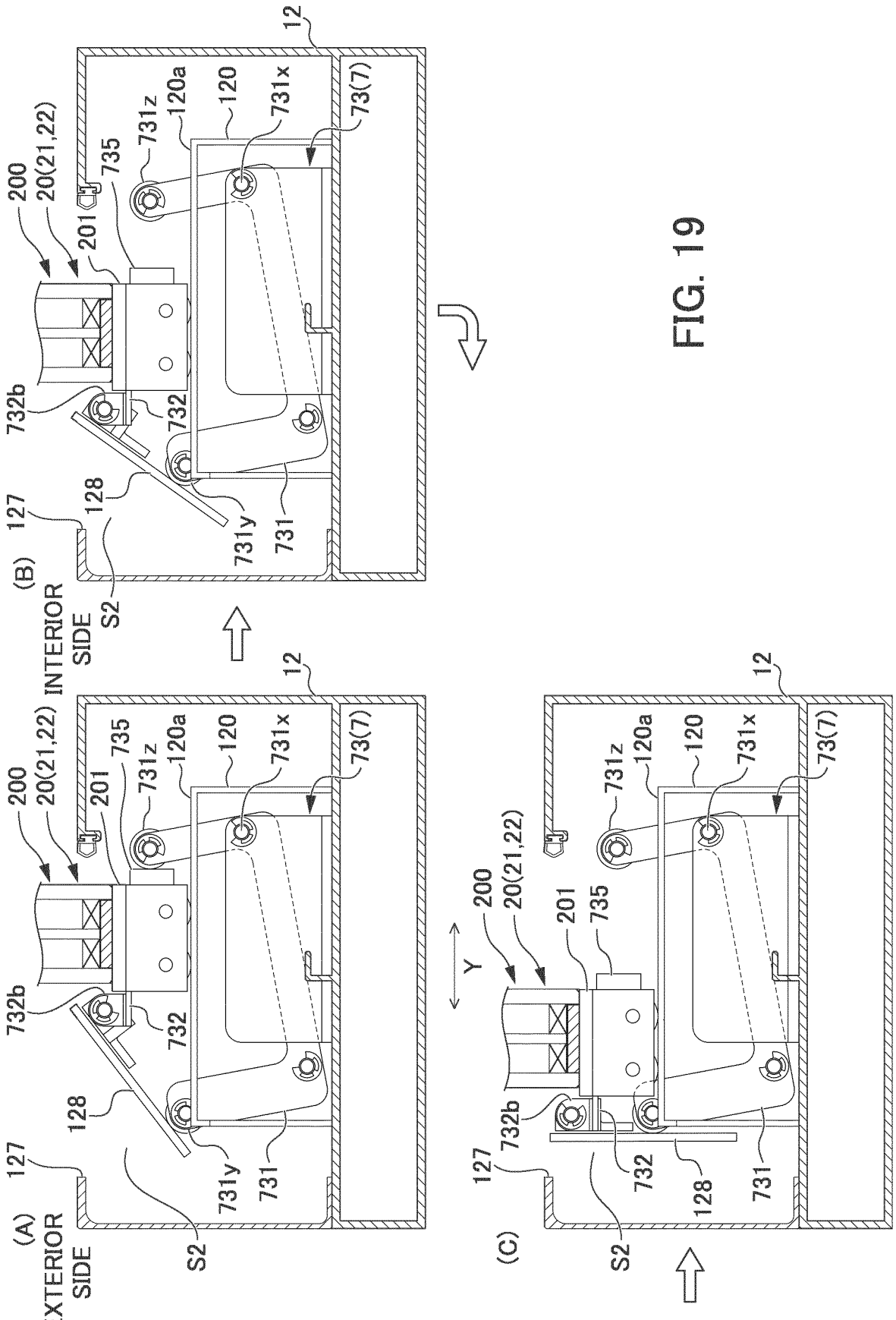

(A)
EXTERIOR SIDE
(B)
INTERIOR SIDE
(C)
Y
S2
127
128
731y
731
732b
732
731z
735
201
200
20(21,22)
120a
120
731x
73(7)
12

FIG. 19

FIG. 20

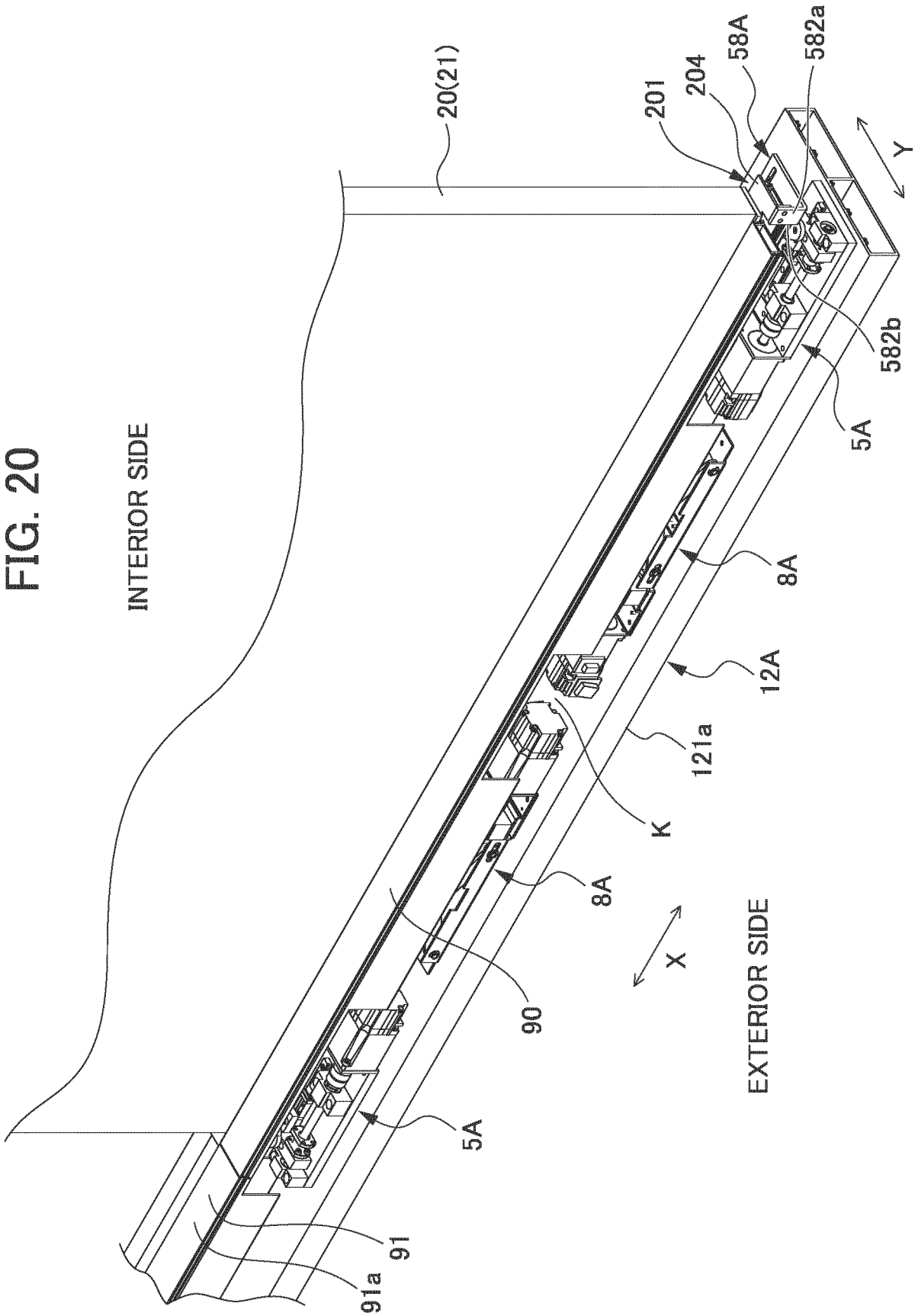

INTERIOR SIDE
EXTERIOR SIDE
20(21)
201
204
58A
582a
582b
5A
8A
12A
121a
K
90
91
91a
X
Y

FIG. 21

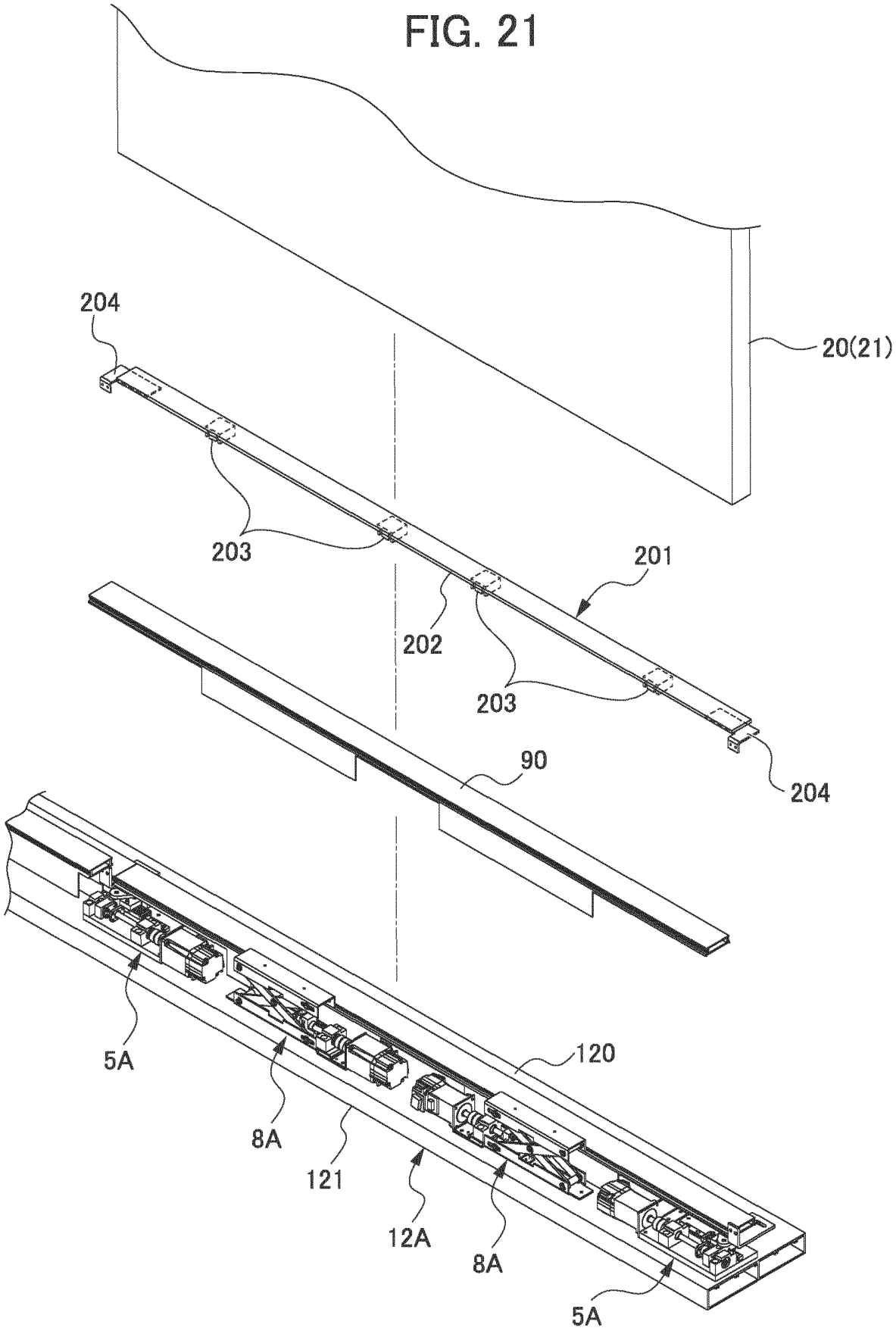


FIG. 22

