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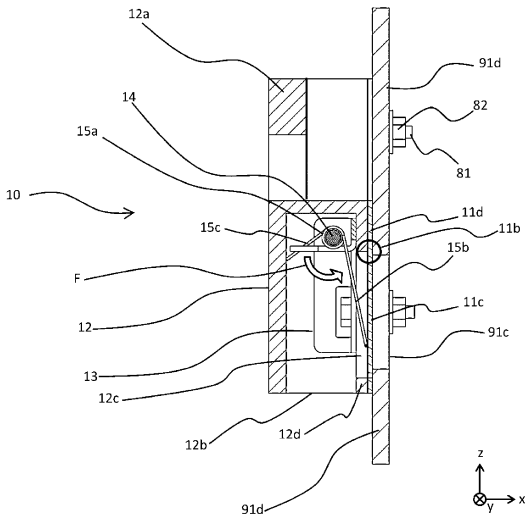
(54) **STORAGE BOX AND OPENING/CLOSING DEVICE**

(57) Provided are a storage box and a switchgear that can achieve decrease of the weight of the storage box while preventing foreign matter from entering the storage box. A storage box (91) stores therein a switch (100) and includes: a side wall; a pressure release hole (91c) which is formed in the side wall and through which an internal pressure of the storage box (91) is released; and a pressure release device (10) mounted on the side wall (91c). The pressure release device (10) includes a pressure release sheet (11) having: a movable portion (11c) movable between a closing position at which the pressure release hole (91c) is closed and an opening position at which the pressure release hole (91c) is opened; and a deformable portion (11b) which is elastically deformable and which is deformed according to movement of the movable portion (11c). An elastic force of the deformable portion (11b) applies, when the movable portion (11c) is at the opening position, a load to the movable portion (11c) in such a direction as to restore the movable portion (11c) to the closing position.

FIG. 6



EP 4 443 463 A1

Description

TECHNICAL FIELD

[0001] The present disclosure relates to a storage box and a switchgear.

BACKGROUND ART

[0002] A switchgear includes: a switch; and a storage box such as a protective box that stores therein the switch and that prevents the switch from being exposed to foreign matter such as rain or dust. The storage box is configured to have a high sealability in order to prevent such foreign matter from entering the storage box. Meanwhile, the internal pressure of the storage box might be increased owing to occurrence of an arc at the time of current interruption, and thus a pressure release device for preventing increase in the pressure at the time of current interruption is provided on the storage box. The pressure release device is configured to: maintain the sealability of the storage box at times other than the time of current interruption; and discharge gas inside the storage box to outside at the time of current interruption, to prevent rapid increase of the internal pressure of the storage box. As a structure for realizing such a pressure release device, a pressure release structure including a pressure release hole formed in a storage box and a pressure release lid that opens the pressure release hole at the time of current interruption and that closes the pressure release hole at times other than the time of current interruption, is disclosed (see, for example, Patent Document 1). In the pressure release structure of Patent Document 1, an O-ring-mounted member is provided around the pressure release hole and formed in a protruding shape, and the pressure release lid is formed in a recessed shape so as to cover the pressure release hole in addition to the O-ring-mounted member. The pressure release lid shifts between an opening position and a closing position by utilizing the relationship between an elastic force of a torsion coil spring and increase in the internal pressure at the time of current interruption. Further, the pressure release lid is provided with an engaged-and-fixed member for retaining the pressure release lid at the closing position. The pressure release lid is retained at the closing position by the above engaged-and-fixed member being engaged with and fixed to an engaging-and-fixing member provided to the pressure release hole, whereby foreign matter can be prevented from entering the storage box.

CITATION LIST

PATENT DOCUMENT

[0003] Patent Document 1: Japanese Laid-Open Patent Publication No. 2003-263944

SUMMARY OF THE INVENTION

PROBLEM TO BE SOLVED BY THE INVENTION

[0004] In the pressure release structure of Patent Document 1, the mass of the pressure release lid is, owing to the recessed shape thereof and the engaged-and-fixed member mounted thereon, higher than that of a pressure release sheet formed of only a simple plate-shaped member. Consequently, a stronger gravitational force is exerted to the pressure release lid. The gravitational force exerted to the pressure release lid acts in a such a direction as to delay movement of the pressure release lid from the closing position to the opening position. Thus, it takes the pressure release lid of Patent Document 1 a longer time to move from the closing position to the opening position at the time of current interruption. In a case where the period from current interruption to pressure release is elongated, the strength of the storage box needs to be increased to deal with increase in the pressure during this period. However, the increase in the strength leads to complication of the structure of the storage box and increase of the weight of the storage box.

[0005] The present disclosure has been made to solve the above problem, and an object of the present disclosure is to provide a storage box and a switchgear that can achieve decrease of the weight of the storage box while preventing foreign matter from entering the storage box.

MEANS TO SOLVE THE PROBLEM

[0006] A storage box according to the present disclosure is a storage box for storing therein a switch, the storage box including: a side wall; a pressure release hole which is formed in the side wall and through which an internal pressure of the storage box is released; and a pressure release device, for the switch, which is mounted on the side wall. The pressure release device for the switch includes a pressure release sheet having: a movable portion movable between a closing position at which the pressure release hole is closed and an opening position at which the pressure release hole is opened; and a deformable portion which is elastically deformable and which is deformed according to movement of the movable portion. An elastic force of the deformable portion applies, when the movable portion is at the opening position, a load to the movable portion in such a direction as to restore the movable portion to the closing position.

[0007] In addition, another aspect of the storage box according to the present disclosure is a storage box for storing therein a switch, the storage box including: a side wall; a pressure release hole which is formed in the side wall and through which an internal pressure of the storage box is released; and a pressure release device, for the switch, which is mounted on the side wall. The pressure release device for the switch includes: a pressure release sheet having a movable portion which is rotated with one

end thereof being a central axis of rotation and which is movable between a closing position at which the pressure release hole is closed and an opening position at which the pressure release hole is opened; a supporting body fixed to the side wall at both sides thereof in a direction of the central axis; a shaft supported by the supporting body by penetrating through through-holes formed in the supporting body; and a torsion coil spring which is fixed to the shaft and which applies, when the movable portion is at the closing position, a load to the movable portion in such a direction as to retain the movable portion at the closing position and applies, when the movable portion is at the opening position, a load to the movable portion in such a direction as to restore the movable portion to the closing position. The pressure release sheet includes: a plate-shaped portion having a flat plate shape; and an arm provided to one end of the plate-shaped portion and having a hole into which the shaft is fitted. An entirety of the pressure release sheet is rotated together with the shaft.

EFFECT OF THE INVENTION

[0008] The storage box according to the present disclosure can achieve decrease of the weight of the storage box while preventing foreign matter from entering the storage box.

