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(54) **CEILING DEVICE OF ELEVATOR CAR**

**DECKENVORRICHTUNG FÜR AUFZUGSKABINE**

**DISPOSITIF DE PLAFOND POUR CABINE D'ASCENSEUR**

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## Description

### TECHNICAL FIELD

**[0001]** The present invention relates to an elevator car ceiling apparatus in which an internal ceiling plate is disposed further inside a car than an external ceiling plate.

### BACKGROUND ART

**[0002]** Conventionally, elevator car ceiling apparatuses have been proposed that have: a ceiling plate in which an emergency rescue hatchway is disposed; and a suspended ceiling plate that is disposed under the ceiling plate and in which an inspection opening portion is disposed. A cover that opens and closes the emergency rescue hatchway is disposed on the ceiling plate, and a cover that opens and closes the inspection opening portion is disposed on the suspended ceiling plate. The emergency rescue hatchway is opened by the cover that is disposed on the ceiling plate being rotated outward from the car. The inspection opening portion is opened by the cover that is disposed on the suspended ceiling plate being rotated inward into the car (See Patent Literature 1).

**[0003]** Moreover, patent literature 2 is related to an elevator car, in which a removable cover plate is lifted upwards and stored in a space between an external ceiling plate and a plate located adjacent the original position of the removed cover plate.

[Patent Literature 1]

**[0004]** Japanese Patent Laid-Open No. 2001-316061 (Gazette)

[Patent Literature 2]

**[0005]** JP S62176168 U

### DISCLOSURE OF THE INVENTION

#### PROBLEM TO BE SOLVED BY THE INVENTION

**[0006]** However, because the cover is rotated inward into the car when opening the inspection opening portion, care must be taken not to hit users inside the car with the cover if the inspection opening portion is opened fully since an end portion of the cover reaches a region close to a floor of the car.

**[0007]** If, for example, running of the elevator stops in an emergency, etc., passengers inside the car can be rescued onto the top of the car through the inspection opening portion and the emergency rescue hatchway, but because the cover remains suspended inside the car when the inspection opening portion is open, the cover is obstructive when the passengers move onto the top of the car from inside the car, or when rescuers move

into the car from on top of the car.

**[0008]** The present invention aims to solve the above problems and an object of the present invention is to provide an elevator car ceiling apparatus that can reduce an opening action region required in order to open an inspection hatchway, and that can also facilitate movement of users between an interior portion of a car and a top of the car.

#### 10 MEANS FOR SOLVING THE PROBLEM

**[0009]** In order to achieve the above object, there is provided an elevator car ceiling apparatus according to claim 1.

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#### EFFECTS OF THE INVENTION

**[0010]** In an elevator car ceiling apparatus according to the present invention, because the inspection hatchway opening and closing cover is held by the internal ceiling plate when in an inspection hatchway closing position that closes the inspection hatchway, and is also removed from the internal ceiling plate by being displaced to a holding release position that is offset horizontally from the inspection hatchway closing position to disengage holding by the internal ceiling plate, the inspection hatchway opening and closing cover can be removed from the internal ceiling plate in a state that is close to horizontal. Consequently, an opening action region required in order to open the inspection hatchway can be reduced. Because passengers, rescuers, etc., can pass through the inspection hatchway and the rescue hatchway with the inspection hatchway opening and closing cover removed from the internal ceiling plate, movement of users between an interior portion of a car and a top of the car can be facilitated.

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#### BRIEF DESCRIPTION OF THE DRAWINGS

40 **[0011]**

Figure 1 is a plan that shows an elevator car ceiling apparatus according to Embodiment 1 of the present invention;

Figure 2 is a cross section that is taken along Line II - II in Figure 1;

Figure 3 is a perspective that shows an inspection hatchway locking apparatus from Figure 2;

Figure 4 is a perspective that shows a triangular key from Figure 2;

Figure 5 is a plan that shows a rescue hatchway locking apparatus from Figure 2;

Figure 6 is a plan that shows a state in which locking of the rescue hatchway locking apparatus in Figure 5 is released;

Figure 7 is a cross section that shows a state when an inspection hatchway opening and closing cover from Figure 2 is in a holding release position;

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Figure 8 is a cross section that shows a state when the inspection hatchway opening and closing cover in Figure 7 is removed from an internal ceiling plate; Figure 9 is a cross section that shows a state when a rescue hatchway opening and closing cover in Figure 8 is displaced to a rescue hatchway opening position;

Figure 10 is a cross section that shows a state when the rescue hatchway opening and closing cover from Figure 2 is displaced to a rescue hatchway opening position;

Figure 11 is a cross section that shows a state when the inspection hatchway opening and closing cover in Figure 10 is in a holding release position;

Figure 12 is a cross section that shows a state when the inspection hatchway opening and closing cover in Figure 11 is removed from the internal ceiling plate; Figure 13 is a plan that shows an elevator car ceiling apparatus according to Embodiment 2 of the present invention;

Figure 14 is a cross section that is taken along Line XIV - XIV in Figure 13;

Figure 15 is a cross section that shows a state when an inspection hatchway opening and closing cover from Figure 14 is in a holding release position;

Figure 16 is a cross section that shows a state when the inspection hatchway opening and closing cover in Figure 15 is removed from an internal ceiling plate; Figure 17 is a cross section that shows a state when a rescue hatchway opening and closing cover in Figure 16 is displaced to a rescue hatchway opening position;

Figure 18 is a cross section that shows a state when the rescue hatchway opening and closing cover from Figure 14 is displaced to a rescue hatchway opening position;

Figure 19 is a cross section that shows a state when a thumbscrew and a nut from Figure 18 are removed from the inspection hatchway opening and closing cover;

Figure 20 is a cross section that shows a state when the inspection hatchway opening and closing cover in Figure 19 is removed from the internal ceiling plate; and

Figure 21 is a partial perspective that shows a second example of an elevator car ceiling apparatus according to Embodiment 2 of the present invention.

#### BEST MODE FOR CARRYING OUT THE INVENTION

**[0012]** Preferred embodiments of the present invention will now be explained with reference to the drawings.

#### Embodiment 1

**[0013]** Figure 1 is a plan that shows an elevator car ceiling apparatus according to Embodiment 1 of the present invention. Figure 2 is a cross section that is taken

along Line II - II in Figure 1. Moreover, Figure 1 is a plan that shows the car ceiling apparatus when viewed from inside a car. In the figures, an external ceiling plate 2 (Figure 2), and an internal ceiling plate 3 that is disposed further inside a car 1 than the external ceiling plate 2 (i.e., below the external ceiling plate 2) are disposed on an upper portion of a car 1. Specifically, an external ceiling plate 2 and an internal ceiling plate 3 that face each other vertically are disposed on the upper portion of the car 1. A plurality of lighting devices 4 (Figure 1) for illuminating inside the car 1 are disposed between the external ceiling plate 2 and the internal ceiling plate 3. Each of the lighting devices 4 is mounted to a lower surface of the external ceiling plate 2.

**[0014]** A rescue hatchway 5 that is disposed so as to avoid each of the lighting devices 4 is disposed on the external ceiling plate 2. A rescue hatchway opening and closing cover 6 that opens and closes the rescue hatchway 5 is also mounted on the external ceiling plate 2. The rescue hatchway opening and closing cover 6 is mounted to the external ceiling plate 2 by means of a hinge 7 that is disposed on an edge portion of the rescue hatchway 5.

**[0015]** The rescue hatchway opening and closing cover 6 can be displaced between a rescue hatchway closing position that closes the rescue hatchway 5, and a rescue hatchway opening position that is positioned further outside the car 1 than the rescue hatchway closing position, and that opens the rescue hatchway 5 by being rotated around an axis of the hinge 7. An edge portion of the rescue hatchway opening and closing cover 6 is engaged in the external ceiling plate 2 when the rescue hatchway opening and closing cover 6 is in the rescue hatchway closing position (i.e., when the rescue hatchway opening and closing cover 6 closes the rescue hatchway 5). In other words, displacement of the rescue hatchway opening and closing cover 6 further inside the car 1 than the rescue hatchway closing position is restricted by engagement of the rescue hatchway opening and closing cover 6 with the external ceiling plate 2.

**[0016]** A lighting opening 8 (Figure 1) that faces each of the lighting devices 4, and an inspection hatchway 9 that faces the rescue hatchway 5 are disposed on the internal ceiling plate 3. A semitransparent lighting cover 10 (Figure 1) that covers the lighting opening 8, and an inspection hatchway opening and closing cover 11 that opens and closes the inspection hatchway 9 are each mounted removably onto the internal ceiling plate 3.

**[0017]** The inspection hatchway opening and closing cover 11 is held by the internal ceiling plate 3 when in an inspection hatchway closing position that closes the inspection hatchway 9 (Figure 2). Holding of the inspection hatchway opening and closing cover 11 by the internal ceiling plate 3 is disengaged by the inspection hatchway opening and closing cover 11 being displaced to a holding release position that is offset horizontally from the inspection hatchway closing position (Figure 7). Consequently, the inspection hatchway opening and closing cover 11

is mounted onto the internal ceiling plate 3 by being displaced to the inspection hatchway closing position and held by the internal ceiling plate 3, and is removed from the internal ceiling plate 3 by being displaced to the holding release position to disengage holding by the internal ceiling plate 3.

**[0018]** The inspection hatchway opening and closing cover 11 has: a plate-shaped cover main body 12 that has a design surface and a back surface; a first cover frame 13 that is disposed on a first end portion of the cover main body 12; and a second cover frame 14 that is disposed on a second end portion of the cover main body 12. The cover main body 12 is mounted to the internal ceiling plate 3 such that the back surface is oriented toward the external ceiling plate 2 (upward). The first cover frame 13 and the second cover frame 14 are mounted to the back surface of the cover main body 12.

**[0019]** The first cover frame 13 has: a fixed portion 13a that is fixed to the cover main body 12; and a perpendicular portion 13b that extends from the fixed portion 13a so as to be perpendicular to the cover main body 12. The second cover frame 14 has: a fixed portion 14a that is fixed to the cover main body 12; and a perpendicular portion 14b that extends from the fixed portion 14a so as to be perpendicular to the cover main body 12. The respective fixed portions 13a and 14a of the first cover frame 13 and the second cover frame 14 are each placed on the internal ceiling plate 3 when the inspection hatchway opening and closing cover 11 is in the inspection hatchway closing position (Figure 2).

**[0020]** A first bracket (a first restricting body) 15 and a second bracket (a second restricting body) 16 that face each other on opposite sides of the inspection hatchway 9 in a horizontal direction are disposed on a surface of the internal ceiling plate 3 near the external ceiling plate 2 (i.e., an upper surface of the internal ceiling plate 3). Displacement of the inspection hatchway opening and closing cover 11 between the inspection hatchway closing position and the holding release position is performed inside a range between the first bracket 15 and the second bracket 16 (an inter-bracket range). The inspection hatchway opening and closing cover 11 is engaged by the first bracket 15 when in the inspection hatchway closing position (Figure 2), and is engaged by the second bracket 16 when in the holding release position (Figure 7).

**[0021]** The first bracket 15 has: a fixed portion 15a that is fixed to the internal ceiling plate 3; a vertical plate portion (a horizontal direction restricting portion) 15b that extends upward from the fixed portion 15a; and a lateral plate portion (the vertical direction restricting portion) 15c that extends horizontally from an upper end portion of the vertical plate portion 15b.

**[0022]** The second bracket 16 has: a fixed portion 16a that is fixed to the internal ceiling plate 3; and a vertical plate portion (a horizontal direction restricting portion) 16b that extends upward from the fixed portion 16a.

**[0023]** When the inspection hatchway opening and

closing cover 11 is in the inspection hatchway closing position, the perpendicular portion 13b of the first cover frame 13 is placed in contact with the vertical plate portion 15b of the first bracket 15 and the perpendicular portion 13b of the first cover frame 13 also faces the lateral plate portion 15c of the first bracket 15 in a vertical direction (Figure 2). Thus, displacement of the inspection hatchway opening and closing cover 11 outside the inter-bracket range from the inspection hatchway closing position is restricted and excessive the displacement above the first cover frame 13 is also restricted.

**[0024]** When the inspection hatchway opening and closing cover 11 is in the holding release position, the fixed portion 14a of the second cover frame 14 is placed in contact with the vertical plate portion 16b of the second bracket 16 (Figure 7). Thus, displacement of the inspection hatchway opening and closing cover 11 outside the inter-bracket range from the holding release position is restricted.

**[0025]** An inspection hatchway locking apparatus 17 is disposed on the inspection hatchway opening and closing cover 11. The inspection hatchway locking apparatus 17 performs locking and unlocking of the inspection hatchway opening and closing cover 11 by being subjected to either manual operation from outside the car 1, or operation by a triangular key (a special purpose key) 18 from inside the car 1. Locking and unlocking of the inspection hatchway opening and closing cover 11 can be performed when the inspection hatchway opening and closing cover 11 is in the inspection hatchway closing position.