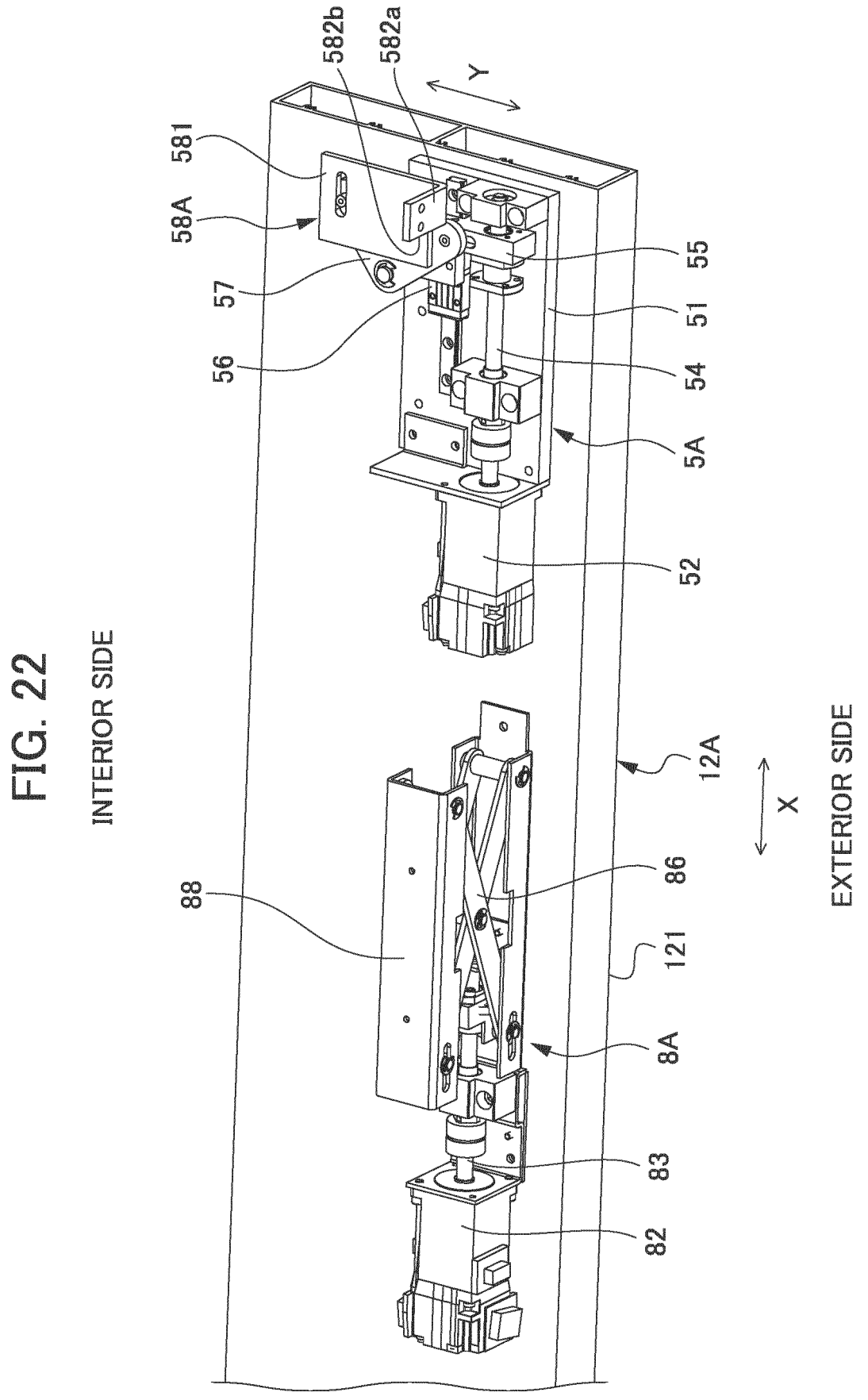

582b
582a
Y
581
58A
57
56
55
51
54
5A
52
12A
X
INTERIOR SIDE
EXTERIOR SIDE
88
86
121
8A
83
82

FIG. 23A

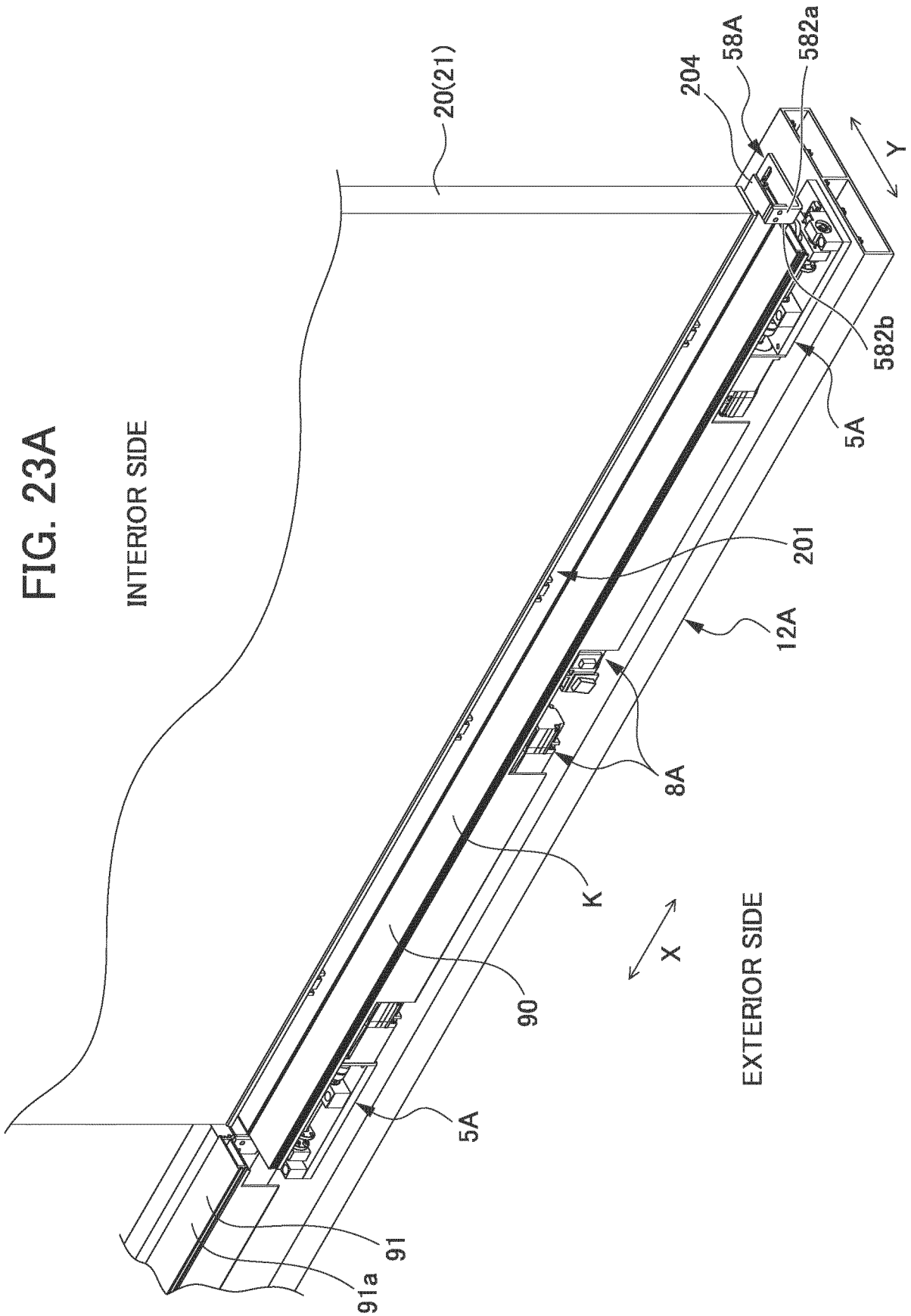

INTERIOR SIDE
EXTERIOR SIDE
20(21)
204
58A
582a
582b
5A
201
12A
8A
K
90
91
91a
X
Y

FIG. 23B

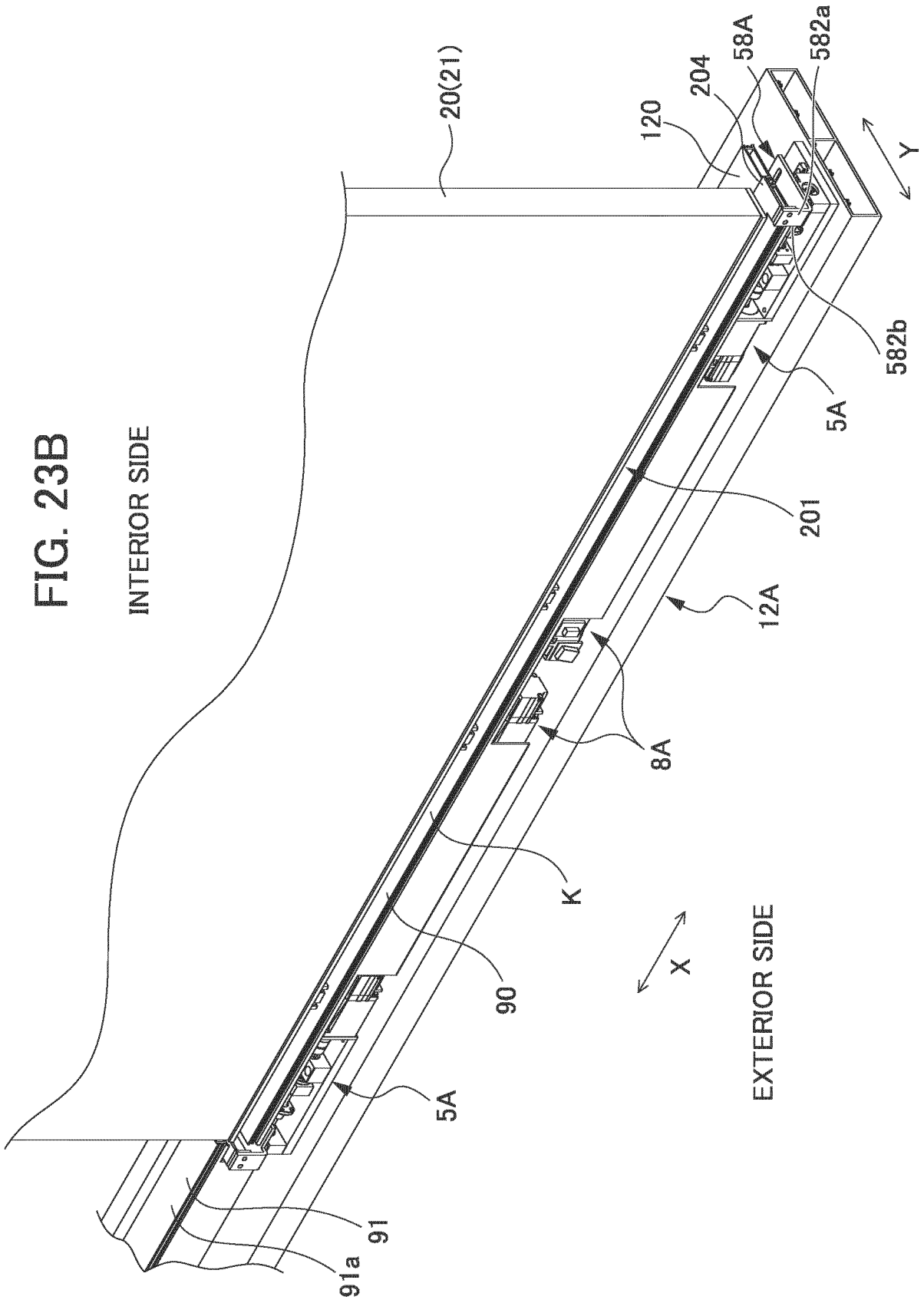

INTERIOR SIDE
20(21)
120
204
58A
582a
582b
5A
201
12A
8A
K
90
91
91a
X
Y