BRIEF DESCRIPTION OF THE DRAWINGS

[0009]

[FIG. 1] FIG. 1 is a perspective view of a switchgear in embodiment 1.
[FIG. 2] FIG. 2 is a front view of a pressure release device in embodiment 1.
[FIG. 3] FIG. 3 is a parts development of the pressure release device in embodiment 1.
[FIG. 4A] FIG. 4A is a front view of a pressure release sheet according to embodiment 1.
[FIG. 4B] FIG. 4B is a front view showing another example of the pressure release sheet according to embodiment 1.
[FIG. 4C] FIG. 4C is a front view showing still another example of the pressure release sheet according to embodiment 1.
[FIG. 5] FIG. 5 is a perspective view for explaining a fixation method for a torsion coil spring according to embodiment 1.
[FIG. 6] FIG. 6 is a cross-sectional view, taken along A-A, of the pressure release device in embodiment 1 and shows a state where the pressure release sheet is at a closing position.
[FIG. 7] FIG. 7 is a cross-sectional view, taken along A-A, of the pressure release device in embodiment 1 and shows a state where the pressure release sheet is at an opening position.
[FIG. 8] FIG. 8 is a diagram for explaining a restoration operation of the pressure release sheet.
[FIG. 9] FIG. 9 is a cross-sectional view, taken along A-A, of a pressure release device in embodiment 2 and shows a state where a pressure release sheet is at the closing position.
[FIG. 10] FIG. 10 is a cross-sectional view, taken along A-A, of the pressure release device in embodiment 2 and shows a state where the pressure release sheet is at the opening position.
[FIG. 11] FIG. 11 a cross-sectional view, taken along A-A, of a pressure release device in embodiment 3.
[FIG. 12] FIG. 12 is a front view of a pressure release device in embodiment 4.

DESCRIPTION OF EMBODIMENTS

Embodiment 1

[0010] Embodiment 1 will be described with reference to FIG. 1 to FIG. 8. FIG. 1 is a perspective view of a switchgear in embodiment 1. A switchgear 1000 includes, for example, a switch 100 for power and a storage box 91 such as a protective box storing therein the switch. The storage box 91 is, for example, a box composed of two upper and lower stages and is configured to have a high sealability so as to prevent foreign matter from entering the box. It is noted that coordinate axes are set as below for description. That is, the vertical direction is set as a z axis, directions perpendicular to the z axis, i.e., horizontal directions, are set as an x axis and a y axis. A direction along the long-side direction of the storage box 91 is set as the x axis, and a direction along the short-side direction of the storage box 91 is set as the y axis. In the z axis, the upward direction is set as a +z axis direction, and the downward direction is set as a -z axis direction. In each of the x axis and y axis, one direction is set as a corresponding one of a +x axis direction and a +y axis direction, and the direction opposite thereto is set as a corresponding one of a -x axis direction and a -y axis direction (positive direction), as shown in FIG. 1. An upper portion 91A of the storage box has a trapezoidal cross section such that the width thereof decreases toward the upper surface side. However, the shape of the storage box 91 is not limited to that shown in FIG. 1.

[0011] The upper portion 91A has side walls 91Aa along the short-side direction (y axis direction). The side walls 91Aa have outer surfaces on which pressure release devices 10A and 10B, i.e., pressure release devices for the switch, are mounted. Pressure release holes (not shown in FIG. 1) are formed at the positions, on the side wall 91Aa, at which the pressure release devices are mounted. In FIG. 1, one pressure release device is mounted on each of the side walls 91Aa on both sides, i.e., two pressure release devices are mounted as one set. However, the number of the pressure release devices to be mounted and the mounting positions therefor are not particularly limited. The pressure release devices 10 may be mounted on side walls 91Ab along the long-

side direction (x axis direction) of the storage box 91. A lower portion 91B has a side wall 91Bb along the long-side direction (x axis direction). The side wall 91Bb has holes (not shown) through which busbars 92 penetrate.

[0012] The following description will be given with the pressure release device 10A being taken as an example.

[0013] FIG. 2 is a front view of the pressure release device in embodiment 1. In FIG. 2, the pressure release device 10A is seen in the +x axis direction in FIG. 1. The same applies to the pressure release device 10B, and thus the pressure release device 10A will be simply referred to as the pressure release device 10 in the following description.

[0014] The pressure release device 10 is mounted on a pressure-release-device-mounting portion 91d provided at a predetermined position of the corresponding side wall 91Aa. The position and the range of the pressure-release-device-mounting portion 91d are not particularly limited as long as the position and the range cover pressure release holes 91c formed in the side wall 91Aa and allow formation of screw holes or the like necessary for mounting the pressure release device 10. The pressure release device 10 includes: a pressure release sheet 11 covering the pressure release holes 91c; a cover 12 covering the pressure release sheet 11; a supporting body 13 fixed to the pressure-release-device-mounting portion 91d and including two plate-shaped members disposed on both sides in the y axis direction of a movable portion 11c of the pressure release sheet 11; a shaft 14 penetrating through through-holes 13aa formed in the supporting body 13; and a torsion coil spring 15 mounted on the shaft 14 and having a double torsion shape. Although two circular holes adjacent to each other are formed as the pressure release holes 91c in FIG. 2, the shapes and the number of the pressure release holes 91c are not limited thereto and can be arbitrarily set.

[0015] The pressure release sheet 11 has the same external shape as that of the cover 12 and is configured to prevent a gap from being generated between the cover 12 and the pressure-release-device-mounting portion 91d when being mounted on the pressure-release-device-mounting portion 91d together with the cover 12. In addition, a U-shaped slit 11a is formed in the pressure release sheet 11, and the movable portion 11c is provided within a range enclosed by the U-shaped slit 11a. The movable portion 11c is moved between a closing position at which the movable portion 11c is in close contact with the side wall 91Aa so as to close the pressure release holes 91c and an opening position at which the movable portion 11c is away from the side wall 91Aa so as to open the pressure release holes 91c. In an ordinary state, the movable portion 11c is at the closing position. Therefore, the position and the range of the movable portion 11c need to be set such that at least the pressure release holes 91c can be closed. A more detailed configuration of the pressure release sheet 11 will be described later.

[0016] The cover 12 is mounted on the pressure-release-device-mounting portion 91d. An opening (not shown in FIG. 2) is formed in the cover 12 correspondingly to the movable portion 11c. In addition, the cover 12 has an upper portion at which a handle portion 12a capable of being gripped is integrally provided. The handle portion 12a is formed by causing end portions on both sides in the y axis direction of the upper portion of the cover 12 to protrude upward and joining the protruding portions on both sides.

[0017] The supporting body 13 is fixed to the storage box 91 so as to be integrated with the pressure release sheet 11 and the cover 12 by using fastening members such as bolts and nuts. The shaft 14 is rotatably supported by the supporting body 13 by penetrating through the through-holes 13aa. In addition, the shaft 14 has both ends, in the axial direction, that interfere with inner walls of the cover 12, whereby the shaft 14 is shifted in the axial direction to only a limited extent and is prevented from falling off from the through-holes 13aa. The torsion coil spring 15 has a pressing portion 15b which applies, to the movable portion 11c of the pressure release sheet 11, a load due to an elastic force of the torsion coil spring 15.