**[0026]** Now, Figure 3 is a perspective that shows the inspection hatchway locking apparatus 17 from Figure 2. Figure 4 is a perspective that shows the triangular key 18 from Figure 2. In the figures, the inspection hatchway locking apparatus 17 has: a cylinder 19 that is fixed to the inspection hatchway opening and closing cover 11; a through shaft 20 that is disposed rotatably in the cylinder 19; a rotating plate (an inspection hatchway external operating portion) 21 that is fixed to the through shaft 20; and an engaging member (an inspection hatchway lock portion) 22 that is fixed to the rotating plate 21.

**[0027]** The cylinder 19 has an opening portion that is exposed near the design surface of the cover main body 12. The triangular key 18 is inserted into the opening portion when locking and unlocking of the inspection hatchway opening and closing cover 11 is performed.

**[0028]** The through shaft 20 is disposed so as to be perpendicular to the cover main body 12. The through shaft 20 has: a key interfitting portion (an inspection hatchway internal operating portion) 20a that is disposed inside the opening portion of the cylinder 19; and a rotating plate fixing portion 20b that is exposed through the cylinder 19 near a back surface of the inspection hatchway opening and closing cover 11. The triangular key 18 is fitted together with the key interfitting portion 20a by the triangular key 18 being inserted into the opening portion of the cylinder 19. Moreover, the cross-sectional

shape of the key interfitting portion 20a is approximately triangular.

**[0029]** The rotating plate 21 is fixed to the rotating plate fixing portion 20b. The rotating plate 21 is disposed so as to be parallel to the cover main body 12. In addition, the rotating plate 21 is rotated around an axis of the through shaft 20 together with the through shaft 20. In this example, the shape of the rotating plate 21 is rectangular.

**[0030]** Thus, the rotating plate 21 can be rotated by the rotating plate 21 being operated manually from outside the car 1, and can also be rotated by the key interfitting portion 20a being operated by the triangular key 18 from inside the car 1. Operation of the key interfitting portion 20a from inside the car 1 cannot be performed manually, and is possible only using the triangular key 18.

**[0031]** The engaging member 22 is fixed to a portion of the rotating plate 21 that is away from the through shaft 20. Consequently, the engaging member 2 is displaced on an arc that is centered around the through shaft 20 when the rotating plate 21 is rotated. When the inspection hatchway opening and closing cover 11 is in the inspection hatchway closing position, the engaging member 2 can be displaced by rotation of the rotating plate 21 between a locked position (Figure 2) where it is engaged in the second bracket 16, and an unlocked position (Figure 7) in which engagement by the second bracket 16 is disengaged. The engaging member 22 stops displacement of the inspection hatchway opening and closing cover 11 from the inspection hatchway closing position to the holding release position by being engaged in the second bracket 16. The engaging member 22 releases stopping of the displacement of the inspection hatchway opening and closing cover 11 by engagement with the second bracket 16 being disengaged.

**[0032]** The triangular key 18 has: a tubular key main body 23; and a rod-shaped handle member 24 that is disposed on the key main body 23. A first end portion of the key main body 23 constitutes an inserted portion 23a that is fitted together with the key interfitting portion 20a. The cross-sectional shape of the inserted portion 23a is a hollow, approximately triangular shape. The key interfitting portion 20a and the inserted portion 23a are fitted together with each other by the inserted portion 23a being inserted into the key interfitting portion 20a. The handle member 24 is disposed on a second end portion of the key main body 23.

**[0033]** A leaf spring (a position holding member) 25 that selectively holds the engaging member 22 in either the locked position or the unlocked position is fixed to the perpendicular portion 14b of the second cover frame 14 (Figure 2). The leaf spring 25 is pushed against a side surface of the rotating plate 21. The leaf spring 25 is pushed by the rotating plate 21 and elastically deformed when the rotating plate 21 is rotated. In addition, the leaf spring 25 is pushed against a short side portion of the rotating plate 21 when the engaging member 22 is displaced to the locked position, and is pushed against a

long side portion of the rotating plate 21 when the engaging member 22 is displaced to the unlocked position.

**[0034]** Similarly, a recess portion 26 that is open outside the car 1 is disposed on the rescue hatchway opening and closing cover 6. A rescue hatchway locking apparatus 27 is mounted in the recess portion 26. In other words, the rescue hatchway locking apparatus 27 that is mounted in the recess portion 26 is disposed on the rescue hatchway opening and closing cover 6 so as to be exposed outside the car 1. The rescue hatchway locking apparatus 27 performs locking and unlocking of the rescue hatchway opening and closing cover 6 by being subjected to either manual operation from outside the car 1, or operation by the triangular key (the special purpose key) 18 from inside the car 1. Locking and unlocking of the rescue hatchway opening and closing cover 6 can be performed when the rescue hatchway opening and closing cover 6 is in the rescue hatchway closing position.

**[0035]** Now, Figure 5 is a plan that shows the rescue hatchway locking apparatus 27 from Figure 2. Figure 6 is a plan that shows a state in which locking of the rescue hatchway locking apparatus 27 in Figure 5 is released. In the figures, the rescue hatchway locking apparatus 27 is mounted to a support bracket 28 that is fixed inside the recess portion 26. The rescue hatchway locking apparatus 27 has: a through shaft 29 that is rotatably supported by the support bracket 28; a rotating cam 30 that includes a first projecting portion 30a and a second projecting portion 30b that project from the through shaft 29 in mutually-different directions in a plane that is perpendicular to the through shaft 29, and that is fixed to the through shaft 29; a lever (a rescue hatchway external operating portion) 31 that is connected to the first projecting portion 30a of the rotating cam 30; and a pin (the rescue hatchway lock portion) 32 that is connected to the second projecting portion 30b of the rotating cam 30.

**[0036]** The through shaft 29 is disposed so as to be perpendicular to the rescue hatchway opening and closing cover 6. The through shaft 29 has a key interfitting portion (a rescue hatchway internal operating portion) 29a that is exposed on a lower surface side of the rescue hatchway opening and closing cover 6. The inserted portion 23a of the triangular key 18 can be fitted into the key interfitting portion 29a. In other words, the cross-sectional shape of the key interfitting portion 29a is an approximately triangular shape that is an identical shape to the cross-sectional shape of the key interfitting portion 20a in the inspection hatchway locking apparatus 17.

**[0037]** The rotating cam 30 is rotated around the axis of the through shaft 29 together with the through shaft 29. The shape of the rotating cam 30 is an approximately triangular shape that has vertices at the respective positions of the through shaft 29, the first projecting portion 30a, and the second projecting portion 30b.

**[0038]** The pin 32 is reciprocally displaced interdependently with the rotation of the rotating cam 30. When the rescue hatchway opening and closing cover 6 is in the rescue hatchway closing position, the pin 32 is dis-

placeable between a locked position in which it is engaged in a fixed member 33 that is fixed to a lower surface of the external ceiling plate 2 (Figure 5), and an unlocked position in which engagement with the fixed member 33 is disengaged (Figure 6). The displacement of the pin 32 is performed by the rotation of the rotating cam 30. The pin 32 stops displacement of the rescue hatchway opening and closing cover 6 from the rescue hatchway closing position to the rescue hatchway opening position by being engaged in the fixed member 33. The pin 32 releases stopping of the displacement of the rescue hatchway opening and closing cover 6 by engagement with the fixed member 33 being disengaged.

**[0039]** Specifically, the pin 32 projects outward from a region of the rescue hatchway opening and closing cover 6 by being displaced to the locked position, and retreats inside the region of the rescue hatchway opening and closing cover 6 by being displaced to the unlocked position. The pin 32 is inserted inside a pin insertion slot 34 that is disposed on the fixed member 33 when displaced to the locked position and projecting outward from the rescue hatchway opening and closing cover 6. The pin 32 is engaged in the fixed member 33 by insertion inside the pin insertion slot 34.

**[0040]** The lever 31 is reciprocally displaced interdependently with the rotation of the rotating cam 30. The lever 31 is displaced between a pushed-in position (Figure 5) and a pulled-out position (Figure 6) by the rotation of the rotating cam 30. When the rescue hatchway opening and closing cover 6 is in the rescue hatchway closing position, the pin 32 is displaced toward the locked position by the lever 31 being displaced toward the pushed-in position, and the pin 32 is displaced toward the unlocked position by the lever 31 being displaced toward the pulled-out position.

**[0041]** The rotating cam 30 can be rotated by the lever 31 being operated manually from outside the car 1, and can also be rotated by the key interfitting portion 29a being operated by the triangular key 18 from inside the car 1. Operation of the key interfitting portion 29a from inside the car 1 cannot be performed manually, and is possible only using the triangular key 18.

**[0042]** A forcing spring (a forcing body) 35 that forces the pin 32 in a direction so as to be displaced toward the locked position is disposed on the rescue hatchway locking apparatus 27. When the pin 32 is in the locked position, the pin 32 is held in the locked position by the force from the forcing spring 35.

**[0043]** A holding mechanism that acts against the force from the forcing spring 35 and stops the rotation of the rotating cam 30 when the pin 32 is in the unlocked position is disposed on the rescue hatchway locking apparatus 27. The holding mechanism locks the rotating cam 30 when the lever 31 reaches the pulled-out position.

**[0044]** In addition, a release mechanism 35 that releases the stopping of the rotation of the rotating cam 30 when the rescue hatchway opening and closing cover 6 is displaced to the rescue hatchway closing position is

disposed on the rescue hatchway locking apparatus 27. The release mechanism 35 has a displaceable magnet 36 that is displaceable relative to the support bracket 28. A fixed magnet 37 that faces the displaceable magnet 36 when the rescue hatchway opening and closing cover 6 is displaced to the rescue hatchway closing position is fixed to the fixed member 33. The displaceable magnet 36 and the fixed magnet 37 oppose each other when facing each other. The displaceable magnet 36 is displaced to an advanced position by displacement of the lever 31 to the pulled-out position (Figure 6), and is displaced to a retracted position by facing the fixed magnet 37 and being repelled (Figure 5). The release mechanism 35 releases stopping of the rotation of the rotating cam 30 by displacement of the displaceable magnet 36 to the retracted position.

**[0045]** Moreover, a locked state detecting apparatus that detects presence or absence of displacement of the pin 32 to the locked position is disposed on the rescue hatchway locking apparatus 27.

**[0046]** Next, a procedure when opening the inspection hatchway 9 and the rescue hatchway 5 from inside the car 1 will be explained. Figure 7 is a cross section that shows a state when the inspection hatchway opening and closing cover 11 from Figure 2 is in a holding release position. Figure 8 is a cross section that shows a state when the inspection hatchway opening and closing cover 11 in Figure 7 is removed from the internal ceiling plate 3. In addition, Figure 9 is a cross section that shows a state when the rescue hatchway opening and closing cover 6 in Figure 8 is displaced to a rescue hatchway opening position.

**[0047]** As shown in the figures, first insert the triangular key 18 into the opening portion of the cylinder 19 from inside the car 1, fitting the inserted portion 23a together with the key interfitting portion 20a. Next, turn the triangular key 18 to displace the engaging member 22 from the locked position to the unlocked position. Stopping of displacement of the inspection hatchway opening and closing cover 11 from the inspection hatchway closing position to the holding release position is thereby released.

**[0048]** Next, lift and offset the inspection hatchway opening and closing cover 11 horizontally to displace the inspection hatchway opening and closing cover 11 from the inspection hatchway closing position to the holding release position (Figure 7). Holding of the inspection hatchway opening and closing cover 11 by the internal ceiling plate 3 is thereby disengaged. Next, lower the inspection hatchway opening and closing cover 11 into the car 1 to remove the inspection hatchway opening and closing cover 11 from the internal ceiling plate 3 (Figure 8). The inspection hatchway 9 is thereby opened.

**[0049]** Next, fit the inserted portion 23a of the triangular key 18 together with the key interfitting portion 29a of the rescue hatchway locking apparatus 27 from a side near the inspection hatchway 9, and turn the triangular key 18 to displace the pin 32 from the locked position to the

unlocked position. Stopping of displacement of the rescue hatchway opening and closing cover 6 from the rescue hatchway closing position to the rescue hatchway opening position is thereby released.

**[0050]** Next, rotate the rescue hatchway opening and closing cover 6 outward from the car 1 to displace the rescue hatchway opening and closing cover 6 from the rescue hatchway closing position to the rescue hatchway opening position (Figure 9). The rescue hatchway 5 is thereby opened.

**[0051]** Next, a procedure when opening the inspection hatchway 9 and the rescue hatchway 5 from outside the car 1 will be explained. Figure 10 is a cross section that shows a state when the rescue hatchway opening and closing cover 6 from Figure 2 is displaced to a rescue hatchway opening position. Figure 11 is a cross section that shows a state when the inspection hatchway opening and closing cover 11 in Figure 10 is in a holding release position. In addition, Figure 12 is a cross section that shows a state when the inspection hatchway opening and closing cover 11 in Figure 7 is removed from the internal ceiling plate 3.