EXTERIOR SIDE

FIG. 24

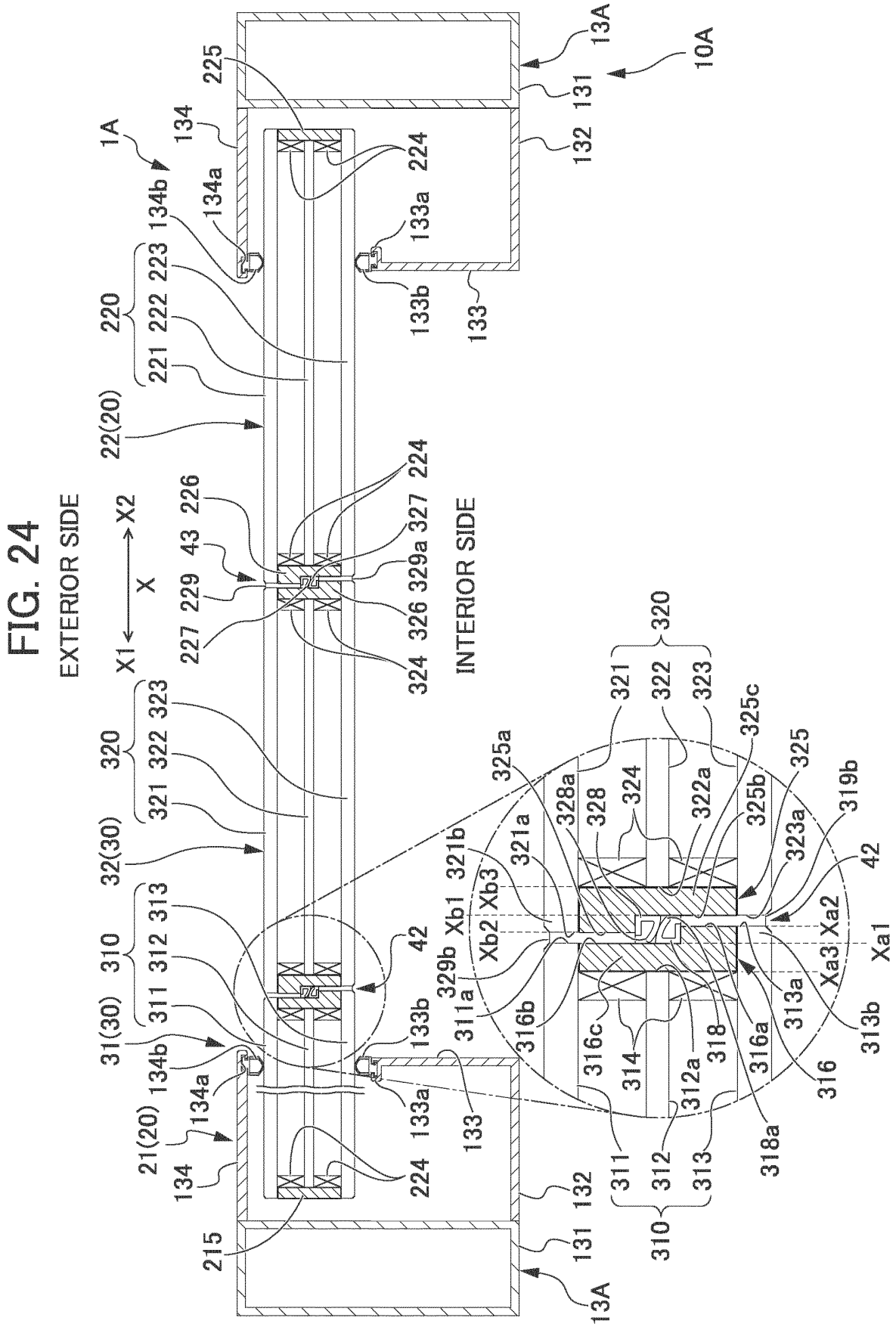

EXTERIOR SIDE
INTERIOR SIDE
X1
X2
X
1A
10A
13A
131
132
133
133a
133b
134
134a
134b
225
224
220
221
222
223
22(20)
226
43
227
229
324
326
327
329a
320
321
322
323
32(30)
310
311
312
313
31(30)
42
329b
311a
316b
316c
314
312a
318
316a
313a
316
313b
318a
325a
328a
328
324
321a
321b
322a
325c
325
325b
323a
319b
Xb1
Xb2
Xb3