[0018] FIG. 3 is a parts development of the pressure release device in embodiment 1. In FIG. 3, the alternate long and short dash lines indicate assembling positions of bolts 81 and nuts 82 which are fastening members. As shown in FIG. 3, holes 91e into which the bolts 81 are inserted are formed at predetermined positions on the pressure-release-device-mounting portion 91d. The pressure release device 10 is mounted on the storage box 91 (pressure-release-device-mounting portion 91d) in the following manner. First, as shown in FIG. 3, the supporting body 13 on which the torsion coil spring 15 and the shaft 14 have been mounted is inserted into the cover 12 from an opening 12b formed in the lower end of the cover 12, whereby one part is assembled. Next, the pressure release sheet 11 is disposed to be sandwiched between the above part (the cover 12, the supporting body 13, the shaft 14, and the torsion coil spring 15) and the pressure-release-device-mounting portion 91d, and the above part and the pressure release sheet 11 are fastened and fixed by using the bolts 81 and the nuts 82. Consequently, each part is mounted on the pressure-release-device-mounting portion 91d. At this time, the positions of an opening 12c of the cover 12 and the movable portion 11c of the pressure release sheet 11 are matched. In addition, a side surface, of the cover 12, that is located on the pressure-release-device-mounting portion 91d side and that excludes the opening 12c is brought into close contact with the pressure-release-device-mounting portion 91d.

[0019] In each part to be mounted on the pressure-release-device-mounting portion 91d as well, holes through which the bolts 81 are inserted are formed at positions corresponding to the positions of the holes 91e. Although the pressure release device 10 is mounted on the pressure-release-device-mounting portion 91d by using the fastening members which are the bolts 81 and

the nuts 82 in embodiment 1, a mounting method in which other fixation members such as rivets are used may be employed.

[0020] Next, a more detailed configuration of the pressure release sheet 11 will be described. FIG. 4A is a front view of the pressure release sheet according to embodiment 1. In FIG. 4A, the pressure release sheet 11 is seen in the +x axis direction in FIG. 1. As described above, the pressure release sheet 11 has the same external shape as that of the cover 12 and has an external shape with an upper portion thereof being partially recessed. The U-shaped slit 11a is formed at a center portion in the up-down direction of the pressure release sheet 11, and the movable portion 11c is provided within the range enclosed by the U-shaped slit 11a. A deformable portion 11b extending in the y axis direction and elastically deformable is provided at the upper end of the movable portion 11c and an opening portion of the U-shaped slit 11a. The movable portion 11c is rotated about the y axis with the deformable portion 11b being the center of rotation, through elastic deformation of the deformable portion 11b. Consequently, the movable portion 11c undergoes an opening/closing motion in the same manner as a hinge, whereby the movable portion 11c is movable between the closing position and the opening position. A region, of the pressure release sheet 11, other than the range enclosed by the U-shaped slit 11a is a fixation portion 11d. Holes 11e through which the bolts 81 are inserted are formed in the fixation portion 11d, and the fixation portion 11d is fixed to the pressure-release-device-mounting portion 91d by using the bolts 81 and the nuts 82. The positions and the number of the holes 11e correspond to the positions and the number of the holes 91e in the pressure-release-device-mounting portion 91d.

[0021] FIG. 4B is a front view showing another example of the pressure release sheet according to embodiment 1. In the example shown in FIG. 4B, the U-shaped slit 11a is not formed. A pressure release sheet 111 includes, at a center portion thereof in the z axis direction, a deformable portion 111b extending in the y axis direction and elastically deformable. The deformable portion 111b is formed to extend between both ends of the pressure release sheet 111 in the y axis direction, the portion above the deformable portion 111b is a fixation portion 111d, and the portion below the deformable portion 111b is a movable portion 111c. The movable portion 111c is rotated about the y axis with the deformable portion 111b being the center of rotation, through elastic deformation of the deformable portion 111b. Consequently, the movable portion 111c undergoes an opening/closing motion in the same manner as a hinge, whereby the movable portion 111c is movable between the closing position and the opening position. Holes 11e through which bolts 81 are inserted are formed in the fixation portion 111d, and the fixation portion 111d is fixed to the pressure-release-device-mounting portion 91d by using the bolts 81 and nuts 82.

[0022] FIG. 4C is a front view showing still another example of the pressure release sheet according to embodiment 1. A pressure release sheet 112 includes: two linear slits 11f1 and 11f2 which are formed at portions opposed to each other and which extend from a center portion in the z axis direction to the lower end of the pressure release sheet 112; and a deformable portion 112b which is formed at the center portion in the z axis direction of the pressure release sheet 112 and which extends in the y axis direction between the linear slit 11f1 and the linear slit 11f2. The pressure release sheet 112 further includes: a movable portion 112c formed between the linear slit 11f1 and the linear slit 11f2; and fixation portions 112d formed in portions other than the movable portion 112c, i.e., a portion above the deformable portion 112b and portions that are below the deformable portion 112b and that are closer to the respective ends in the y axis direction than the linear slit 11f1 and the linear slit 11f2 are. The movable portion 112c undergoes an opening/closing motion in the same manner as a hinge, whereby the movable portion 112c is movable between the closing position and the opening position. Holes 11e through which bolts 81 are inserted are formed in the fixation portions 112d, and the fixation portions 112d are fixed to the pressure-release-device-mounting portion 91d by using the bolts 81 and nuts 82. The linear slit 11f1 and the linear slit 11f2 respectively correspond to a first slit portion and a second slit portion. In this manner, the pressure release sheet may be configured to have two slits at portions opposed to each other, such that the region interposed between the two slits serves as a movable portion.

[0023] FIG. 5 is a perspective view for explaining a fixation method for the torsion coil spring according to embodiment 1. The coordinate axes shown in FIG. 5 indicate directions in a state where the pressure release device 10 is mounted on the storage box 91. The supporting body 13 is formed by bending each of two plate-shaped members into an L shape and is fixed to both sides in the y axis direction relative to the movable portion 11c of the pressure release sheet 11. The supporting body 13 includes: side portions 13a perpendicular to the y axis direction and having the through-holes 13aa through which the shaft 14 penetrates; bottom portions 13b perpendicular to the side portions 13a (perpendicular to the x axis direction) and having holes (not shown) through which bolts 81 are inserted; and raised portions 13c formed by raising parts of the bottom portions 13b in the -x axis direction which is a direction toward the shaft 14, the parts being located on the inner sides (sides close to the movable portion 11c). A gap is formed between the shaft 14 and each raised portion 13c. The gap is formed such that the width thereof is smaller than the thickness of a winding forming a corresponding one of winding portions 15a of the torsion coil spring 15. A hole 13ca is formed in the raised portion 13c. The through-holes 13aa formed in the side portions 13a of the supporting body 13 at both sides thereof are opposed to each

other. The shaft 14 extends along the y axis direction and is supported by the supporting body 13 at both sides thereof by penetrating through the through-holes 13aa on said both sides. The supporting body 13 only has to be configured to support the shaft 14 on both sides in the y axis direction relative to the movable portion 11c, and thus the shape of the supporting body 13 is not limited to a plate shape. For example, the supporting body 13 may be a box fixed to the pressure-release-device-mounting portion 91d and having holes through which the shaft 14 penetrates.

[0024] The torsion coil spring 15 has a double torsion shape as described above and is fixed to the shaft 14 through penetration by the shaft 14 through two winding portions 15a. Each winding portion 15a is disposed on the inner side relative to the corresponding raised portion 13c, i.e., between the movable portion 11c and the raised portion 13c. As described above, the width of the gap between the raised portion 13c and the shaft 14 is smaller than the thickness of the winding forming the winding portion 15a. Thus, the winding portion 15a is configured such that movement thereof along the axial direction of the shaft 14 is restricted by the raised portion 13c. In addition, each winding portion 15a has one end portion extending in the -z axis direction (downward direction), whereby the pressing portion 15b is formed in a U shape by the winding portions 15a on both sides. In other words, the pressing portion 15b formed in the U shape is connected to one end of each of the two winding portions. The pressing portion 15b is the point of load of the torsion coil spring 15. Each winding portion 15a has another end portion 15c penetrating through the hole 13ca in the corresponding raised portion 13c and is engaged with the hole 13ca. Consequently, the end portion 15c is formed as a fixed end of the torsion coil spring 15.