**[0052]** As shown in the figures, first pull the lever 31 from outside the car 1 to displace the lever 31 from the pushed-in position to the pulled-out position. The pin 32 is thereby displaced from the locked position to the unlocked position, and stopping of displacement of the rescue hatchway opening and closing cover 6 from the rescue hatchway closing position to the rescue hatchway opening position is released. Next, rotate the rescue hatchway opening and closing cover 6 outward from the car 1 to displace the rescue hatchway opening and closing cover 6 from the rescue hatchway closing position to the rescue hatchway opening position (Figure 10). The rescue hatchway 5 is thereby opened.

**[0053]** Next, rotate the rotating plate 21 of the inspection hatchway locking apparatus 17 manually from a side near the rescue hatchway 5. The engaging member 22 is thereby displaced from the locked position to the unlocked position. Next, displace the inspection hatchway opening and closing cover 11 from the inspection hatchway closing position to the holding release position, and remove the inspection hatchway opening and closing cover 11 first from the internal ceiling plate 3 inward into the car 1 (Figure 11).

**[0054]** Next, remove the inspection hatchway opening and closing cover 11 outside the car 1 from inside the car 1 through the inspection hatchway 9 and the rescue hatchway 5 (Figure 12).

**[0055]** In an elevator car ceiling apparatus of this kind, because the inspection hatchway opening and closing cover 11 is held by the internal ceiling plate 3 when in an inspection hatchway closing position that closes the inspection hatchway 9, and is also removed from the internal ceiling plate 3 by being displaced to a holding release position that is offset horizontally from the inspection hatchway closing position to disengage holding by the internal ceiling plate 3, the inspection hatchway open-

ing and closing cover 11 can be removed from the internal ceiling plate 3 in a state that is close to horizontal. Consequently, an opening action region required in order to open the inspection hatchway 9 can be reduced. Because passengers, rescuers; etc., can pass through the inspection hatchway 9 and the rescue hatchway 5 with the inspection hatchway opening and closing cover 11 removed from the internal ceiling plate 3, movement of users between an interior portion of a car and a top of the car can be facilitated.

**[0056]** Because the inspection hatchway locking apparatus 17 has: a rotating plate 21 that can be operated manually from outside the car 1; a key interfitting portion 20a that can be operated from inside the car 1 only using a triangular key 18; and an engaging member 22 that can be displaced between a locked position and an unlocked position by operating either the rotating plate 21 or the key interfitting portion 20a, general passengers can be prevented from opening the inspection hatchway 9 from inside the car 1, and the inspection hatchway 9 can be opened easily from outside the car 1.

**[0057]** Because the rescue hatchway locking apparatus 27 has: a lever 31 that can be operated manually from outside the car 1; a key interfitting portion 29a that can be operated from inside the car 1 only using a triangular key 18; and a pin 32 that is displaced between a locked position and an unlocked position by operating either the lever 31 or the key interfitting portion 29a, general passengers can be prevented from opening the rescue hatchway 5 from inside the car 1, and the rescue hatchway 5 can be opened easily from outside the car 1.

**[0058]** Moreover, in the above example, the inspection hatchway opening and closing cover 11 becomes completely independent from the internal ceiling plate 3 when removed from the internal ceiling plate 3, but the inspection hatchway opening and closing cover 11 and the internal ceiling plate 3 may also be joined together by a fall preventing cord. The inspection hatchway opening and closing cover 11 can thereby be prevented from falling to the car floor. A chain, a rope, or a tape, etc., can be used for the fall preventing cord, for example. The inspection hatchway opening and closing cover 11 and the internal ceiling plate 3 can also be joined together by connecting a first end portion of the fall preventing cord to the first bracket 15 and connecting a second end portion to the cover main body 12, for example.

## Embodiment 2

**[0059]** Figure 13 is a plan that shows an elevator car ceiling apparatus according to Embodiment 2 of the present invention. Figure 14 is a cross section that is taken along Line XIV - XIV in Figure 13. In the figures, an inspection hatchway opening and closing cover 41 that opens and closes an inspection hatchway 9 is mounted removably onto the internal ceiling plate 3. The inspection hatchway opening and closing cover 41 has a plurality of (two) partial covers 42 and 43 that are fastened

to each other. Each of the partial covers 42 and 43 partially closes the inspection hatchway 9.

**[0060]** The first partial cover 42 has: a first partial cover main body 44 that has a design surface and a back surface; and a first cover frame 13 that is disposed on an end portion of the first partial cover main body 44. The second partial cover 43 has: a second partial cover main body 45 that has a design surface and a back surface; and a second cover frame 14 that is disposed on an end portion of the second partial cover main body 45. An inspection hatchway locking apparatus 17 is disposed on the second partial cover 43.

**[0061]** Cover overlapping portions that overlap with each other on a back surface side when the partial covers 42 and 43 are fastened to each other are disposed on both the first partial cover main body 44 and the second partial cover main body 45. The cover overlapping portions are fastened to each other by being fastened between a thumbscrew 47 that is passed through each of the cover overlapping portions and a nut 46 into which the thumbscrew 47 is screwed. The cover overlapping portions can be disconnected from each other by unscrewing the nut 46 from the thumbscrew 47. The thumbscrew 47 can be turned manually. Consequently, fastening between the thumbscrew 47 and the nut 46 and removal of the thumbscrew 47 from the nut 46 can be performed manually.

**[0062]** In other words, the partial covers 42 and 43 can be fastened to each other by manual operation outside the car 1. Fastening between the partial covers 42 and 43 can also be released by manual operation outside the car 1. The rest of the configuration is similar to that of Embodiment 1.

**[0063]** Next, a procedure when opening the inspection hatchway 9 and the rescue hatchway 5 from inside the car 1 will be explained. Figure 15 is a cross section that shows a state when the inspection hatchway opening and closing cover 41 from Figure 14 is in a holding release position. Figure 16 is a cross section that shows a state when the inspection hatchway opening and closing cover 41 in Figure 15 is removed from the internal ceiling plate 3. In addition, Figure 17 is a cross section that shows a state when the rescue hatchway opening and closing cover 6 in Figure 16 is displaced to a rescue hatchway opening position.

**[0064]** As shown in the figures, first displace the engaging member 22 from the locked position to the unlocked position using the triangular key 18 from inside the car 1 to release stopping of the displacement of the inspection hatchway opening and closing cover 41 from the inspection hatchway closing position to the holding release position, in a similar manner to Embodiment 1.

**[0065]** Next, lift and offset the inspection hatchway opening and closing cover 41 horizontally to displace the inspection hatchway opening and closing cover 41 from the inspection hatchway closing position to the holding release position (Figure 15). Holding of the inspection hatchway opening and closing cover 41 by the internal

ceiling plate 3 is thereby disengaged. Next, lower the inspection hatchway opening and closing cover 41 into the car 1, and remove the inspection hatchway opening and closing cover 41 from the internal ceiling plate 3 (Figure 16). The inspection hatchway 9 is thereby opened.

**[0066]** Next, displace the pin 32 from the locked position to the unlocked position using the triangular key 18 from a side near the inspection hatchway 9 to release stopping of the displacement of the rescue hatchway opening and closing cover 6 from the rescue hatchway closing position to the rescue hatchway opening position, in a similar manner to Embodiment 1. Next, rotate the rescue hatchway opening and closing cover 6 outward from the car 1 to displace the rescue hatchway opening and closing cover 6 from the rescue hatchway closing position to the rescue hatchway opening position (Figure 17). The rescue hatchway 5 is thereby opened.

**[0067]** Next, a procedure when opening the inspection hatchway 9 and the rescue hatchway 5 from outside the car 1 will be explained. Figure 18 is a cross section that shows a state when the rescue hatchway opening and closing cover 6 from Figure 14 is displaced to a rescue hatchway opening position. Figure 19 is a cross section that shows a state when the thumbscrew 47 and the nut 46 from Figure 18 are removed from the inspection hatchway opening and closing cover 41. In addition, Figure 20 is a cross section that shows a state when the inspection hatchway opening and closing cover 41 in Figure 19 is removed from the internal ceiling plate 3.

**[0068]** As shown in the figures, first displace the pin 32 from the locked position to the unlocked position by pulling the lever 31 from outside the car 1 to release stopping of the displacement of the rescue hatchway opening and closing cover 6 from the rescue hatchway closing position to the rescue hatchway opening position, in a similar manner to Embodiment 1. Next, rotate the rescue hatchway opening and closing cover 6 outward from the car 1 to displace the rescue hatchway opening and closing cover 6 from the rescue hatchway closing position to the rescue hatchway opening position (Figure 18). The rescue hatchway 5 is thereby opened.

**[0069]** Next, rotate the rotating plate 21 of the inspection hatchway locking apparatus 17 manually from a side near the rescue hatchway 5 to displace the engaging member 22 from the locked position to the unlocked position. Turn the thumbscrew 47 and remove the thumbscrew 47 and the nut 46 from the inspection hatchway opening and closing cover 41 (Figure 19). The inspection hatchway opening and closing cover 41 is thereby separated into each of the partial covers 42 and 43. Next, remove each of the partial covers 42 and 43 individually from the internal ceiling plate 3 and remove each of the partial covers 42 and 43 outside the car 1 through the inspection hatchway 9 and the rescue hatchway 5 (Figure 20).

**[0070]** In an elevator car ceiling apparatus of this kind, because the inspection hatchway opening and closing cover 41 has a plurality of partial covers 42 and 43 that

are fastened to each other, and fastening of the partial covers 42 and 43 can be released by manual operation outside the car 1, the inspection hatchway opening and closing cover 41 that has been removed from the internal ceiling plate 3 can be removed outside the car 1 by dividing the plurality of partial covers 42 and 43 into small sections. Consequently, the inspection hatchway opening and closing cover 41 can be removed outside the car 1 even if space is limited outside the car 1.

[0071] Moreover, in the above example, the partial covers 42 and 43 are completely independent when separated from each other, but the partial covers 42 and 43 may also be joined together by a fall preventing cord. The partial covers 42 and 43 can thereby be collectively prevented from falling to the car floor. A chain, a rope, or a tape, etc., can be used for the fall preventing cord, for example. The partial covers 42 and 43 can also be joined together by connecting a first end portion and a second end portion of the fall preventing cord to the respective cover overlapping portions, for example. In addition, either of the partial covers 42 and 43 may also be connected to the internal ceiling plate 3 by a fall preventing cord.

[0072] In the above example, a gap closing plate that closes a gap between an edge portion of the inspection hatchway 9 and the inspection hatchway opening and closing cover 41 may also be mounted to the internal ceiling plate 3.

[0073] For example, Figure 21 is a partial perspective that shows a second example of an elevator car ceiling apparatus according to Embodiment 2 of the present invention. As shown in the figure, a plurality of gap closing plates 51 that close gaps between edge portions of the inspection hatchway opening and closing cover 41 and the inspection hatchway 9 when in the inspection hatchway closing position may also be mounted to the internal ceiling plate 3. The gap closing plates 51 are mounted to the internal ceiling plate 3 by means of hinges 52. The gap closing plates 51 are forced in directions that close the gaps between the edge portions of the inspection hatchway 9 and the inspection hatchway opening and closing cover 41 by forcing springs that are disposed on the hinges 52. Gap closing plates that close gaps between the edge portions of the inspection hatchway 9 and the inspection hatchway opening and closing cover may also be applied to the configuration of Embodiment 1.

[0074] Light from the lighting devices 4 can thereby be prevented from leaking into the car 1 through the gaps between the edge portions of the inspection hatchway 9 and the inspection hatchway opening and closing cover, enabling interior design of the car 1 to be improved.

## Claims

### 1. An elevator car ceiling apparatus comprising:

an external ceiling plate (2) in which a rescue

hatchway (5) is disposed;

an internal ceiling plate (3) in which an inspection hatchway (9) that faces said rescue hatchway (5) is disposed, and that is disposed further inside a car (1) than said external ceiling plate (2);

a rescue hatchway opening and closing cover (6) that is displaceable between a rescue hatchway closing position that closes said rescue hatchway (5), and a rescue hatchway opening position that is positioned further outside said car (1) than said rescue hatchway closing position and that opens said rescue hatchway (5); and

an inspection hatchway opening and closing cover (11) that is held by said internal ceiling plate (3) when in an inspection hatchway closing position that closes said inspection hatchway (9), and that is removed from said internal ceiling plate (3) by being displaced from said inspection hatchway closing position to a holding release position that is offset horizontally to disengage holding by said internal ceiling plate (3) by lowering the inspection hatchway opening and closing cover (11) into the car (1), and

**characterized by** further comprising:

an inspection hatchway locking apparatus which comprises:

an inspection hatchway external operating portion (21) that can be operated manually from outside said car (1);

an inspection hatchway internal operating portion (20a) that can be operated from inside said car (1) only using a special purpose key (18); and

an inspection hatchway lock portion (22) that can be displaced between a locked position that stops displacement of said inspection hatchway opening and closing cover (11) from said inspection hatchway closing position to said holding release position and an unlocked position that releases stopping of said displacement of said inspection hatchway opening and closing cover (11) by operating either said inspection hatchway external operating portion (21) or said inspection hatchway internal operating portion (20a).