Xa1
Xa2
Xa3
21(20)
215

FIG. 25

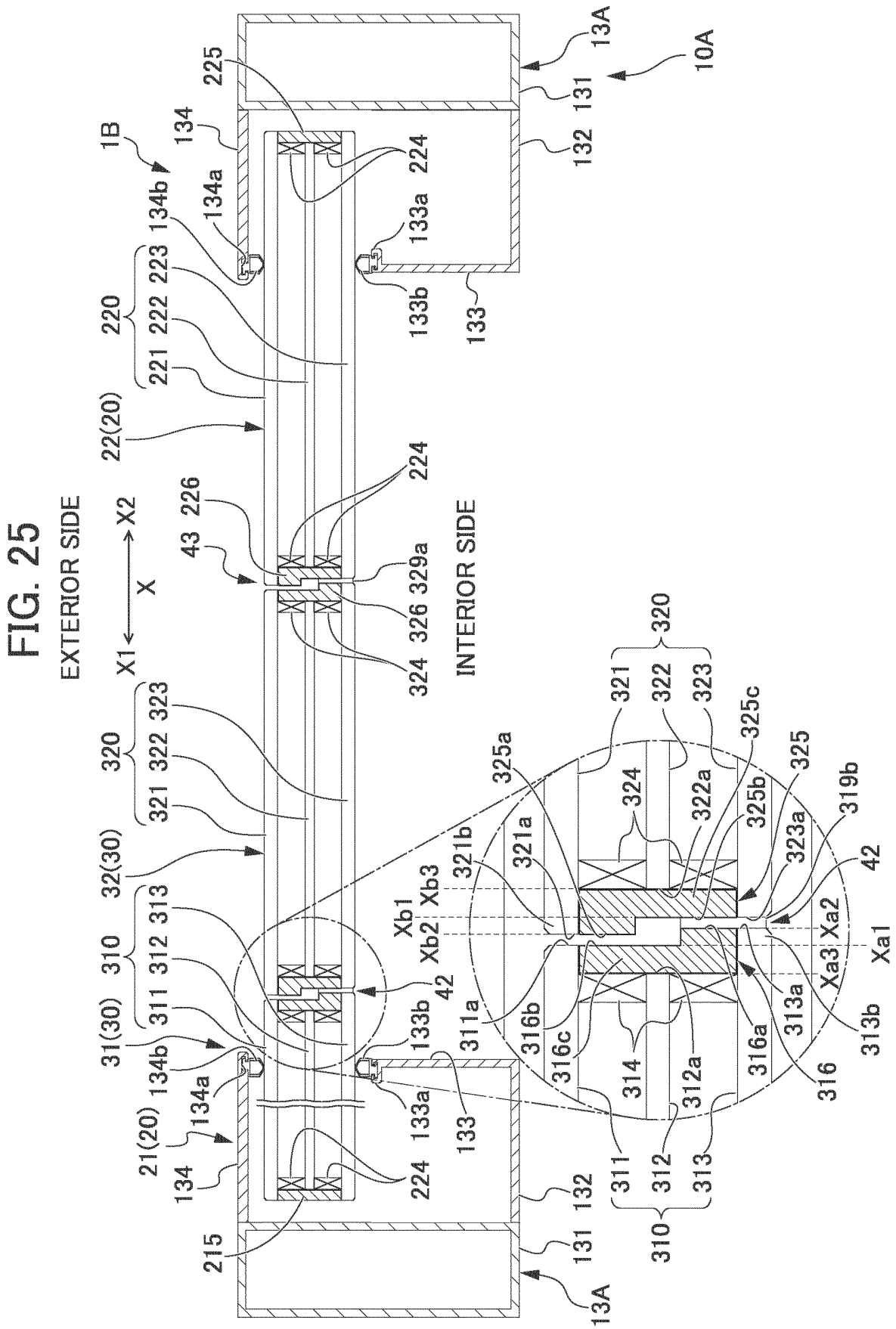

EXTERIOR SIDE
INTERIOR SIDE
X1
X2
X
10A
13A
131
132
133
134
1B
134a
134b
133a
133b
225
224
220
221
222
223
22(20)
226
43
329a
326
324
320
321
322
323
325a
325b
325c
325
319b
32(30)
310
311
312
313
31(30)
21(20)
215
42
Xb1
Xb2
Xb3
Xa1
Xa2
Xa3
321a
321b
322a
323a
324
311a
312a
313a
314
316
316a
316b
316c
313b