[0025] FIG. 6 is a cross-sectional view, taken along A-A, of the pressure release device in embodiment 1 and shows a state where the pressure release sheet is at the closing position. As shown in FIG. 6, in the state where the pressure release sheet 11 is at the closing position, the deformable portion 11b is not deformed, and the entirety of the pressure release sheet 11 has a flat plate shape extending in the up-down direction. The movable portion 11c is in close contact with the pressure-release-device-mounting portion 91d and closes the pressure release holes 91c and the opening 12c in the cover 12. The pressing portion 15b retains the movable portion 11c at the closing position by applying a load F to the movable portion 11c through exertion of the elastic force of the torsion coil spring 15 such that the movable portion 11c is pressed against the pressure-release-device-mounting portion 91d.

[0026] A side wall on the +x axis direction side (storage box 91 side) of the cover 12 has a portion other than the opening 12c. This portion is fixed to the pressure-release-device-mounting portion 91d without any gap therebetween and is in close contact with the pressure-release-device-mounting portion 91d. Although the opening 12b is formed on the lower side, a lower end portion 12d on the +x axis direction side of the cover 12 is also in close contact with the pressure-release-device-mounting portion 91d. Therefore, the cover 12 continuously covers the outer periphery of the movable portion 11c which is at the closing position. Foreign matter having entered the cover 12 from the opening 12b is prevented from entering the storage box 91, by the movable portion 11c which is at the closing position. Thus, the cover 12 having the above structure can prevent foreign matter from entering the storage box 91 from not only the horizontal direction sides (the x axis direction side and the y axis direction side) and the upward direction side but also the downward direction side.

[0027] A pressure release operation by the pressure release device 10 will be described. FIG. 7 is a cross-sectional view, taken along A-A, of the pressure release device in embodiment 1 and shows a state where the pressure release sheet is at the opening position. When the switch 100 stored in the storage box 91 performs a current interruption operation, the internal pressure of the storage box 91 is increased. As shown in FIG. 7, the increased pressure causes increase of a load P being applied to the movable portion 11c of the pressure release sheet 11 in a direction toward the outside of the storage box 91. As described above, the load F is applied to the movable portion 11c mainly by the torsion coil spring 15. However, when the internal pressure of the storage box 91 is increased and becomes higher than a first pressure, the load P becomes higher than the load F. Consequently, the deformable portion 11b starts to be elastically deformed, whereby the movable portion 11c is moved away from the pressure-release-device-mounting portion 91d. The movable portion 11c is pressed by the load P and rotated about the y axis with the deformable portion 11b being the center of rotation. The rotation direction is a direction (in FIG. 7, the clockwise direction) in which the movable portion 11c is lifted. The movable portion 11c is rotated until the lower end thereof comes into contact with an inner wall of the cover 12. Consequently, the opening position shown in FIG. 7 is reached. By the above rotation of the movable portion 11c, the pressing portion 15b of the torsion coil spring 15 is also rotated. When the movable portion 11c has reached the opening position, the lower end of the pressing portion 15b and the lower end of each end portion 15c are also in contact with the inner surface of the cover 12. The "first pressure" is predetermined according to the mass of the movable portion 11c and the elastic force of the torsion coil spring 15.

[0028] When the movable portion 11c is moved away from the pressure-release-device-mounting portion 91d so as to open each pressure release hole 91c, gas G in the storage box 91 starts to be discharged via the pressure release hole 91c and the opening 12c to the outside of the storage box 91. By discharging the gas G to the outside of the storage box 91 in this manner, pressure release is performed. The gas G discharged to the out-

side of the storage box 91 flows into the cover 12. However, since the cover 12 covers the pressure release hole 91c without any gap, the gas G is discharged to the outside of the cover 12 via only the opening 12b.

[0029] When the movable portion 11c is at the opening position, the load P, a reaction force N (not shown) from the inner surface of the cover 12, the load F from the torsion coil spring 15, a load FK (not shown in FIG. 7) due to an elastic force of the deformable portion 11b, and a gravitational force FG (not shown in FIG. 7) are applied to the movable portion 11c. The load P acts to secure the movable portion 11c at the opening position, and the reaction force N prevents further rotation of the movable portion 11c. The load F acts to restore the movable portion 11c to the closing position as shown in FIG. 7. In addition, the deformable portion 11b attempts to return to the original shape thereof, and thus the load FK also acts to restore the movable portion 11c to the closing position. In addition, the gravitational force FG also acts to restore the movable portion 11c to the closing position. When the internal pressure of the storage box 91 decreases owing to the pressure release and becomes lower than a second pressure, the force for retaining the movable portion 11c at the opening position owing to the load P becomes weaker than the force for restoring the movable portion 11c to the closing position owing to the load F, the load FK, and the gravitational force FG. Consequently, the movable portion 11c starts a restoration operation so as to be restored to the closing position and is eventually restored to the closing position. After being restored to the closing position, the movable portion 11c is pressed against the pressure-release-device-mounting portion 91d by the pressing portion 15b, to close the pressure release hole 91c. The "second pressure" is predetermined according to the mass of the movable portion 11c, the elastic force of the deformable portion 11b, and the elastic force of the torsion coil spring 15.

[0030] The restoration operation of the pressure release sheet 11 will be further described. FIG. 8 is a diagram for explaining the restoration operation of the pressure release sheet. For comparison, in FIG. 8, the pressure release sheet 11 in a state where the closing position is taken is shown on the left side, and the pressure release sheet 11 in a state where the opening position is taken is shown on the right side. Firstly, the gravitational force FG acts on the center of gravity 11g of the movable portion 11c. When the movable portion 11c is at the opening position, the movable portion 11c is tilted relative to the direction of the gravitational force FG, and thus the gravitational force FG has a component in a direction orthogonal to a side surface of the movable portion 11c. In comparison between the state where the opening position is taken and the state where the closing position is taken, the center of gravity 11g in the state where the opening position is taken is present at a higher position than the center of gravity 11g in the state where the closing position is taken. Thus, in the state where the opening position is taken, a greater potential energy is obtained regarding the gravitational force. Therefore, the gravitational force FG acts to rotate the movable portion 11c in such a direction as to restore the movable portion 11c to the closing position (in FIG. 8, the anticlockwise direction about the y axis), such that: the movable portion 11c is restored from the opening position to the closing position; and the center of gravity 11g returns to the position having been taken in the state where the closing position is taken.

[0031] Next, the elastic force of the deformable portion 11b is described as follows. In the state where the closing position is taken, the deformable portion 11b is not deformed, and thus no elastic force is generated. Meanwhile, in the state where the opening position is taken, the deformable portion is elastically deformed such that the +x side thereof is stretched and the -x side thereof is shrunk. In this state, an elastic force FE is generated in the deformable portion 11b so as to offset the elastic deformation. Owing to the elastic force FE, the load FK acts on the movable portion 11c, which is at the opening position, in such a direction as to restore the movable portion 11c to the closing position.