### 2. An elevator car ceiling apparatus according to Claim 1, **characterized in** further comprising a rescue hatchway locking apparatus (27) comprising:

a rescue hatchway external operating portion (31) that can be operated manually from outside

said car (1);  
 a rescue hatchway internal operating portion (29a) that can be operated from inside said car (1) only using a special purpose key (18); and  
 a rescue hatchway lock portion (32) that can be displaced between a locked position that stops displacement of said rescue hatchway opening and closing cover (6) from said rescue hatchway closing position to said rescue hatchway opening position and an unlocked position that releases stopping of said displacement of said rescue hatchway opening and closing cover (6) by operating either said rescue hatchway external operating portion (31) or said rescue hatchway internal operating portion (29a).

3. An elevator car ceiling apparatus according to Claim 1, **characterized in that** said inspection hatchway opening and closing cover (11) and said internal ceiling plate (3) are connected to each other using a fall preventing cord.
4. An elevator car ceiling apparatus according to Claim 1, **characterized in that:**  
 said inspection hatchway opening and closing cover (11) has a plurality of partial covers (42,43) that are fastened to each other; and  
 fastening between said partial covers (42,43) can be released by manual operation outside said car (1).
5. An elevator car ceiling apparatus according to Claim 4, **characterized in that** said partial covers (42,43) are connected to each other by a fall preventing cord.

#### Patentansprüche

1. Fahrstuhlfahrkorbdeckenvorrichtung, umfassend:  
 eine äußere Deckplatte (2), in der eine Rettungsluke (5) vorgesehen ist;  
 eine innere Deckplatte (3), in der eine der Rettungsluke (5) zugewandte Inspektionsluke (9) vorgesehen ist, und die weiter innen in einem Fahrkorb (1) angeordnet ist als die äußere Deckplatte (2);  
 eine Rettungsluken-Öffnen/Schließen-Abdeckung (6), die zwischen einer Rettungslukenschließstellung, die die Rettungsluke (5) verschließt, und einer Rettungslukenöffnungsstellung, die weiter außerhalb des Fahrkorbs (1) positioniert ist als die Rettungslukenschließstellung und die die Rettungsluke (5) öffnet, verlagerbar ist; und  
 eine Inspektionsluken-Öffnen/Schließen-Abdeckung (11), die durch die innere Deckplatte (3)

gehalten wird, wenn sie in einer Inspektionslukenschließstellung ist, die die Inspektionsluke (9) verschließt, und die von der inneren Deckplatte (3) entfernt wird, indem sie von der Inspektionslukenschließstellung in eine Haltefreigabestellung verlagert wird, die horizontal versetzt ist, um das Halten durch die innere Deckplatte (3) zu lösen, indem die Inspektionsluken-Öffnen/Schließen-Abdeckung (11) in den Fahrkorb (1) hinein gesenkt wird, und  
**dadurch gekennzeichnet, dass** sie weiterhin umfasst:

eine Inspektionslukerverriegelungsvorrichtung, die umfasst:

einen externen Inspektionslukenbetätigungsabschnitt (21), der von außerhalb des Fahrkorbs (1) manuell betätigt werden kann;  
 einen internen Inspektionslukenbetätigungsabschnitt (20a), der unter Verwendung eines Spezialschlüssels (18) von innerhalb des Fahrkorbs (1) betätigt werden kann; und  
 einen Inspektionslukerverriegelungsabschnitt (22), der zwischen einer Verriegelungsstellung, die eine Verlagerung der Inspektionsluken-Öffnen/Schließen-Abdeckung (11) von der Inspektionslukenschließstellung in die Haltefreigabestellung stoppt, und einer Entriegelungsstellung, die das Stoppen der Verlagerung der Inspektionsluken-Öffnen/Schließen-Abdeckung (11) durch Betätigung entweder des externen Inspektionslukenbetätigungsabschnitts (21) oder des internen Inspektionslukenbetätigungsabschnitts (20a) löst, verlagerbar ist.

2. Fahrstuhlfahrkorbdeckenvorrichtung nach Anspruch 1, **dadurch gekennzeichnet, dass** sie weiterhin eine Rettungslukerverriegelungsvorrichtung (27) umfasst, umfassend:

einen externen Rettungslukenbetätigungsabschnitt (31), der von außerhalb des Fahrkorbs (1) manuell betätigt werden kann;  
 einen internen Rettungslukenbetätigungsabschnitt (29a), der unter Verwendung eines Spezialschlüssels (18) von innerhalb des Fahrkorbs (1) betätigt werden kann, und  
 einen Rettungslukerverriegelungsabschnitt (32), der zwischen einer Verriegelungsstellung, die eine Verlagerung der Rettungsluken-Öffnen/Schließen-Abdeckung (6) von der Rettungslukenschließstellung in die Rettungslu-

kenöffnungsstellung stoppt, und einer Entriegungsstellung, die das Stoppen der Verlagerung der Rettungsluken-Öffnen/Schließen-Abdeckung (6) durch Betätigung entweder des externen Rettungslukenbetätigungsabschnitts (31) oder des internen Rettungslukenbetätigungsabschnitts (29a) löst, verlagerbar ist.

3. Fahrstuhlfahrkorbdeckenvorrichtung nach Anspruch 1, **dadurch gekennzeichnet, dass** die Inspektionsluken-Öffnen/Schließen-Abdeckung (11) und die innere Deckplatte (3) unter Verwendung eines Absturzsicherungsseils miteinander verbunden sind.
4. Fahrstuhlfahrkorbdeckenvorrichtung nach Anspruch 1, **dadurch gekennzeichnet, dass:**
  - die Inspektionsluken-Öffnen/Schließen-Abdeckung (11) eine Vielzahl von Teilabdeckungen (42, 43) aufweist, die aneinander befestigt sind; und
  - die Befestigung zwischen den Teilabdeckungen (42, 43) durch manuelle Betätigung außerhalb des Fahrkorbs (1) gelöst werden kann.
5. Fahrstuhlfahrkorbdeckenvorrichtung nach Anspruch 4, **dadurch gekennzeichnet, dass** die Teilabdeckungen (42, 43) unter Verwendung eines Absturzsicherungsseils miteinander verbunden sind.

## Revendications

1. Dispositif de plafond de cabine d'ascenseur comprenant :
  - un panneau de plafond externe (2) dans lequel une trappe de secours (5) est disposée ;
  - un panneau de plafond interne (3) dans lequel une trappe de contrôle (9) faisant face à ladite trappe secours (5) est disposée, et qui est disposé plus à l'intérieur d'une cabine (1) que ledit panneau de plafond externe (2) ;
  - un couvercle d'ouverture et de fermeture de trappe de secours (6) qui peut être déplacé entre une position de fermeture de trappe de secours qui ferme ladite trappe de secours (5), et une position d'ouverture de trappe de secours qui est positionnée plus à l'extérieur de ladite cabine (1) que ladite position de fermeture de trappe de secours de la cabine et qui ouvre ladite trappe de secours (5) ; et
  - un couvercle d'ouverture et de fermeture de trappe de contrôle (11) qui est maintenu par ledit panneau de plafond interne (3) lorsque dans une position de fermeture de trappe de contrôle qui ferme ladite trappe de contrôle (9), et qui est

dégagé dudit panneau de plafond interne (3) en étant déplacé de ladite position de fermeture de trappe de contrôle vers une position de libération de maintien qui est décalée horizontalement afin de désengager le maintien par ledit panneau de plafond interne (3) en abaissant le couvercle d'ouverture et de fermeture de trappe de contrôle (11) dans la cabine (1), et

**caractérisé en ce qu'il** comprend en outre :

un dispositif de verrouillage de trappe de contrôle qui comprend :

- une partie d'actionnement externe de trappe de contrôle (21) qui peut être actionnée manuellement depuis l'extérieur de ladite cabine (1) ;
- une partie d'actionnement interne de trappe de contrôle (20a) qui peut être actionnée depuis l'intérieur de ladite cabine (1) uniquement en utilisant une clé à usage spécifique (18) ; et
- une partie de blocage de trappe de contrôle (22) qui peut être déplacée entre une position de blocage qui arrête un déplacement dudit couvercle d'ouverture et de fermeture de trappe de contrôle (11) de ladite position de fermeture de trappe de contrôle vers la position de libération de maintien, et une position de déblocage qui libère l'arrêt dudit déplacement dudit couvercle d'ouverture et de fermeture de trappe de contrôle (11) en actionnant soit ladite partie d'actionnement externe de trappe de contrôle (21) soit ladite partie d'actionnement interne de trappe de contrôle (20a).

2. Dispositif de plafond de cabine d'ascenseur selon la revendication 1, **caractérisé en ce qu'il** comprend en outre un dispositif de blocage de trappe de secours (27), comprenant :

- une partie d'actionnement de trappe de secours (31) qui peut être actionnée manuellement depuis l'extérieur de ladite cabine (1) ;
- une partie d'actionnement interne de trappe de secours (29a) qui peut être actionnée depuis l'intérieur de ladite cabine (1) uniquement en utilisant une clé à usage spécifique (18) ; et
- une partie de blocage de trappe de secours (32) qui peut être déplacée entre une position de blocage qui arrête un déplacement dudit couvercle d'ouverture et de fermeture de trappe de secours (6) depuis ladite position de fermeture de trappe de secours vers la position d'ouverture de trappe de secours, et une position de déblo-

cage qui libère l'arrêt dudit déplacement dudit couvercle d'ouverture et de fermeture de trappe de secours (6) en actionnant soit la partie d'actionnement externe de trappe de secours (31) soit la partie d'actionnement interne de trappe de secours (29a). 5

3. Dispositif de plafond de cabine d'ascenseur selon la revendication 1, **caractérisé en ce que** ledit couvercle d'ouverture et de fermeture de trappe de contrôle (11) et ledit panneau de plafond interne (3) sont reliés l'un à l'autre au moyen d'un câble antichute. 10

4. Dispositif de plafond de cabine d'ascenseur selon la revendication 1, **caractérisé en ce que** : 15

ledit couvercle d'ouverture et de fermeture de trappe de contrôle (11) comporte une pluralité de couvercles partiels (42, 43) qui sont fixés les uns aux autres ; et 20  
la fixation entre lesdits couvercles partiels (42, 43) peut être libérée par une opération manuelle à l'extérieur de ladite cabine (1).

5. Dispositif de plafond de cabine d'ascenseur selon la revendication 4, **caractérisé en ce que** lesdits couvercles partiels (42, 43) sont reliés les uns aux autres par un câble antichute. 25