FIG. 26

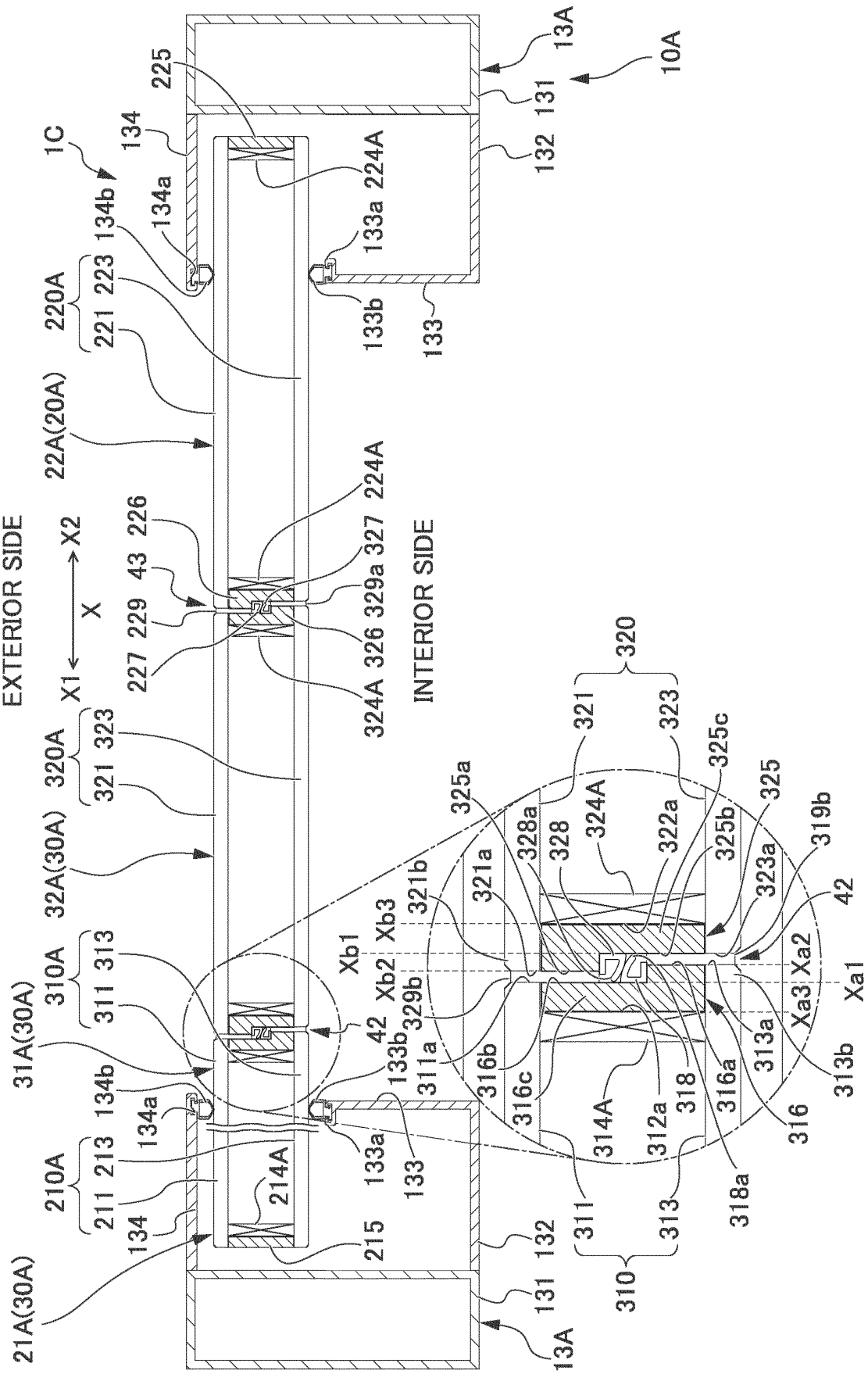

EXTERIOR SIDE
INTERIOR SIDE
X1
X2
X
1C
10A
13A
131
132
133
133a
133b
134
134a
134b
225
224A
220A
221
223
22A(20A)
226
43
227
229
324A
326
327
329a
320
321
323
32A(30A)
320A
310A
311
313
31A(30A)
210A
211
213
214A
215
21A(30A)
42
329b
311a
316b
316c
325a
328a
328
324A
321a
321b
322a
325b
325c
323a
319b
Xb1
Xb2
Xb3
Xa1
Xa2
Xa3
316
313b
313a
316a
318a
318
312a
314A
310

FIG. 27

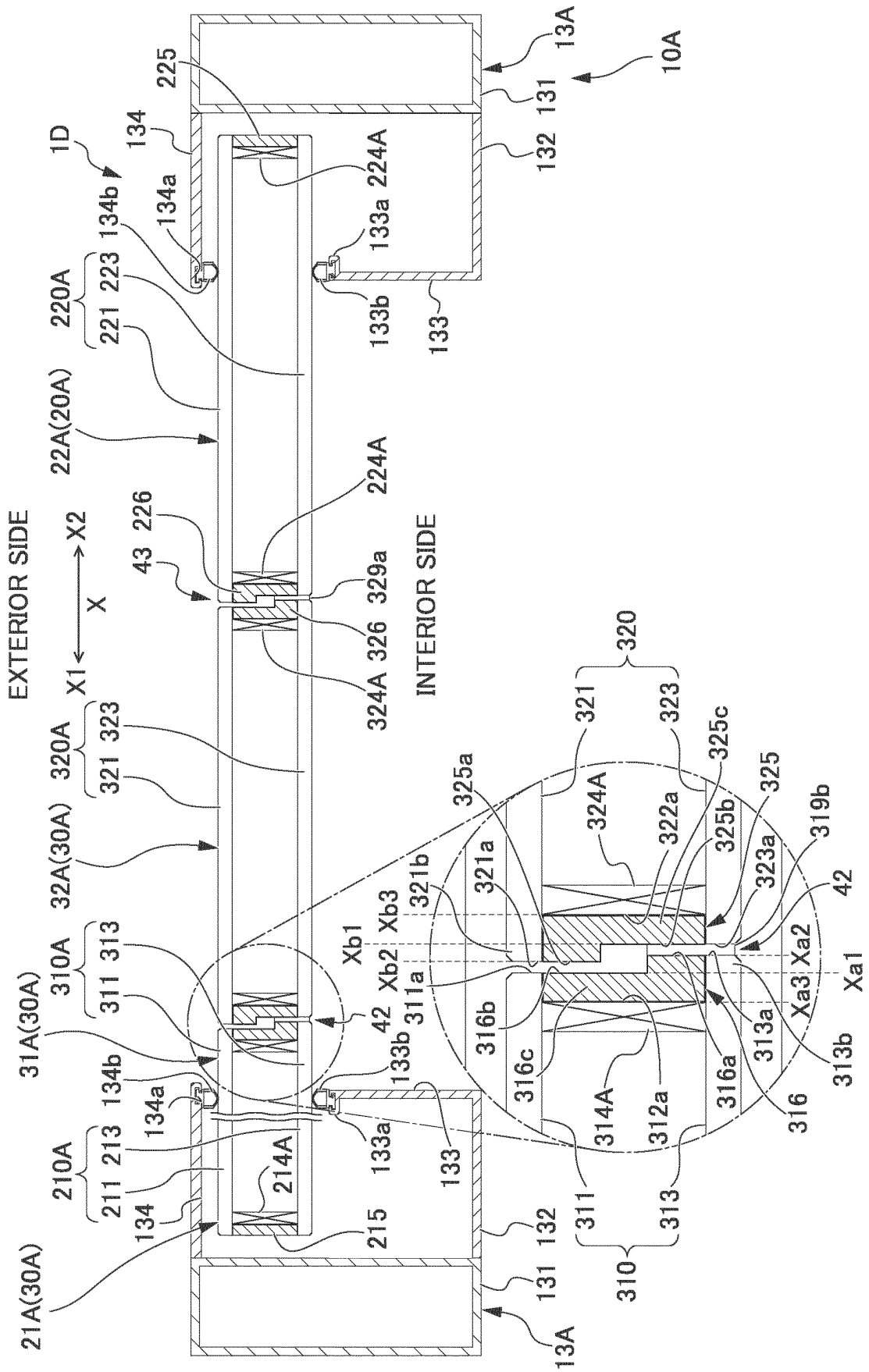

EXTERIOR SIDE
INTERIOR SIDE
X1
X2
X
1D
10A
13A
131
132
133
134
134a
134b
133a
133b
225
224A
220A
221
223
22A(20A)
226
43
329a
326
324A
320A
321
323
320
325
325a
325b
325c
324A
322a
319b
32A(30A)
321a
321b
Xb1
Xb2
Xb3
42
311a
316b
316c
316a
316
313a
313b
Xa1
Xa2
Xa3
31A(30A)
310A
311
313
310
314A
312a
210A
211
213
214A
215
21A(30A)