[0032] Further, as described above, the load F also acts on the movable portion 11c from the torsion coil spring 15 (not shown in FIG. 8) in such a direction as to restore the movable portion 11c to the closing position. As described above, the pressure release device 10 is configured such that the movable portion 11c of the pressure release sheet 11 is automatically restored from the opening position to the closing position by utilizing the load F, the gravitational force FG, and the load FK.

[0033] The pressure release sheet 11 is implemented by a thin sheet made from an elastically deformable resin material. For example, it is conceivable to form the pressure release sheet 11 by using insulation paper including aramid polymer fibers. The thickness of the pressure release sheet 11 is not limited. However, a pressure release sheet 11 formed to have a smaller thickness has a lower weight and leads to a lower load generated in the pressure release sheet 11 by impact and vibration due to operation of the switch 100, and thus, can lead to a lower load (closing load) for retaining the pressure release sheet 11 at the closing position. When the closing load becomes lower, a torsion coil spring 15 having a smaller size can be used, whereby the size and the weight of the pressure release device 10 can also be decreased. In addition, in a case where the pressure release sheet 11 is formed to have a smaller thickness, the elastic force of the deformable portion 11b and the gravitational force that acts on the movable portion 11c also become weaker. As described above, the elastic force of the deformable portion 11b and the gravitational force that acts on the movable portion 11c are exerted so as to move the movable portion 11c to the closing position. Thus, in a case where these forces are weak, it becomes easy to move the movable portion 11c to the opening position at the time of pressure release. Consequently, when the internal pressure of the storage box 91 is increased

through a current interruption operation performed by the switch 100, the movable portion 11c is moved to the opening position in a shorter time, whereby increase of the internal pressure of the storage box 91 can be further suppressed. In this case, the strength required of the storage box 91 can be further decreased, whereby the structure of the storage box 91 can be further simplified, and the weight of the storage box 91 can be further decreased.

[0034] In contrast, in a case where the thickness of the pressure release sheet 11 is increased, as compared to the case where the pressure release sheet 11 is formed to have a smaller thickness, the above advantageous effects such as decrease in the weight deteriorate but the strength of the pressure release sheet 11 can be increased.

[0035] According to embodiment 1, it is possible to achieve decrease of the weight of the storage box while preventing foreign matter from entering the storage box. Specifically, the movable portion of the pressure release sheet in embodiment 1 is configured to realize restoration from the opening position to the closing position by utilizing only the elastic force of the pressure release sheet itself, the elastic force of the torsion coil spring, and the gravitational force, whereby the movable portion of the pressure release sheet can be realized with a simple and lightweight configuration. A larger extent of opening of the pressure release hole causes pressure release to be performed at a higher speed, and thus a faster movement of the movable portion from the closing position to the opening position causes pressure release to be performed at a higher speed. Decrease in the weight of the movable portion as described above leads to the following advantage. That is, in consideration of influence of the gravitational force, a movable portion having a lower weight is moved from the closing position to the opening position in a shorter time so as to allow pressure release to be performed more quickly, whereby increase of the internal pressure of the storage box can be more effectively suppressed. In a case where increase of the internal pressure of the storage box can be more effectively suppressed, the strength required of the storage box may be low. Consequently, the structure of the storage box can be simplified, and the weight of the storage box can be decreased. In addition, the upper portion and the side portions of the pressure release sheet are covered with the cover, whereby foreign matter is also prevented from entering the storage box.

[0036] It is generally known that increase in the internal pressure of the storage box at the time of current interruption facilitates a restrike of an arc in an arc extinguishing chamber inside the switch 100. When a restrike of an arc occurs, the arc voltage generated by the switch 100 decreases, whereby a problem arises in that the period for current interruption is elongated. However, the pressure release device in embodiment 1 also has the advantageous effect of suppressing increase of the internal pressure of the storage box, whereby it is possible to realize prevention of a restrike of an arc and shortening of the period for current interruption.

[0037] In addition, the cover has an upper portion at which the handle portion is integrally provided. Consequently, a handle serving as a handgrip at the time of carrying the storage box does not need to be separately provided, whereby the number of parts can be decreased.

[0038] In addition, between each raised portion provided to the supporting body and the movable portion of the pressure release sheet, the corresponding winding portion is disposed to be sandwiched, and the width of the gap between the raised portion and the shaft is smaller than the thickness of the winding forming the winding portion. Thus, the winding portion is configured such that movement of the winding portion along the axial direction of the shaft is restricted by the raised portion. Consequently, even when vibration and impact occur in association with a closing operation and an opening operation of the pressure release device, the position of the torsion coil spring is fixed without being displaced along the axial direction of the shaft. Therefore, the load to be applied to the pressure release sheet can be inhibited from varying.

[0039] In addition, the cover covers the pressure release hole without any gap. Thus, gas discharged to the outside of the storage box 91 at the time of pressure release is discharged downward from the cover via only the opening in the lower end of the cover. Consequently, discharged substances discharged together with the gas from inside the storage box is discharged only downward. Therefore, the discharged substances can be prevented from being scattered over a wide range, whereby adverse influence of the discharged substances on peripheral devices can be suppressed.

[0040] In addition, in the state where the opening position is taken, the lower end of the movable portion of the pressure release sheet, the fixed ends of the torsion coil spring, and the lower end of the pressing portion are in contact with the inner surface of the cover. Consequently, the movement amounts of the movable portion and the torsion coil spring are restricted owing to the reaction force from the inner surface of the cover, and the pressure release sheet and the torsion coil spring can be prevented from being damaged.

Embodiment 2

[0041] Next, embodiment 2 will be described with reference to FIG. 9 and FIG. 10. It is noted that portions identical or corresponding to those in FIG. 1 to FIG. 8 are denoted by the same reference characters, and description thereof will be omitted. FIG. 9 is a cross-sectional view, taken along A-A, of a pressure release device in embodiment 2 and shows a state where a pressure release sheet is at the closing position. Meanwhile, FIG. 10 shows a state where the pressure release sheet is at the opening position. A pressure release device 20 is

obtained by substituting the pressure release sheet 11 of the pressure release device 10 in embodiment 1 with a pressure release sheet 21 shown in FIG. 9 and FIG. 10. The pressure release sheet 21 has a plate-shaped portion and an arm (described later) and is made from a material that is not easy to elastically deform. Thus, the pressure release sheet 21 has no portion that is elastically deformed as the deformable portion 11b of the pressure release sheet 11 is. The entirety of the above plate-shaped portion of the pressure release sheet 21 is a movable portion 21c. The pressure release sheet 21 is made from, for example, an iron-based metal such as iron or stainless steel, a nonferrous metal such as aluminum or copper, or an insulating material (a thermoplastic resin or a thermosetting resin) such as an epoxy resin or a polyethylene resin, and has a higher rigidity than the pressure release sheet 11. The thickness of the pressure release sheet 21 is not particularly limited, but the pressure release sheet 21 is preferably formed to have a smaller thickness from the viewpoint of weight decrease.