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FIG. 1

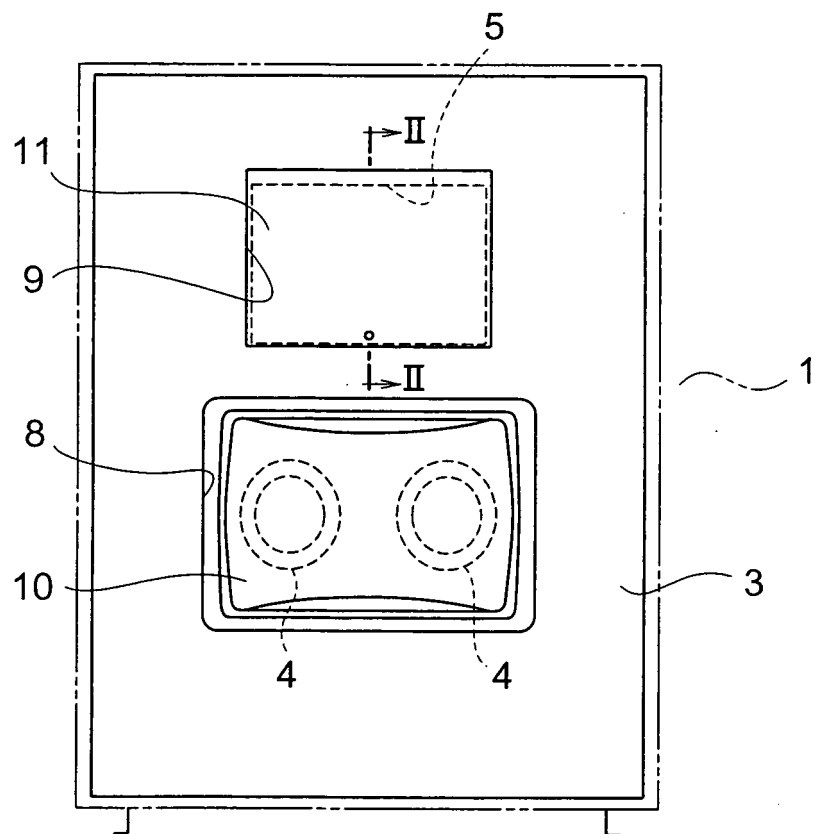


FIG. 2

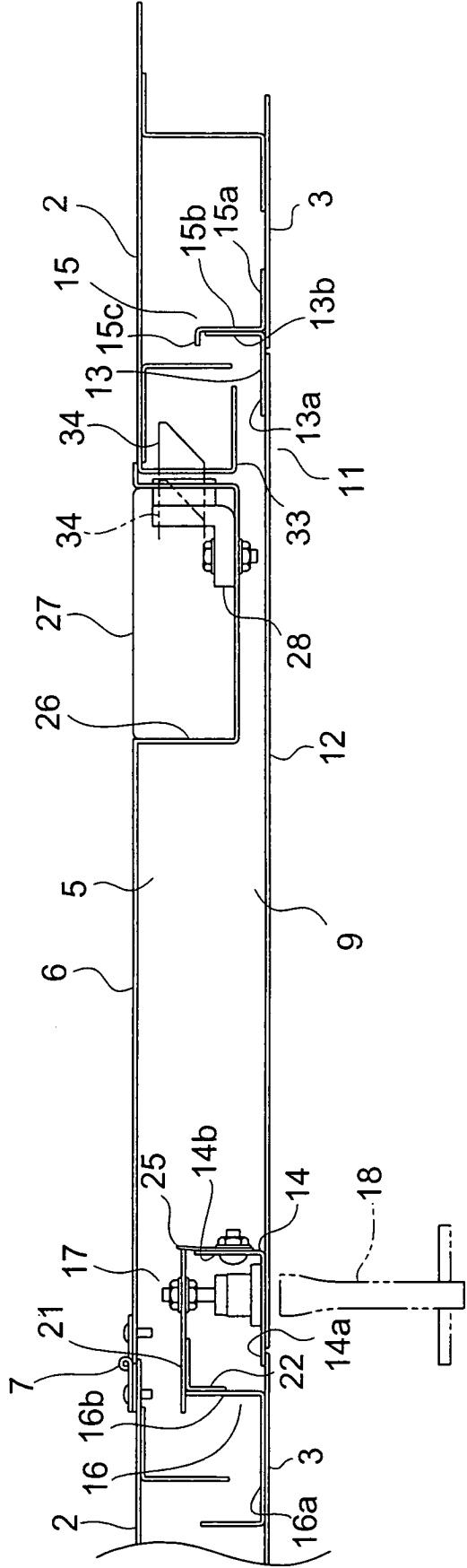


FIG. 3

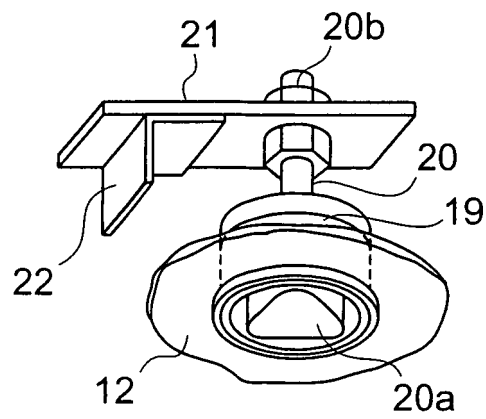


FIG. 4

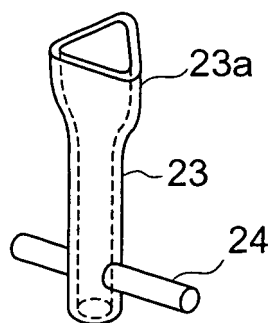


FIG. 5

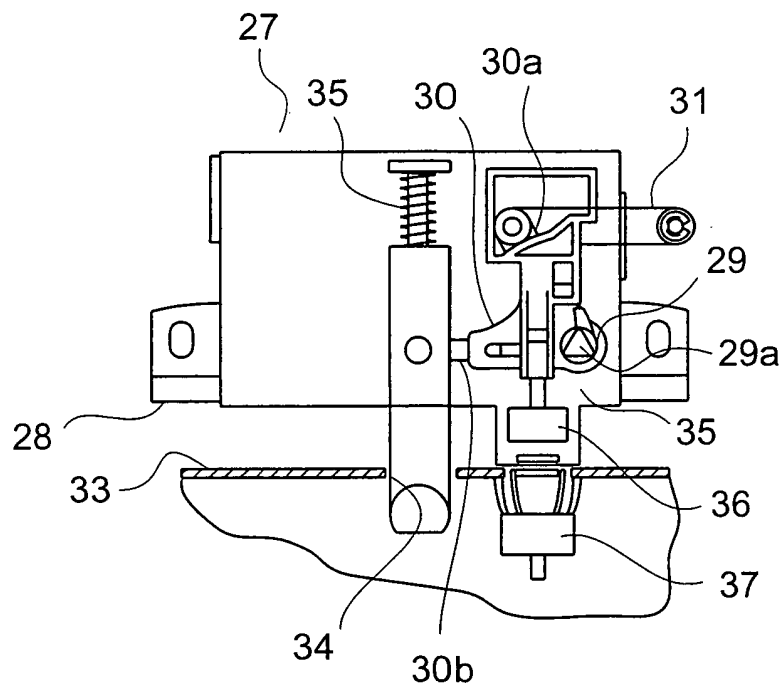


FIG. 6

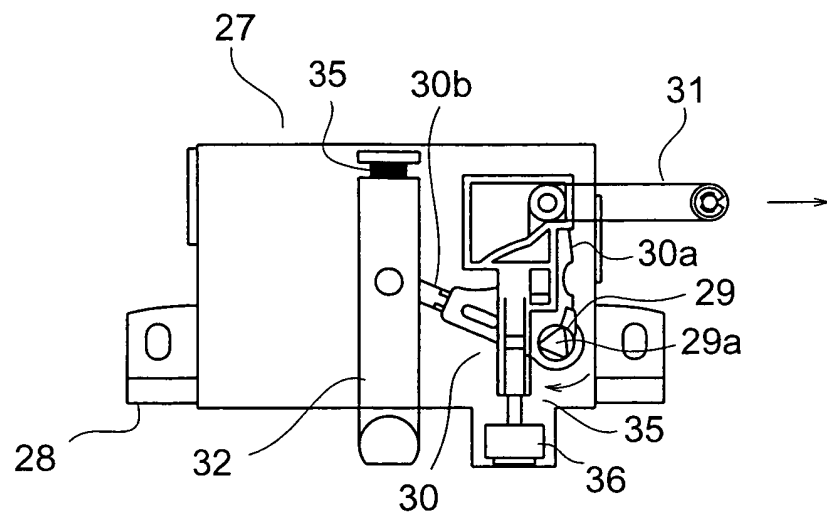
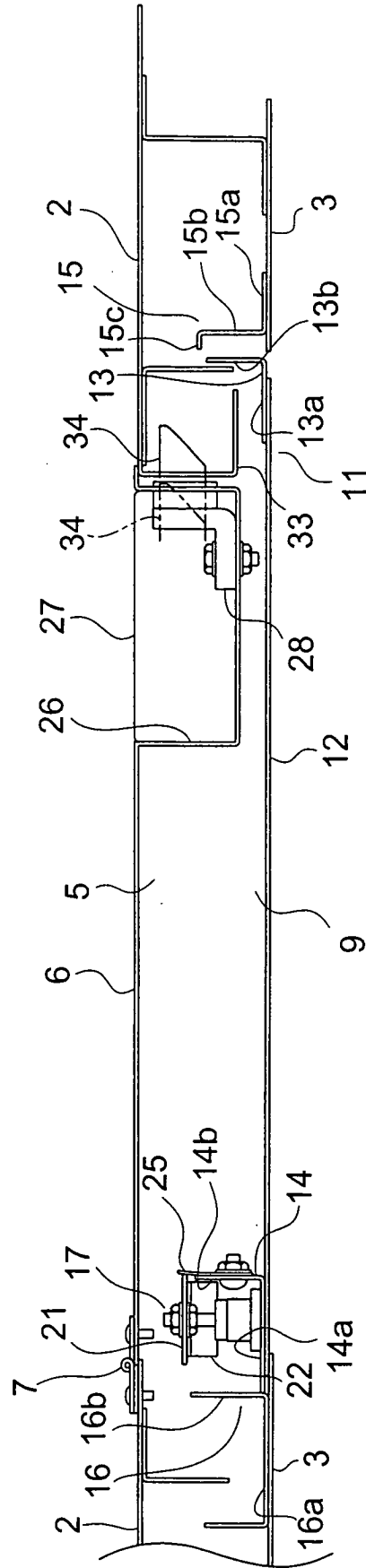