FIG. 28

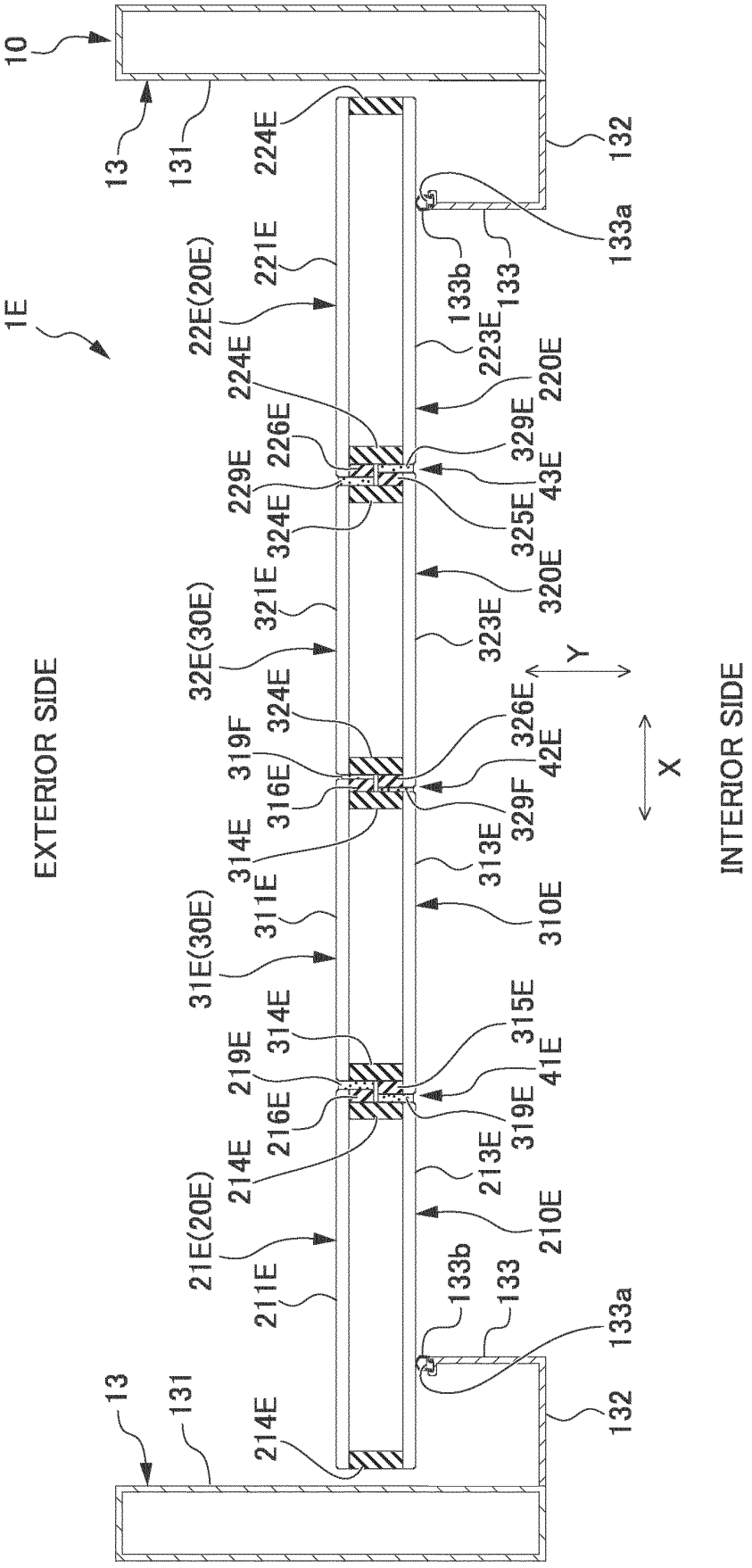

EXTERIOR SIDE
INTERIOR SIDE
1E
10
13
131
132
133
133a
133b
21E(20E)
211E
214E
216E
219E
22E(20E)
221E
223E
224E
226E
229E
31E(30E)
311E
313E
314E
315E
316E
319E
32E(30E)
321E
323E
324E
325E
326E
329E
41E
42E
43E
210E
220E
310E
320E
329F
319F
X
Y

FIG. 29

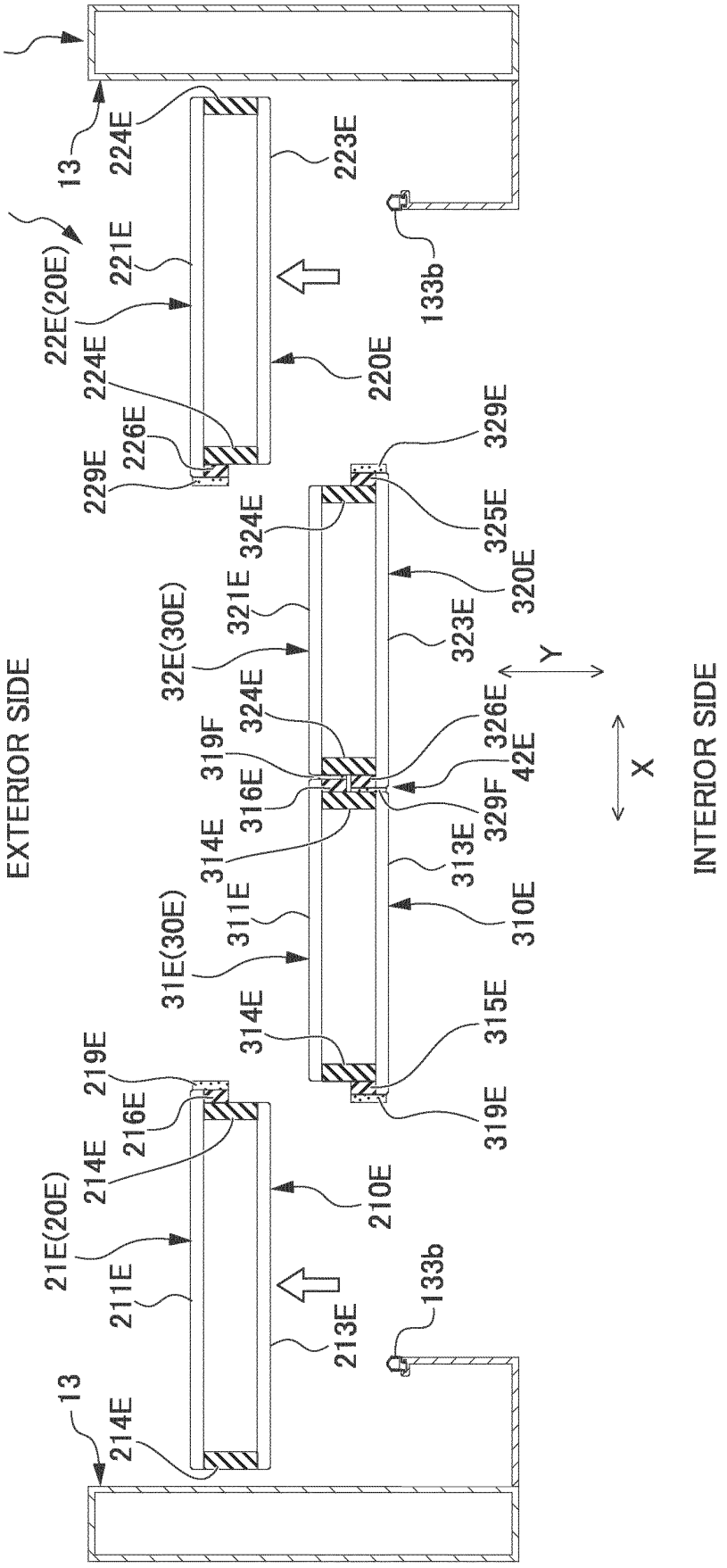

EXTERIOR SIDE
INTERIOR SIDE
10
13
1E
22E(20E)
21E(20E)
32E(30E)
31E(30E)
224E
223E
221E
220E
226E
229E
133b
329E
325E
324E
320E
321E
323E
326E
42E
319F
316E
314E
329F
313E
311E
310E
315E
319E
219E
216E
214E
210E
211E
213E
Y
X