[0042] The movable portion 21c of the pressure release sheet 21 has an upper end provided with an arm 27. The arm 27 is made from, for example, a metal and is formed to be raised from the movable portion 21c. As shown in FIG. 9, when the movable portion 21c is at the closing position, the arm 27 extends in the -x axis direction from the movable portion 21c. The arm 27 has a hole 27a into which the shaft 14 is fitted, and the arm 27 and the movable portion 21c are fixed to the shaft 14 fitted into the hole 27a. With this configuration, the movable portion 21c is rotatable together with the shaft 14. Embodiment 2 is the same as embodiment 1 in that: the torsion coil spring 15 is mounted on the shaft 14; and the movable portion 21c is retained at the closing position by the load of the torsion coil spring 15. In addition, embodiment 2 is the same as embodiment 1 also in that the movable portion 21c is moved from the closing position to the opening position by increase in the internal pressure of the storage box 91 at the time of current interruption. In addition, embodiment 2 is the same as embodiment 1 also in that the movable portion 21c is restored to the closing position after pressure release, although there are no influences of elastic deformation and elastic force as in the pressure release sheet 11 in embodiment 1. When the load F generated by the torsion coil spring 15 and the gravitational force FG (not shown in FIG. 9 and FIG. 10) become higher than the load P (not shown in FIG. 9 and FIG. 10) generated by the internal pressure of the storage box 91, the pressure release sheet 21 which is at the opening position is restored to the closing position by the load F and the gravitational force FG.

[0043] The movable portion 21c has an upper end having, on a side thereof opposed to the storage box 91, a corner that is cut, whereby the corner is formed as a cut portion 21f resulting from eliminating the edge. When the movable portion 21c is moved from the closing position to the opening position, the side of the upper end opposed to the storage box 91 is pressed against the pressure-release-device-mounting portion 91d. At this time, when there is an edge on said side, the edge and a surface on the -x side of the pressure-release-device-mounting portion 91d interfere with each other, whereby smooth movement from the closing position to the opening position might be hindered. However, since the cut portion 21f is formed, the cut portion 21f is moved so as to slide on the surface on the -x side of the pressure-release-device-mounting portion 91d. Therefore, smooth movement of the movable portion 21c from the closing position to the opening position is not hindered.

[0044] The other features are the same as those in embodiment 1, and thus description thereof will be omitted.

[0045] In embodiment 2, the pressure release sheet is made from a metal material or a resin material that has a higher rigidity and that is hardly elastically deformed. Consequently, the flame resistance and the strength of the pressure release sheet can be further increased.

Embodiment 3

[0046] Next, embodiment 3 will be described with reference to FIG. 11. It is noted that portions identical or corresponding to those in FIG. 1 to FIG. 10 are denoted by the same reference characters, and description thereof will be omitted. FIG. 11 is a cross-sectional view, taken along A-A, of a pressure release device in embodiment 3 and shows a state where the pressure release sheet is at the closing position. A pressure release device 30 is obtained by omitting the torsion coil spring 15 from the pressure release device 10 in embodiment 1. In addition, the shaft 14 and the supporting body 13 are also omitted in association with the omission of the torsion coil spring 15. As described above, the deformable portion 11b has elasticity, and thus sealability is obtained to some extent with the pressure release sheet 11 alone. Specifically, when the movable portion 11c is at the closing position, the elastic force of the deformable portion 11b applies a load to the movable portion 11c in such a direction as to retain the movable portion 11c at the closing position. Meanwhile, as is known from FIG. 8, when the movable portion 11c is at the opening position, the elastic force of the deformable portion 11b applies a load to the movable portion 11c in such a direction as to restore the movable portion 11c to the closing position. Thus, an operation of restoration from the opening position to the closing position is realized by the load due to the elastic force of the deformable portion 11b and the gravitational force FG without the load F of the torsion coil spring 15.

[0047] The other features are the same as those in embodiment 1, and thus description thereof will be omitted.

[0048] In embodiment 3, the torsion coil spring, the shaft, and the supporting body are omitted, whereby the configuration of the pressure release device can be further simplified, and the weight of the pressure release device can be further decreased.

Embodiment 4

[0049] Next, embodiment 4 will be described with reference to FIG. 12. It is noted that portions identical or corresponding to those in FIG. 1 to FIG. 12 are denoted by the same reference characters, and description thereof will be omitted. FIG. 12 is a front view of a pressure release device in embodiment 4. A pressure release device 40 has a cover 42 obtained by omitting the handle portion 12a from the cover 12 in embodiment 1.

[0050] The other features are the same as those in embodiment 1, and thus description thereof will be omitted.

[0051] In embodiment 4, the handle is omitted from the cover, whereby the cover is downsized. Therefore, it is possible to downsize the pressure release device and further decrease the weight of the pressure release device.

[0052] Although the disclosure is described above in terms of various exemplary embodiments and implementations, it should be understood that the various features, aspects, and functionality described in one or more of the individual embodiments are not limited in their applicability to the particular embodiment with which they are described, but instead can be applied, alone or in various combinations to one or more of the embodiments of the disclosure.

[0053] It is therefore understood that numerous modifications which have not been exemplified can be devised without departing from the scope of the present disclosure. For example, at least one of the constituent components may be modified, added, or eliminated. At least one of the constituent components mentioned in at least one of the preferred embodiments may be selected and combined with the constituent components mentioned in another preferred embodiment.

DESCRIPTION OF THE REFERENCE CHARACTERS

[0054]

10, 10A, 10B, 20, 30, 40 pressure release device
11, 111, 112, 21 pressure release sheet
11a U-shaped slit
11b, 111b, 112b deformable portion
11c, 111c, 112c, 21c movable portion
11d, 111d, 112d fixation portion
11f1, 11f2 linear slit
12, 42 cover
12a handle portion
12b, 12c opening
12d lower end portion
13 supporting body
13a side portion
13aa through hole
13b bottom portion
13c raised portion
14 shaft
15 torsion coil spring
15a winding portion
15b pressing portion
15c end portion
21f cut portion
27 arm
91 storage box
91Aa, 91Ab side wall
91c pressure release hole
91d pressure-release-device-mounting portion
100 switch
1000 switchgear
F load
FG gravitational force
FE elastic force
FK load
P load

Claims

1. A storage box for storing therein a switch, the storage box comprising:

a side wall;
a pressure release hole which is formed in the side wall and through which an internal pressure of the storage box is released; and
a pressure release device, for the switch, which is mounted on the side wall, wherein
the pressure release device for the switch includes a pressure release sheet having

a movable portion movable between a closing position at which the pressure release hole is closed and an opening position at which the pressure release hole is opened, and
a deformable portion which is elastically deformable and which is deformed according to movement of the movable portion, and

an elastic force of the deformable portion applies, when the movable portion is at the opening position, a load to the movable portion in such a direction as to restore the movable portion to the closing position.

2. The storage box according to claim 1, wherein

a first slit portion and a second slit portion opposed to each other are formed in the pressure release sheet, and
the movable portion is formed in a region interposed between the first slit portion and the second slit portion.

3. The storage box according to claim 1, wherein

a U-shaped slit is formed in the pressure release sheet, and
the movable portion is provided within a range enclosed by the U-shaped slit.

4. The storage box according to any one of claims 1 to 3, further comprising
a torsion coil spring which applies, when the movable portion is at the closing position, a load to the movable portion in such a direction as to retain the movable portion at the closing position and applies, when the movable portion is at the opening position, a load to the movable portion in such a direction as to restore the movable portion to the closing position.