FIG. 7



F/G/8

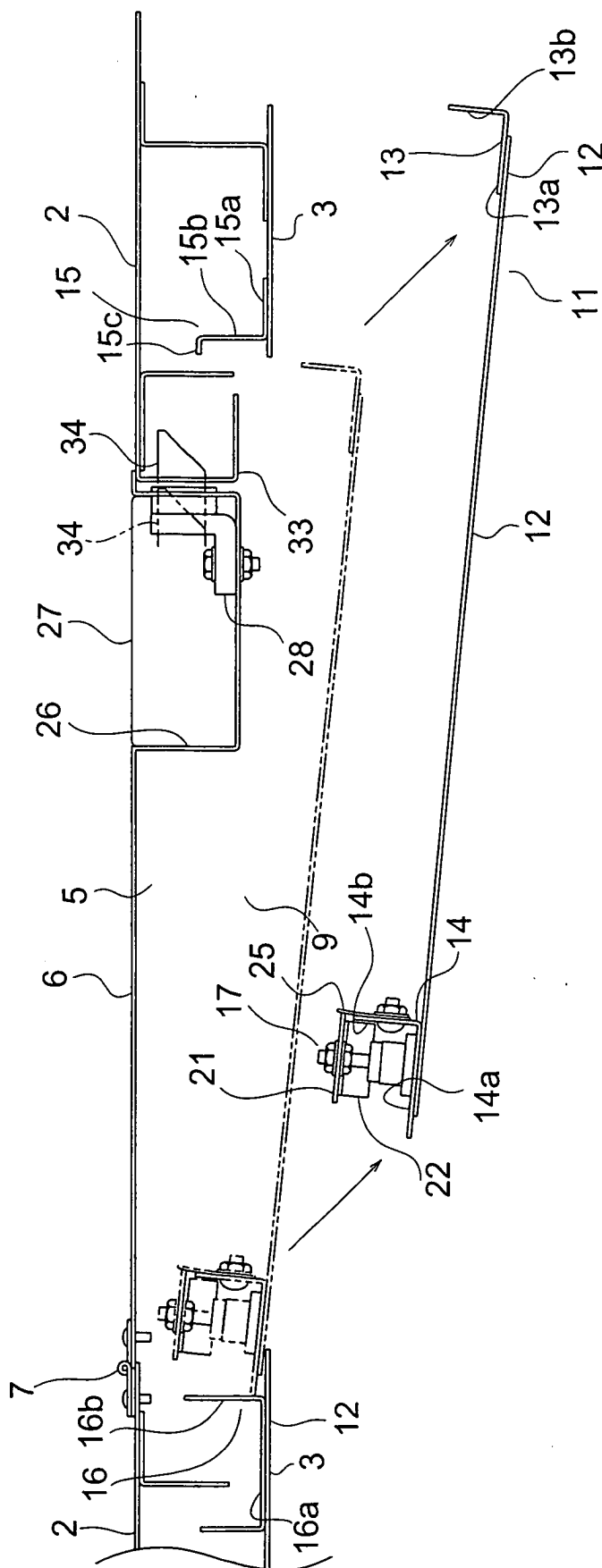


FIG. 9

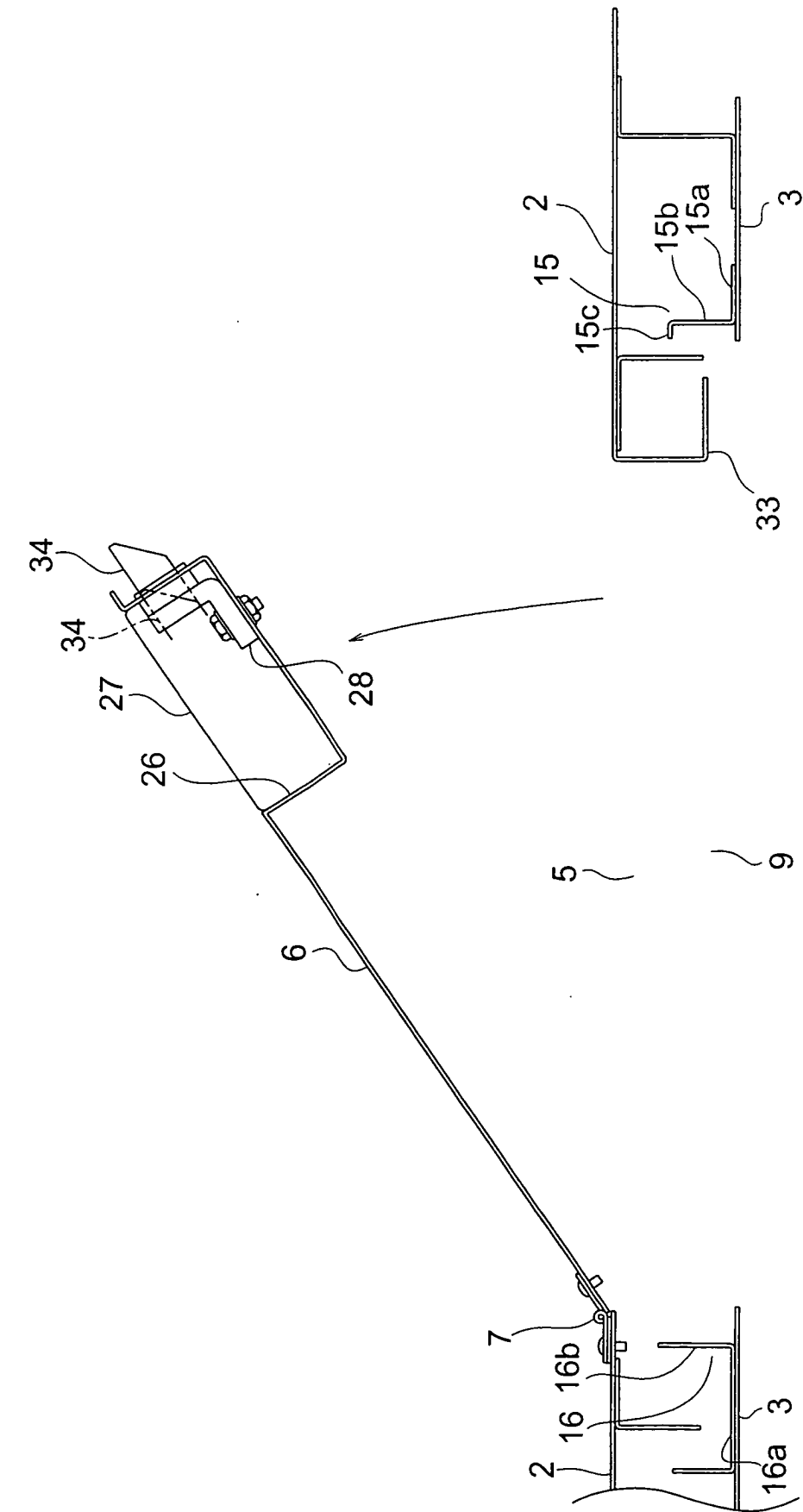


FIG. 10

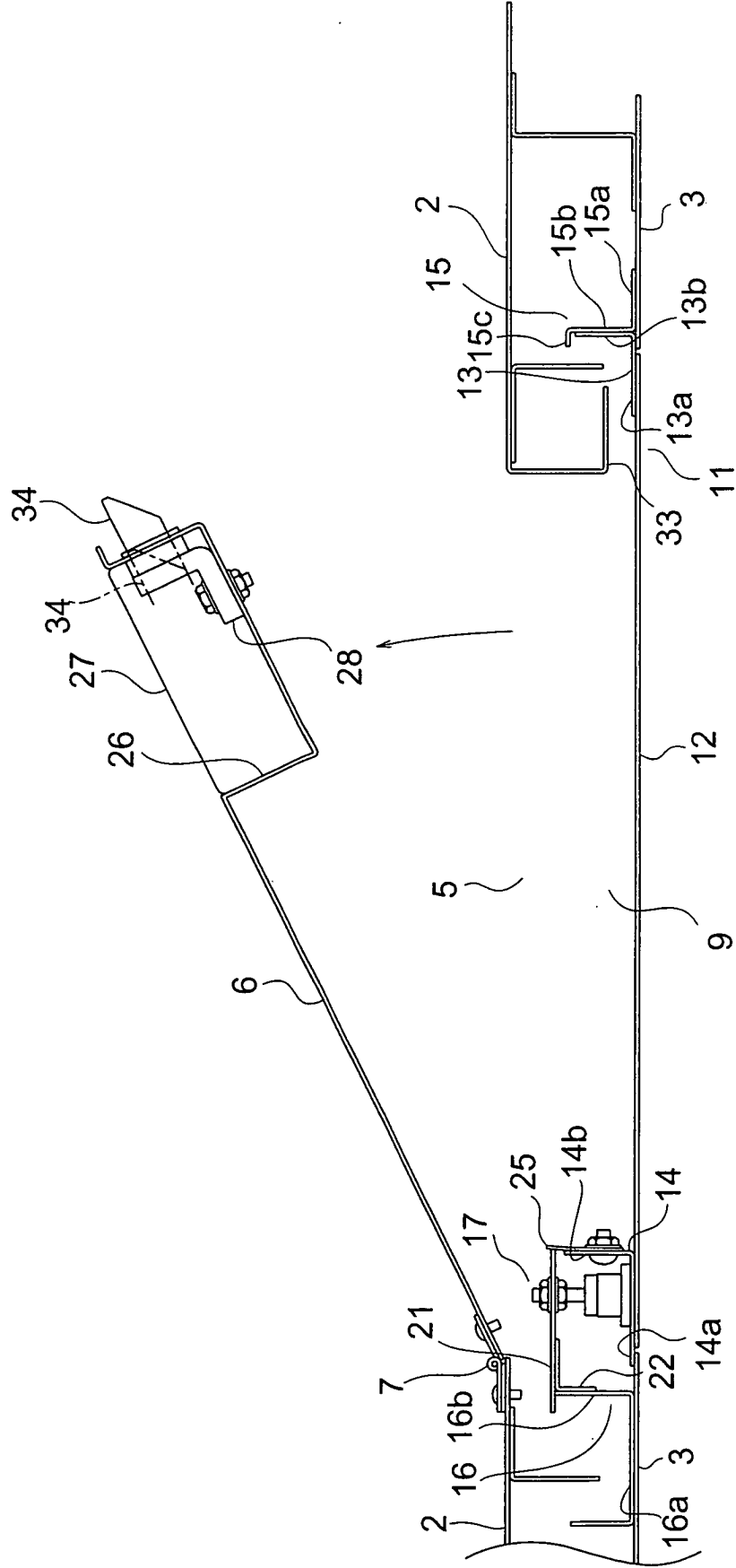
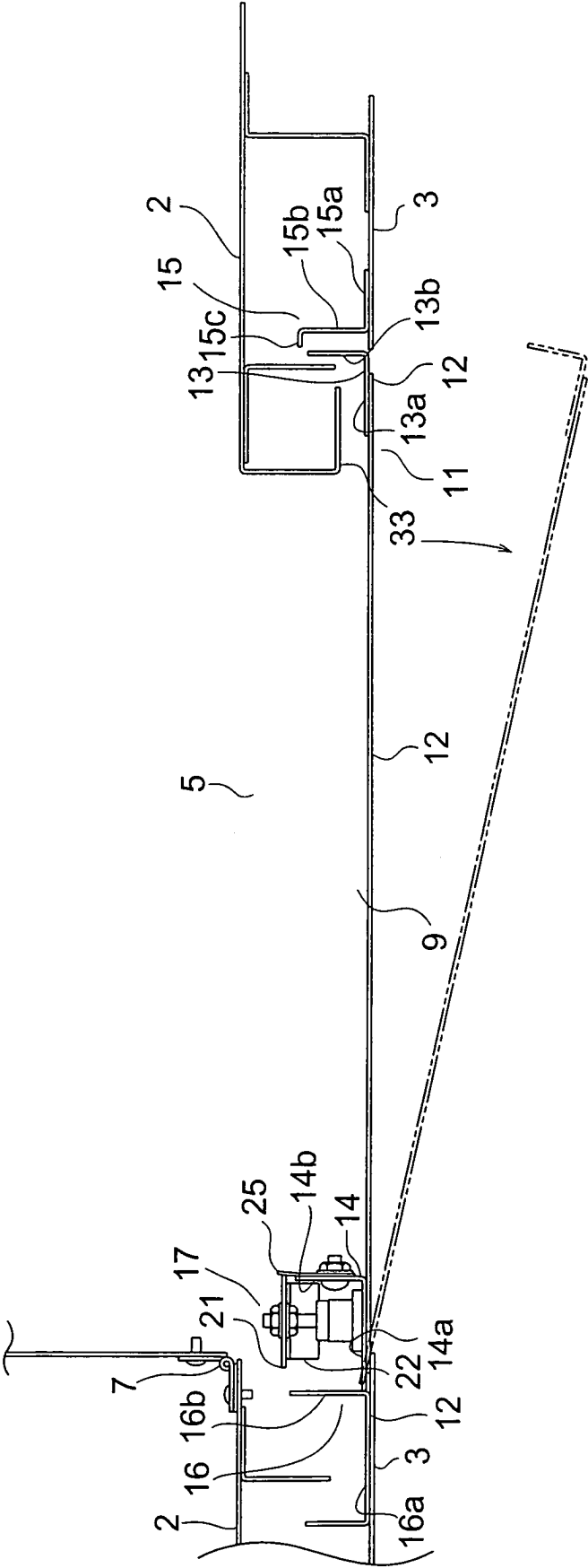