FIG. 30

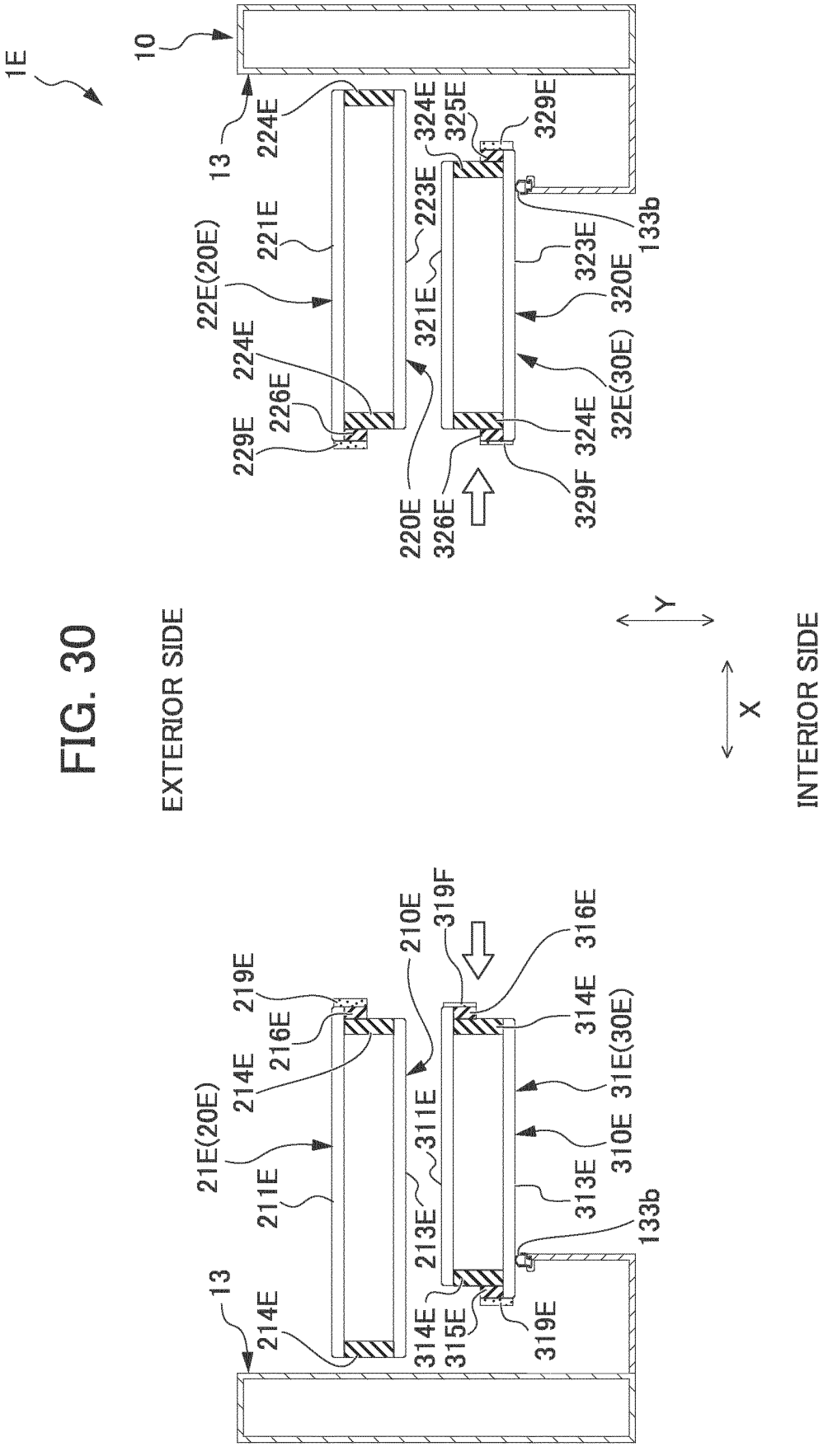

1E
10
13
224E
324E
325E
329E
133b
22E(20E)
221E
223E
323E
320E
224E
321E
32E(30E)
226E
324E
229E
220E
326E
329F
EXTERIOR SIDE
INTERIOR SIDE
Y
X
21E(20E)
219E
210E
319F
316E
214E
216E
314E
31E(30E)
311E
211E
310E
313E
213E
133b
13
214E
314E
315E
319E

FIG. 31

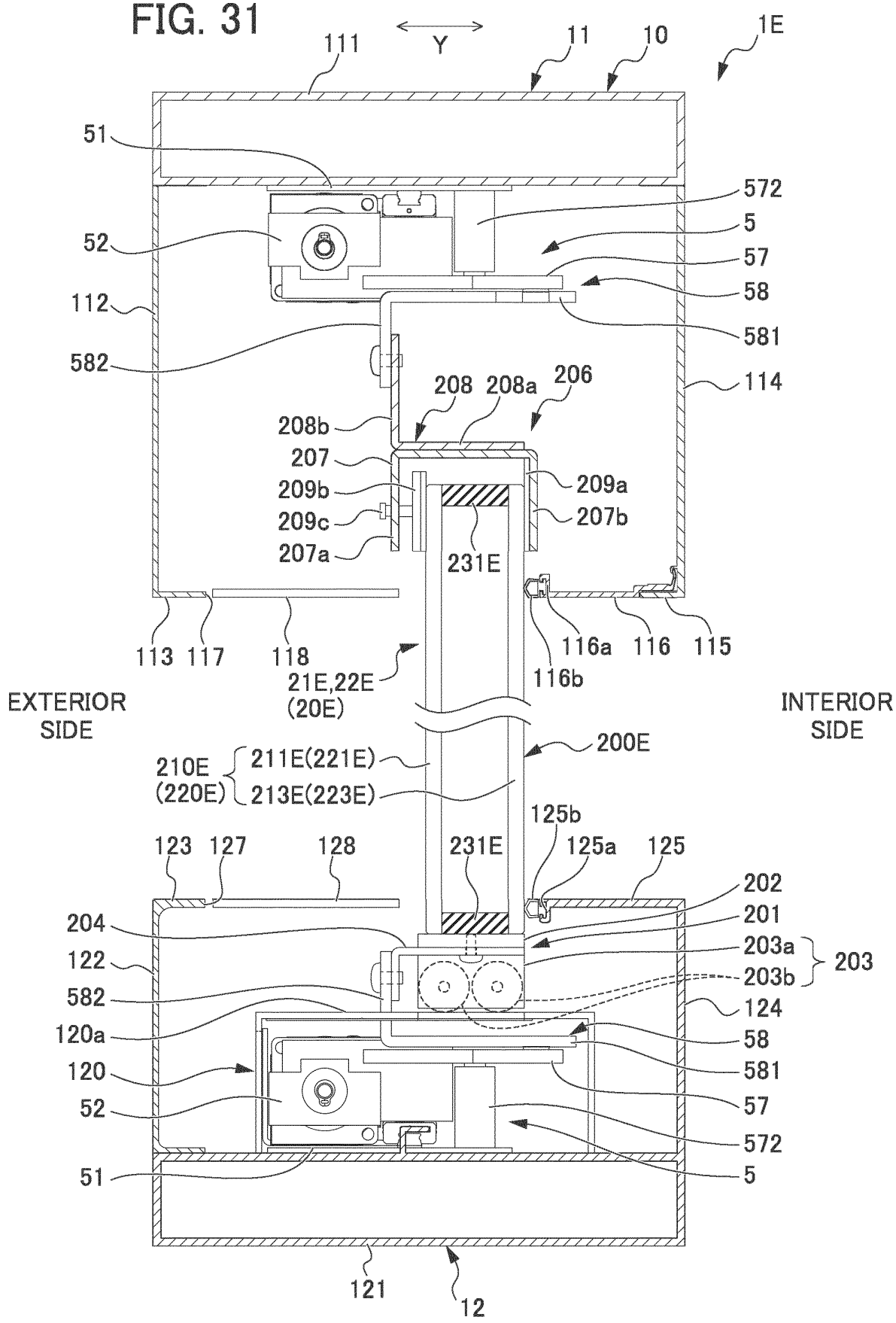

111
Y
11
10
1E
51
572
52
5
57
58
112
581
582
114
208
208a
206
208b
207
209a
209b
207b
209c
207a
231E
113
117
118
116a
116
115
21E,22E
(20E)
116b
EXTERIOR SIDE
INTERIOR SIDE
200E
210E
(220E)
211E(221E)
213E(223E)
125b
123
127
128
231E
125a
125
202
201
204
203a
203
122
203b
582
124
120a
58
120
581
52
57
572
51
5
121
12