5. The storage box according to claim 4, wherein

the movable portion is a movable portion which is rotated with one end thereof being a central axis of rotation,
a supporting body fixed to the side wall at both sides thereof in a direction of the central axis, and a shaft supported by the supporting body by penetrating through through-holes formed in the supporting body, are further provided, and
the torsion coil spring is fixed to the shaft.

6. A storage box for storing therein a switch, the storage box comprising:

a side wall;
a pressure release hole which is formed in the side wall and through which an internal pressure of the storage box is released; and
a pressure release device, for the switch, which is mounted on the side wall, wherein
the pressure release device for the switch includes

a pressure release sheet having a movable portion which is rotated with one end thereof being a central axis of rotation and which is movable between a closing position at which the pressure release hole is closed and an opening position at which the pressure release hole is opened,
a supporting body fixed to the side wall at both sides thereof in a direction of the central axis,
a shaft supported by the supporting body by penetrating through through-holes formed in the supporting body, and
a torsion coil spring which is fixed to the shaft and which applies, when the movable portion is at the closing position, a load to the movable portion in such a direction as to retain the movable portion at the closing position and applies, when the movable portion is at the opening position, a load to the movable portion in such a direction as to restore the movable portion to the closing position,

the pressure release sheet includes

a plate-shaped portion having a flat plate shape and
an arm provided to one end of the plate-shaped portion and having a hole into which the shaft is fitted, and

an entirety of the pressure release sheet is rotated together with the shaft.

7. The storage box according to claim 5 or 6, wherein the torsion coil spring includes

two winding portions through which the shaft penetrates, and
a pressing portion which is formed in a U shape and connected to one end of each of the two winding portions and which applies a load to the movable portion.

8. The storage box according to claim 7, wherein

the supporting body has two plate-shaped members each bent into an L shape,
each of the two plate-shaped members has

a side portion which is perpendicular to the central axis and in which a corresponding one of the through-holes is formed,
a bottom portion perpendicular to the side portion, and
a raised portion formed by raising a part of the bottom portion to the shaft side, the part being located on a side close to the movable portion,

with respect to the direction of the central axis, a corresponding one of the winding portions is sandwiched between the raised portion and the movable portion, and,
between the raised portion and the shaft, a gap having a width smaller than a thickness of a winding forming the winding portion is present.

9. The storage box according to claim 6, wherein
the pressure release sheet has an upper end having, on the side wall side thereof, a corner that is cut.

10. The storage box according to any one of claims 1 to 9, further comprising
a cover covering an upper portion and a side portion of the pressure release sheet and having a lower

end in which an opening is formed.

11. The storage box according to claim 7 or 8, further comprising

a cover covering an upper portion and a side portion of the pressure release sheet and having a lower end in which an opening is formed, wherein
the pressing portion is in contact with an inner surface of the cover when the movable portion is at the opening position.

12. The storage box according to claim 10 or 11, wherein the cover has an upper portion at which a handle portion capable of being gripped is integrally provided.

13. The storage box according to any one of claims 1 to 12, wherein,

in an ordinary state, the movable portion is retained at the closing position,
when the internal pressure of the storage box is increased through a current interruption operation of the switch and becomes higher than a predetermined first pressure, the movable portion is moved to the opening position so as to release the pressure, and,
when the pressure becomes lower than a predetermined second pressure, the movable portion is restored to the closing position.

14. A switchgear comprising:

the storage box according to any one of claims 1 to 13; and
a switch stored in the storage box.

FIG. 1

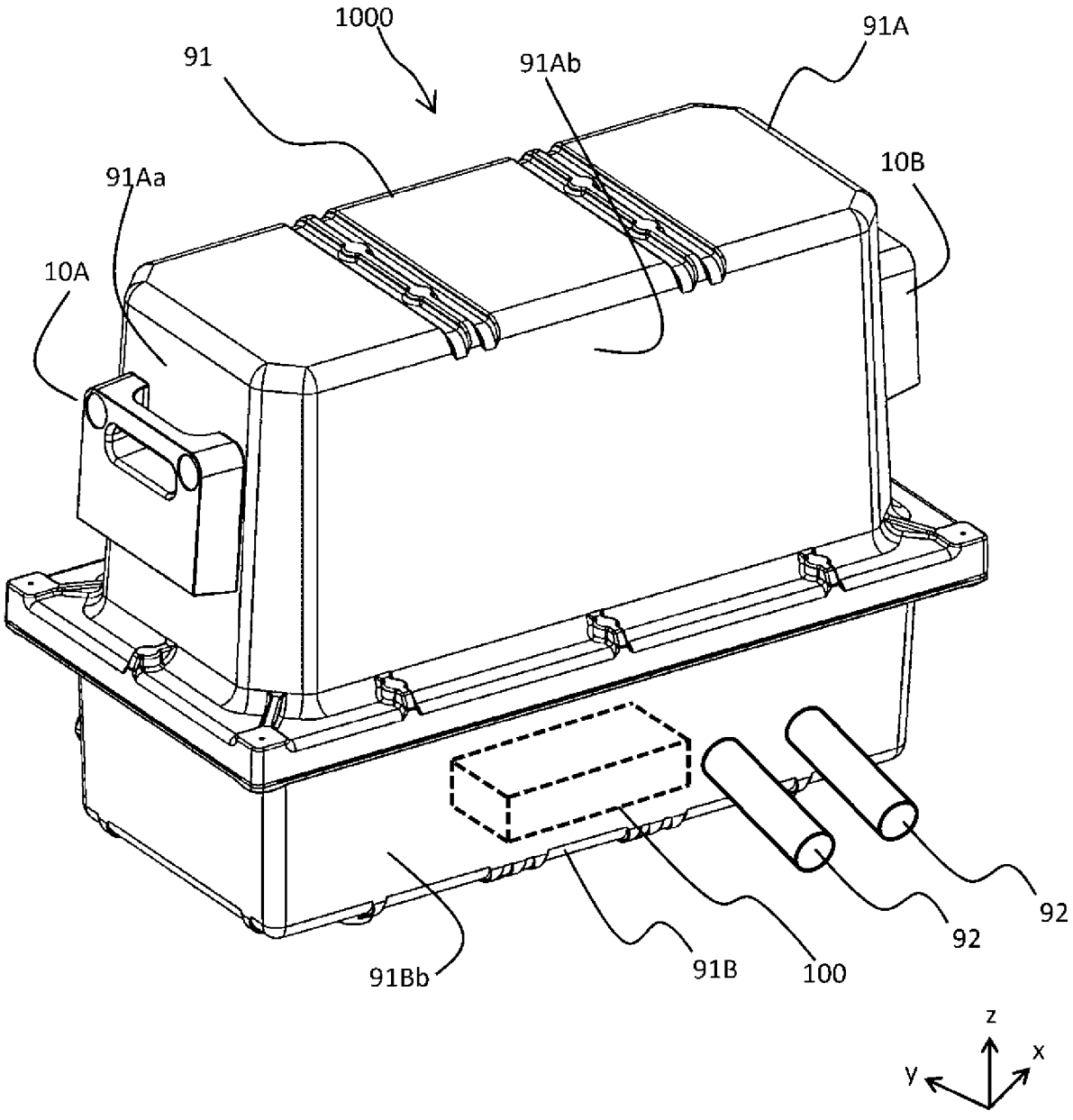
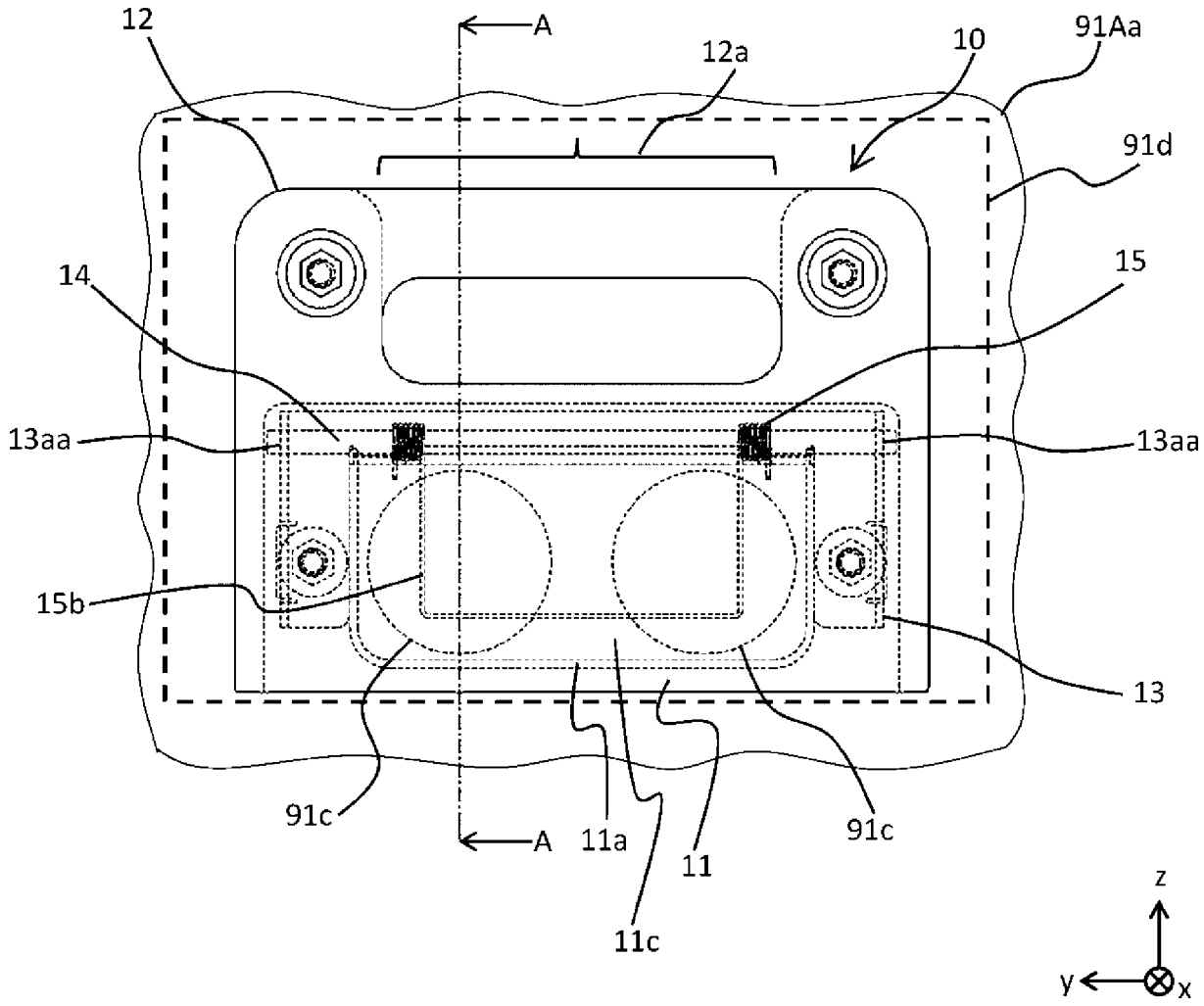