FIG. 11



**FIG. 12**

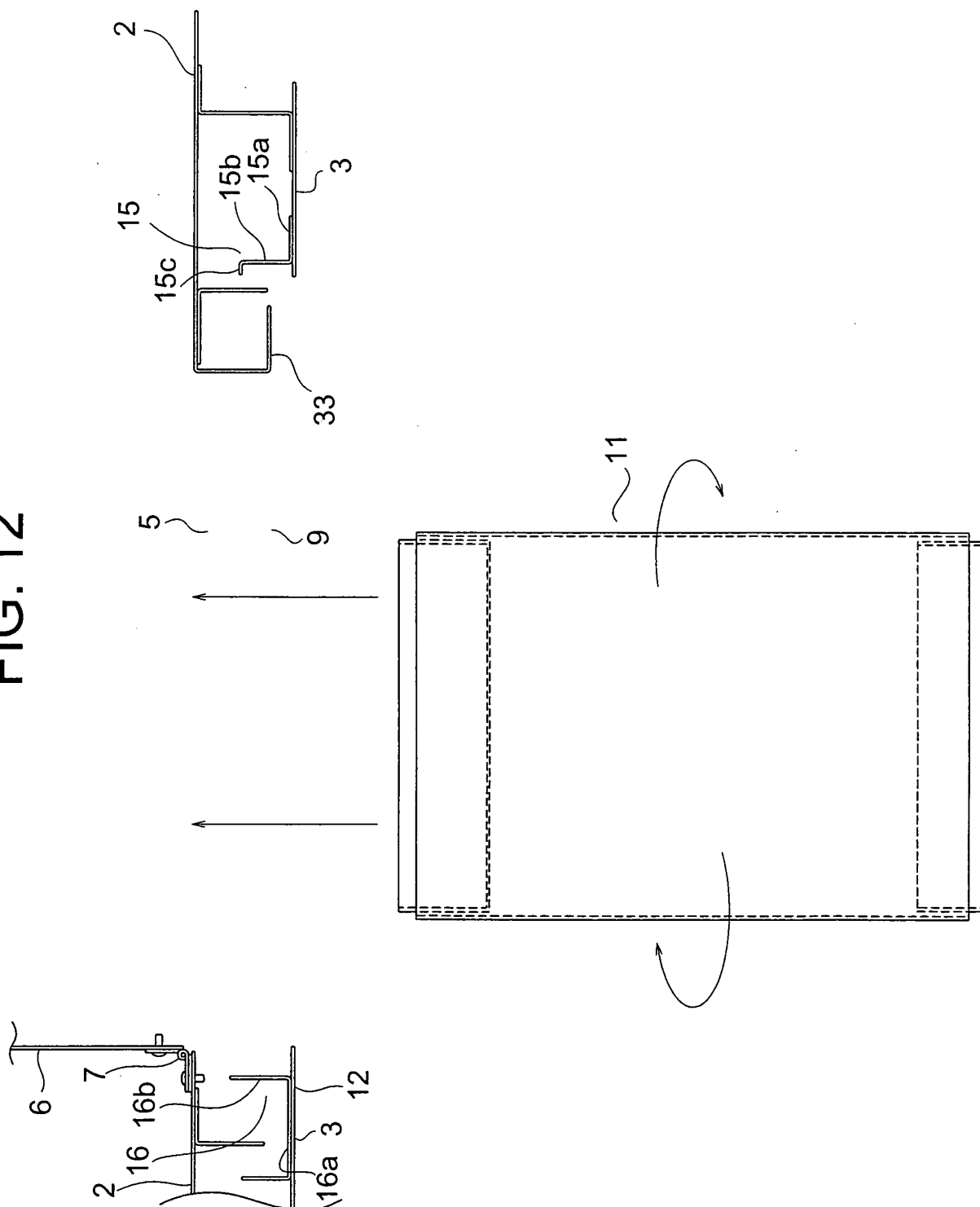


FIG. 13

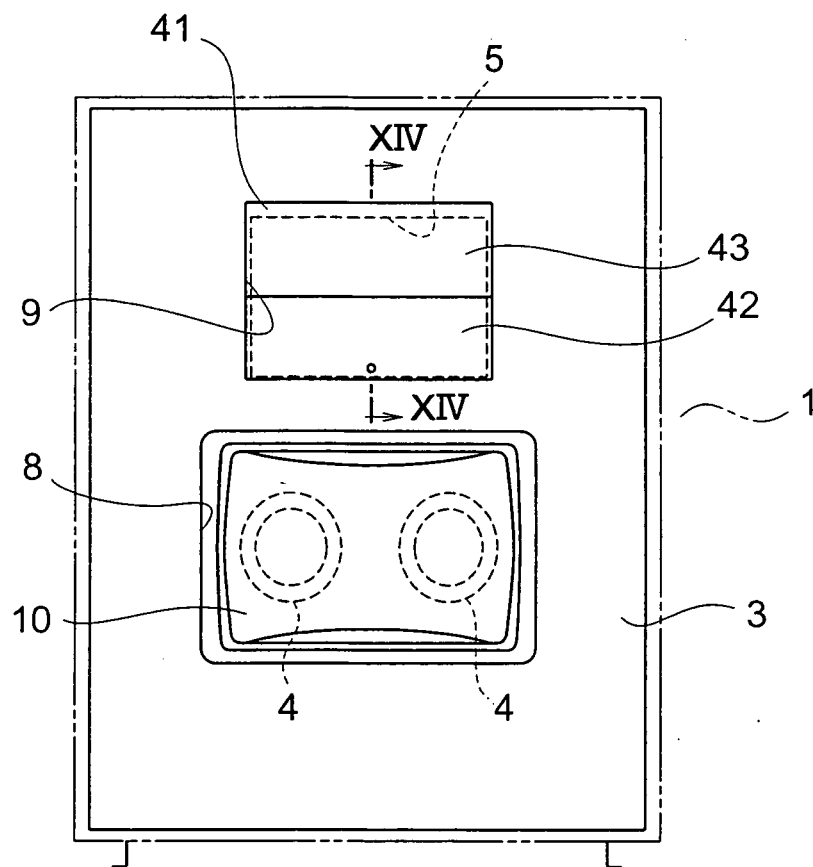


FIG. 14

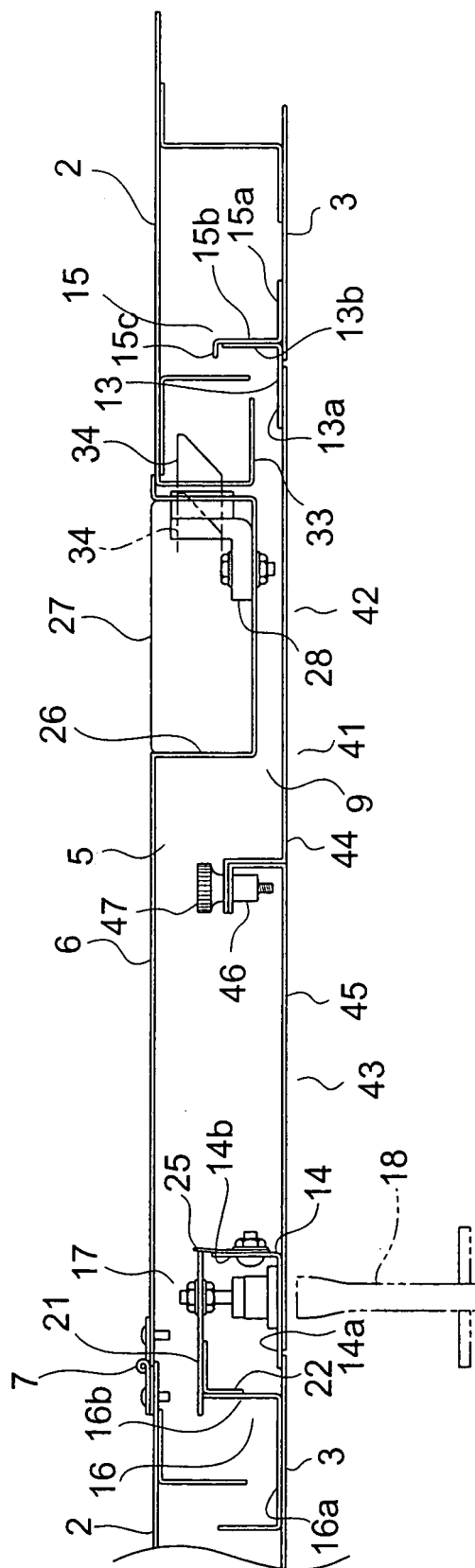


FIG. 15

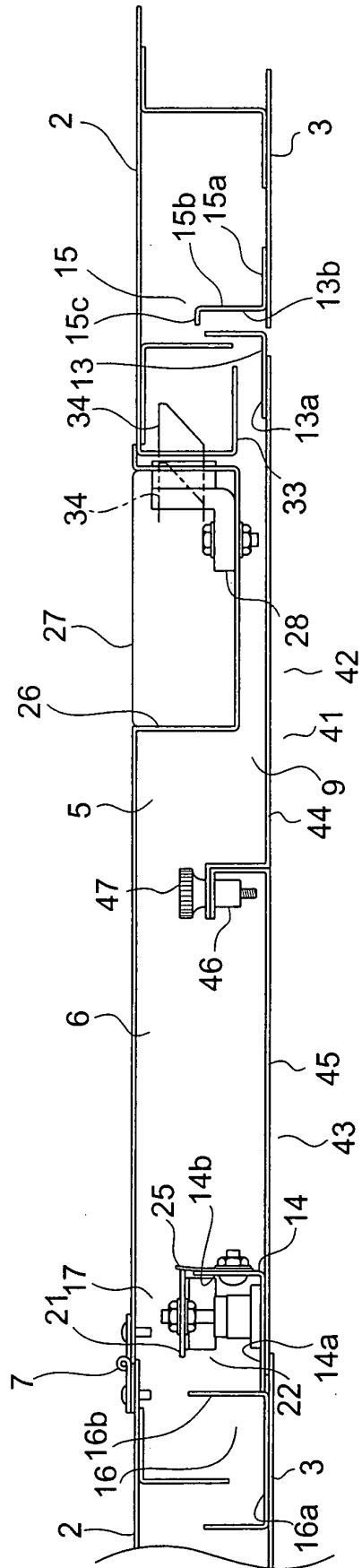


FIG. 16

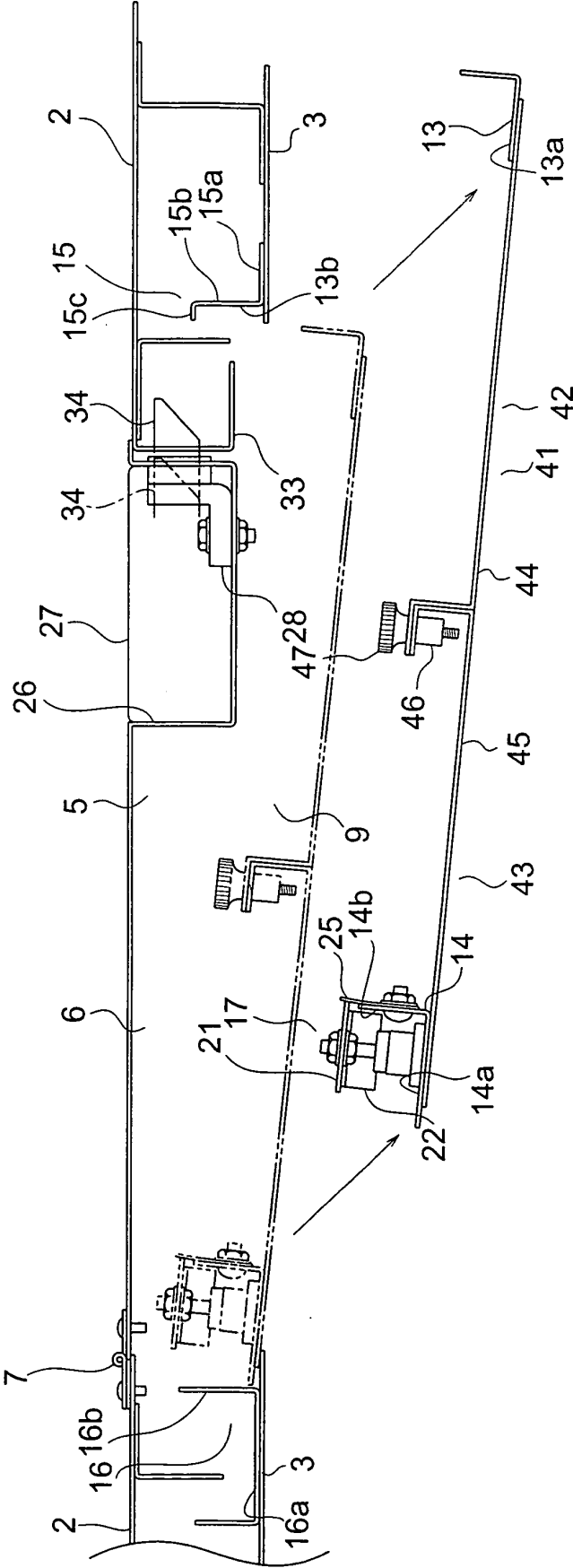


FIG. 17

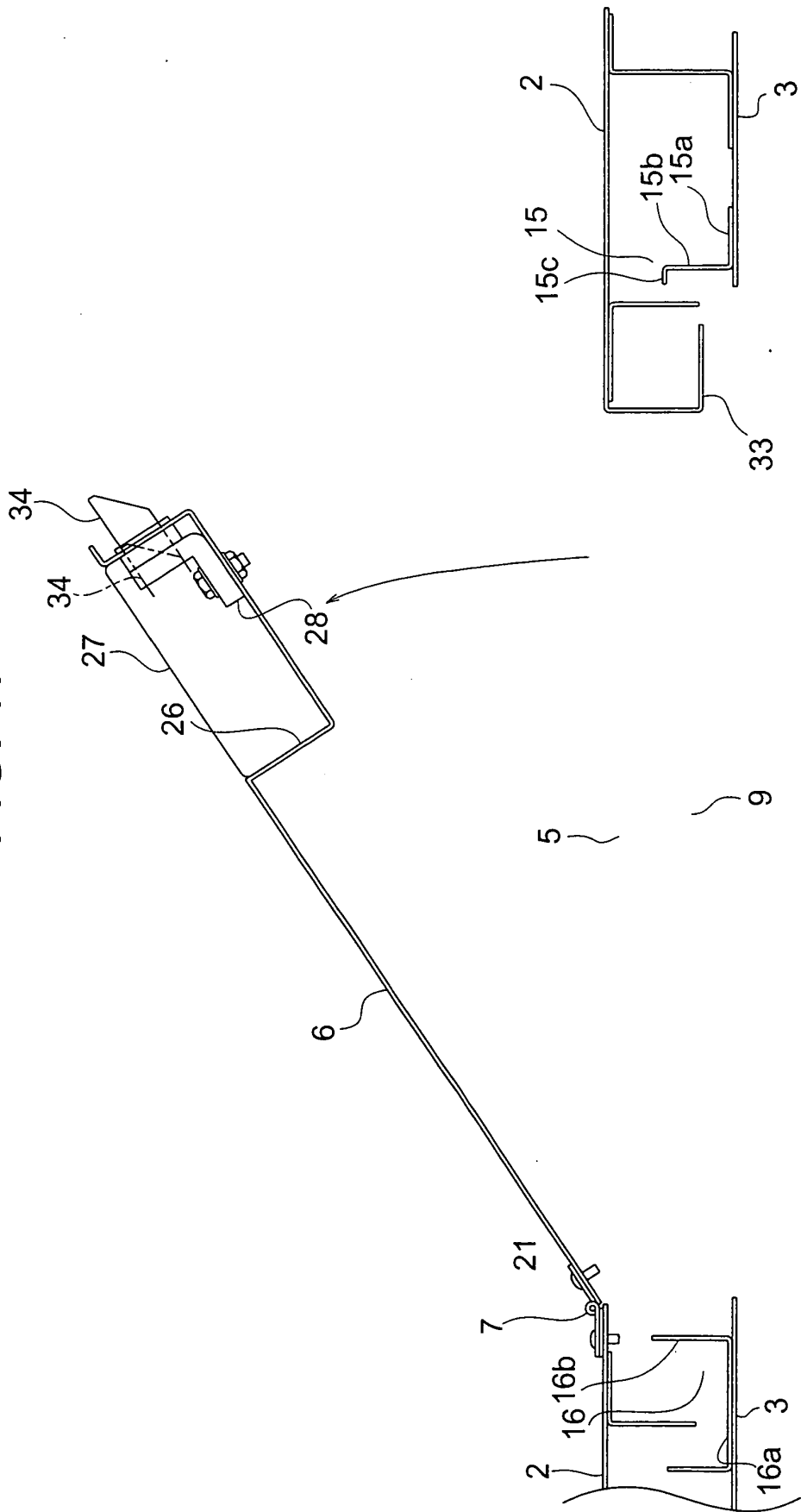