FIG. 32

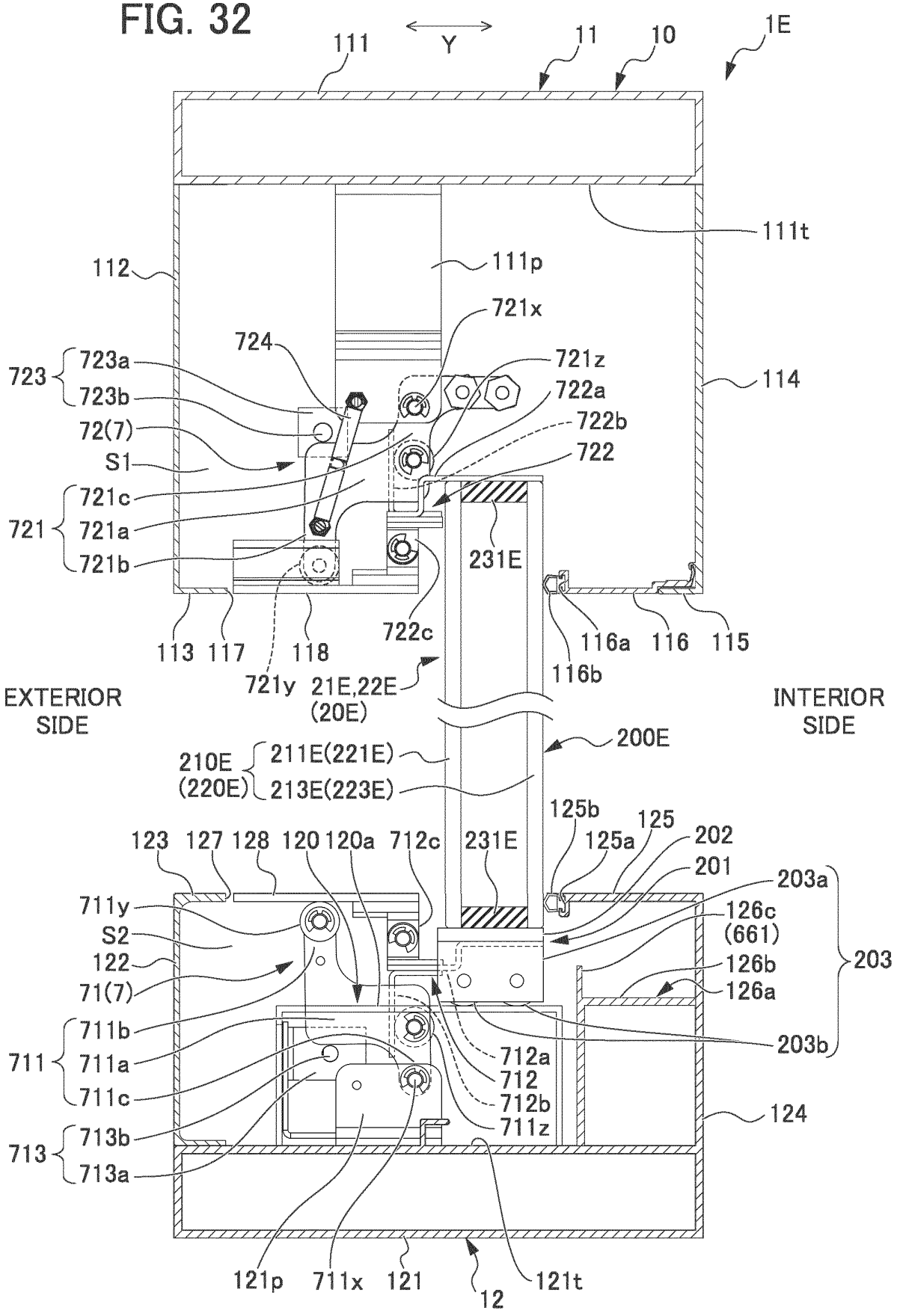
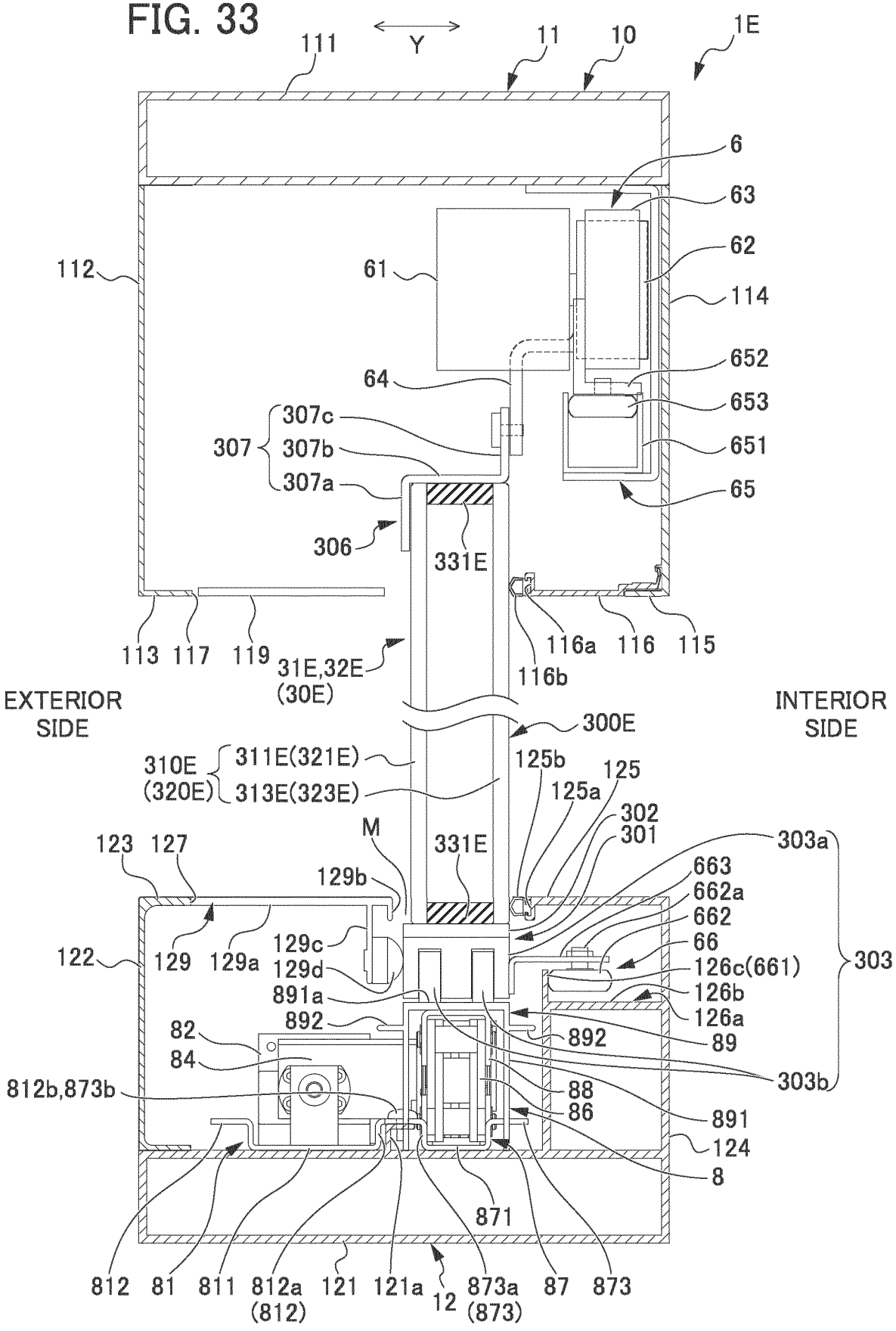

111
Y
11
10
1E
111t
112
111p
721x
724
721z
114
723
723a
723b
722a
722b
72(7)
722
S1
721c
721
721a
721b
231E
722c
116a
116
115
113
117
118
116b
721y
21E,22E
(20E)
EXTERIOR SIDE
INTERIOR SIDE
200E
210E
(220E)
211E(221E)
213E(223E)
125b
125
202
123
127
128
120
120a
712c
231E
125a
201
203a
711y
126c
(661)
S2
203
122
126b
71(7)
126a
203b
711
711b
711a
712a
712
711c
712b
711z
124
713
713b
713a
121p
711x
121
12
121t

FIG. 33


111
Y
11
10
1E
6
63
62
114
112
61
652
64
653
307c
307
307b
307a
651
65
306
331E
113
117
119
31E,32E
(30E)
116a
116
115
116b
EXTERIOR
SIDE
INTERIOR
SIDE
300E
310E
(320E)
311E(321E)
313E(323E)
125b
125
125a
302
301
303a
M
331E
123
127
129b
663
662a
662
66
129c
129
129a
129d
126c(661)
303
122
891a
126b
892
126a
82
892
89
84
303b
812b,873b
88
86
891
124
8
871
812
81
811
812a
(812)
121
121a
12
873a
(873)
87
873

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2019/032472

A. CLASSIFICATION OF SUBJECT MATTER
Int.Cl. E06B7/22(2006.01)i, E05D15/10(2006.01)i, E06B3/46(2006.01)i, E06B3/66(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)
Int.Cl. E06B7/22, E05D15/10, E06B3/46, E06B3/66

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Published examined utility model applications of Japan	1922-1996
Published unexamined utility model applications of Japan	1971-2019
Registered utility model specifications of Japan	1996-2019
Published registered utility model applications of Japan	1994-2019

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X A	JP 9-228748 A (ASAHI GLASS CO., LTD.) 02 September 1997, paragraphs [0001], [0009]-[0010], fig. 1 (Family: none)	1-2 3-24
A	JP 59-59518 A (MESSERSCHMITT-BOLKOW-BLOHM GESELLSCHAFT MIT BESCHRANKTER HAFTUNG) 05 April 1984, page 2, lower right column, line 11 to page 3, upper left column, line 17, fig. 2 & EP 102526 A2 & DE 3232781 A & AT 41371 E	1-24

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

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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
01 November 2019 (01.11.2019)	12 November 2019 (12.11.2019)

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

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INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2019/032472

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	JP 2015-145569 A (AGC-LIXIL WINDOW TECHNOLOGY CO., LTD.) 13 August 2015, paragraphs [0059]-[0063], fig. 7 & WO 2014/157666 A1 & EP 2987936 A1 (paragraphs [0092], [0121], fig. 7)	1-24
A	JP 2008-63746 A (SHIN NIKKEI CO., LTD.) 21 March 2008, paragraphs [0017]-[0026], fig. 4 (Family: none)	1-24
A	Microfilm of the specification and drawings annexed to the request of Japanese Utility Model Application No. 70273/1982 (Laid-open No. 172673/1983) (ABIKO, Seiji) 18 November 1983, specification, page 6, line 17 to page 8, line 11, fig. 2 (Family: none)	1-24
A	JP 2007-100450 A (BS LINE KK) 19 April 2007, paragraphs [0012]-[0015], fig. 1-2 (Family: none)	1-24

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Patent documents cited in the description

- JP H0645074 U **[0005]**
- JP 2018105121 A **[0005]**
- JP 3550244 B **[0005]**
- JP 3189401 U **[0005]**