FIG. 18

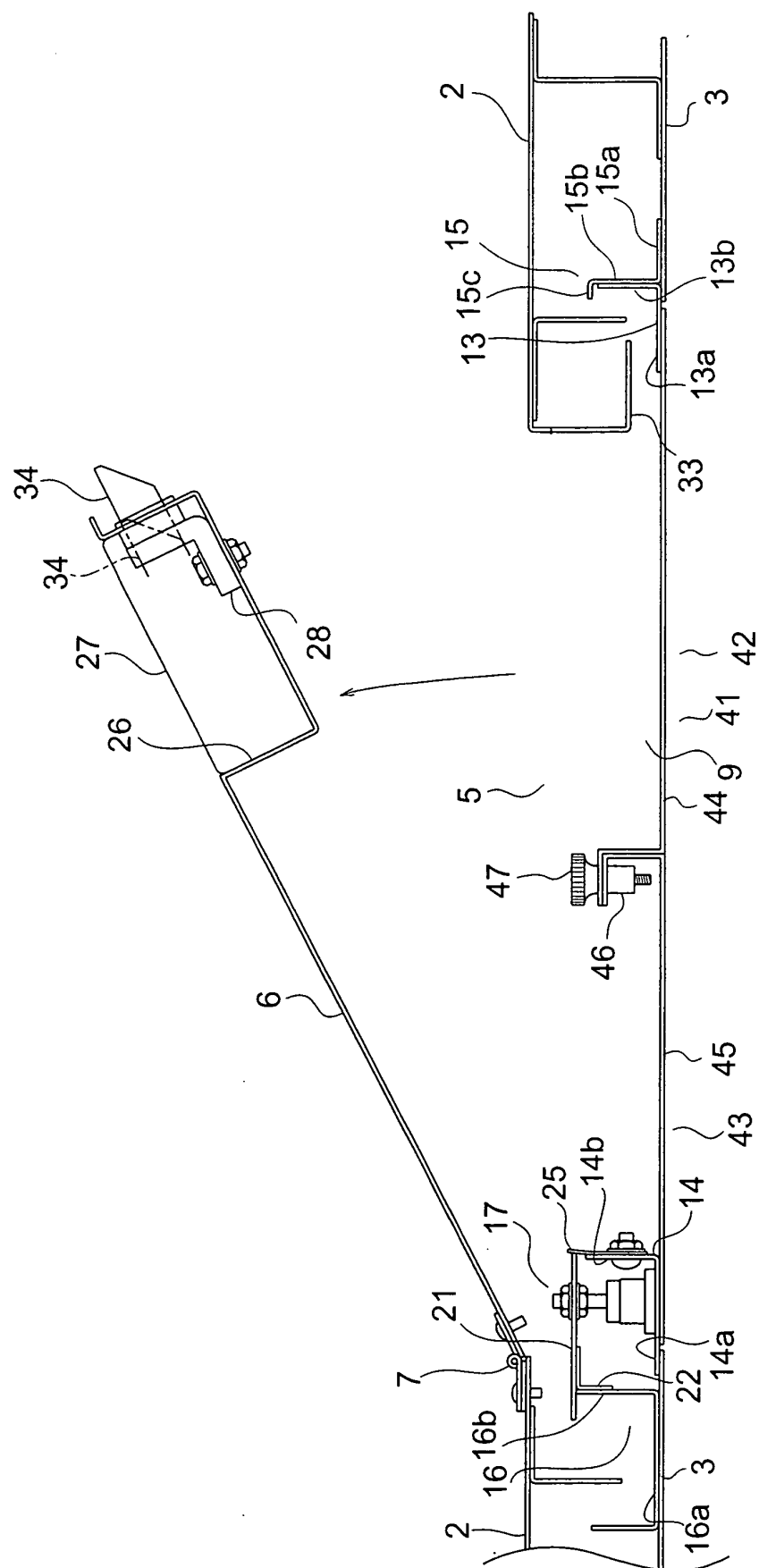


FIG. 19

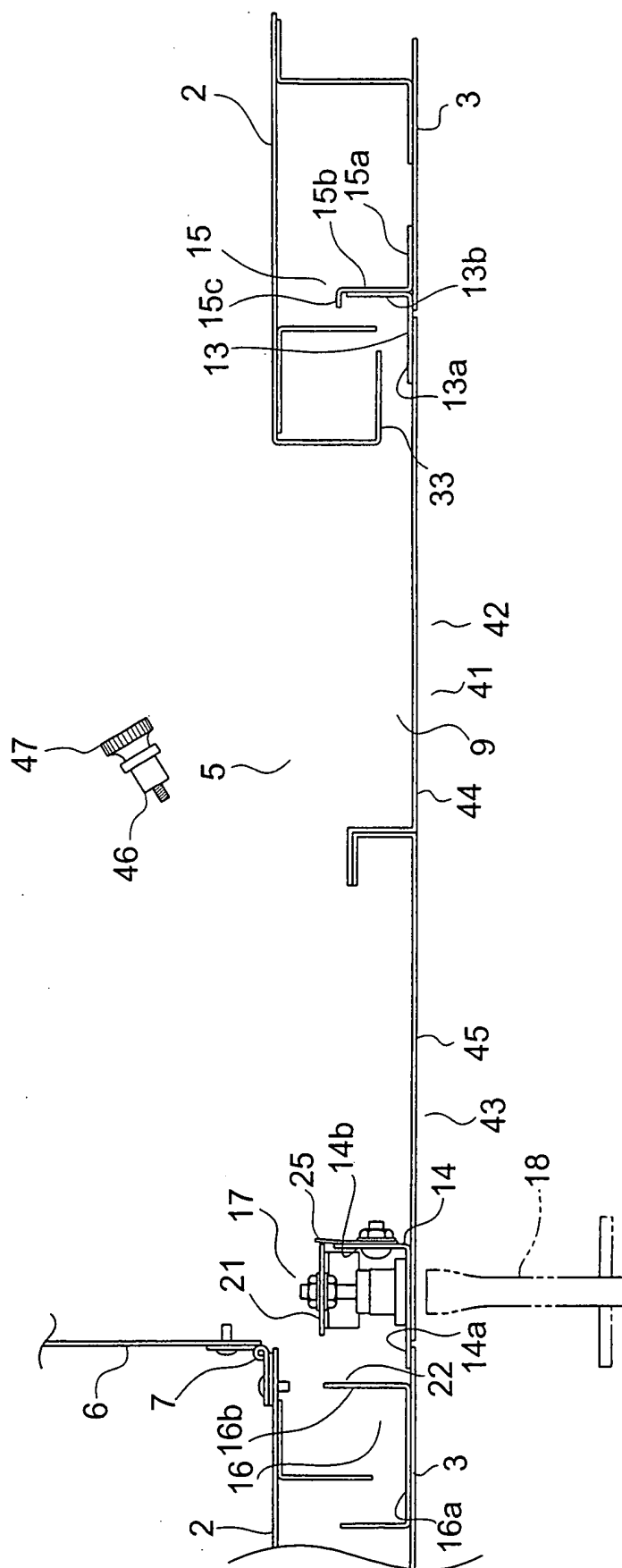


FIG. 20

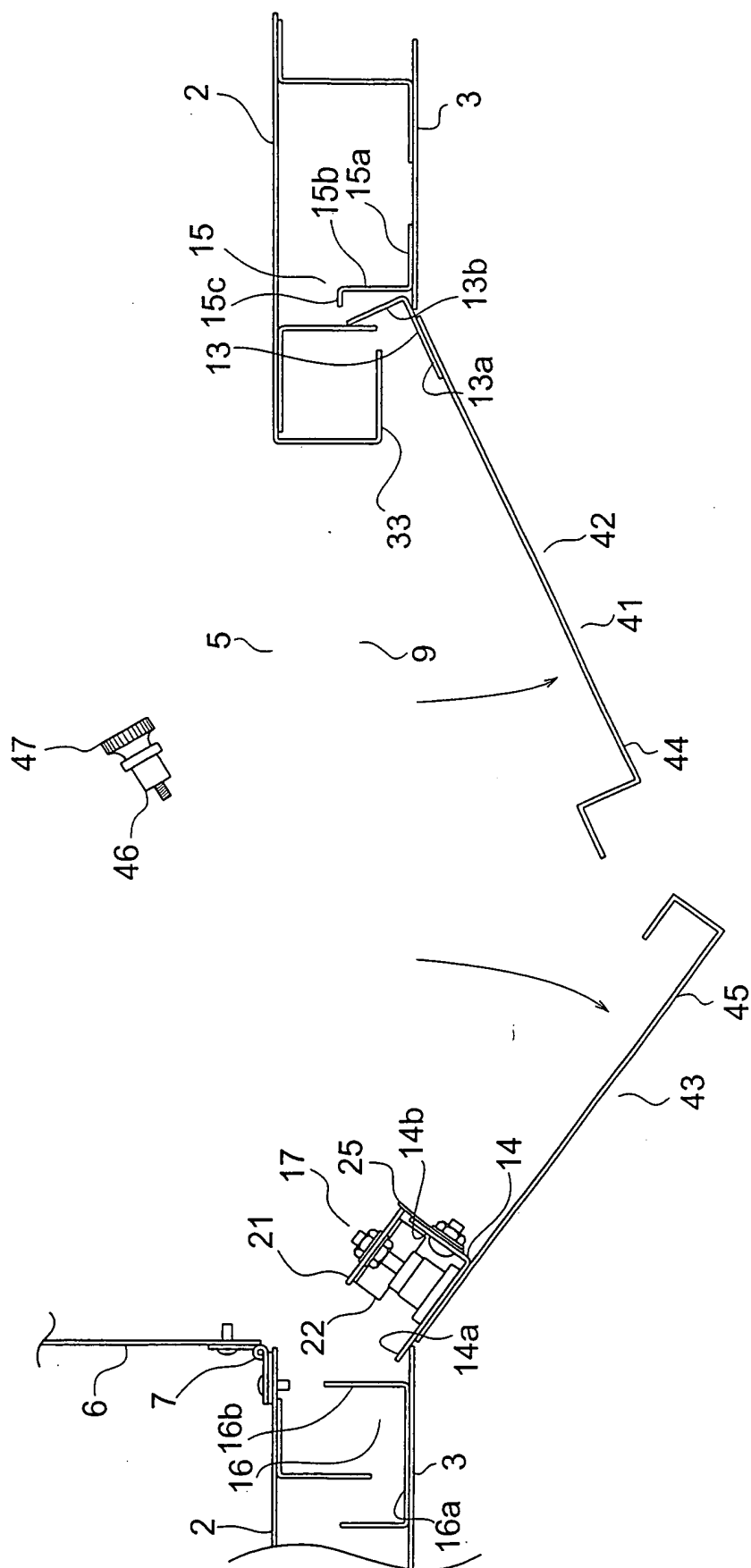
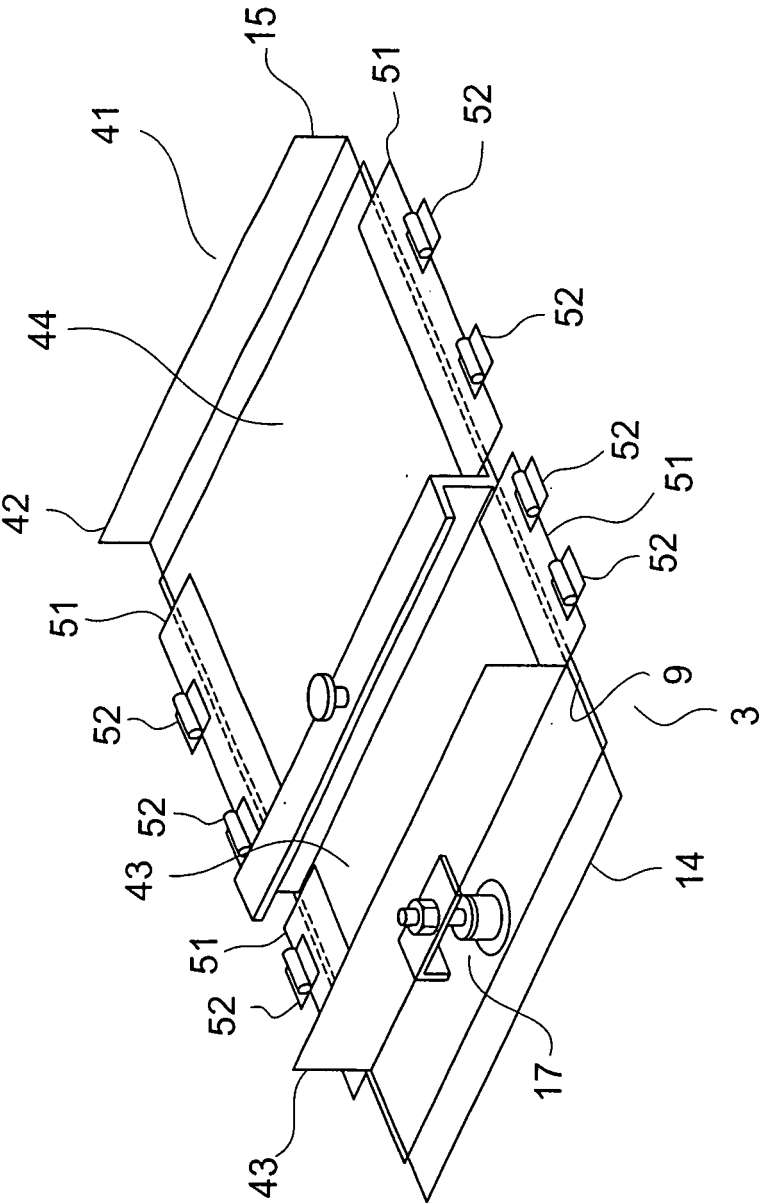


FIG. 21



**REFERENCES CITED IN THE DESCRIPTION**

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