FIG. 2


12
A
12a
10
91Aa
91d
14
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13aa
15b
13
91c
A
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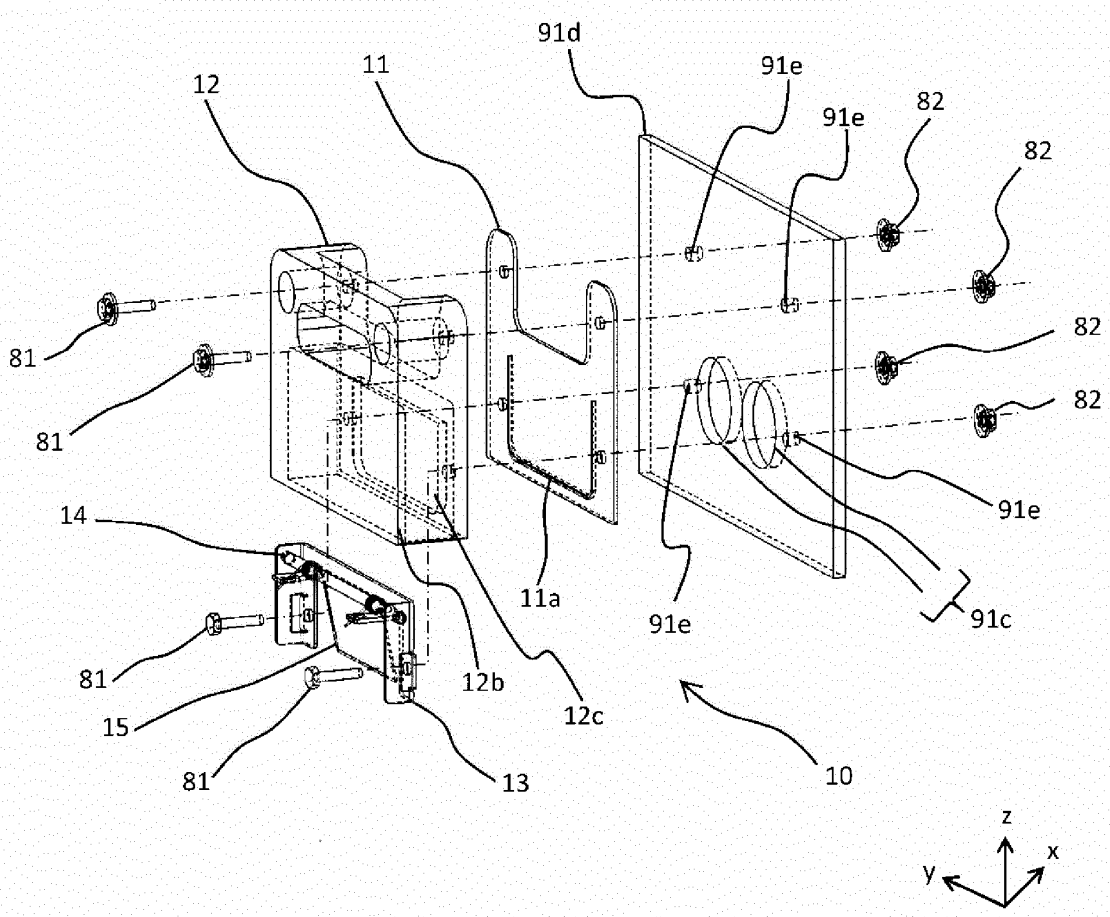
11
91c
11c
z
y
x

FIG. 3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81
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15
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13
10
z
y
x

FIG. 4A

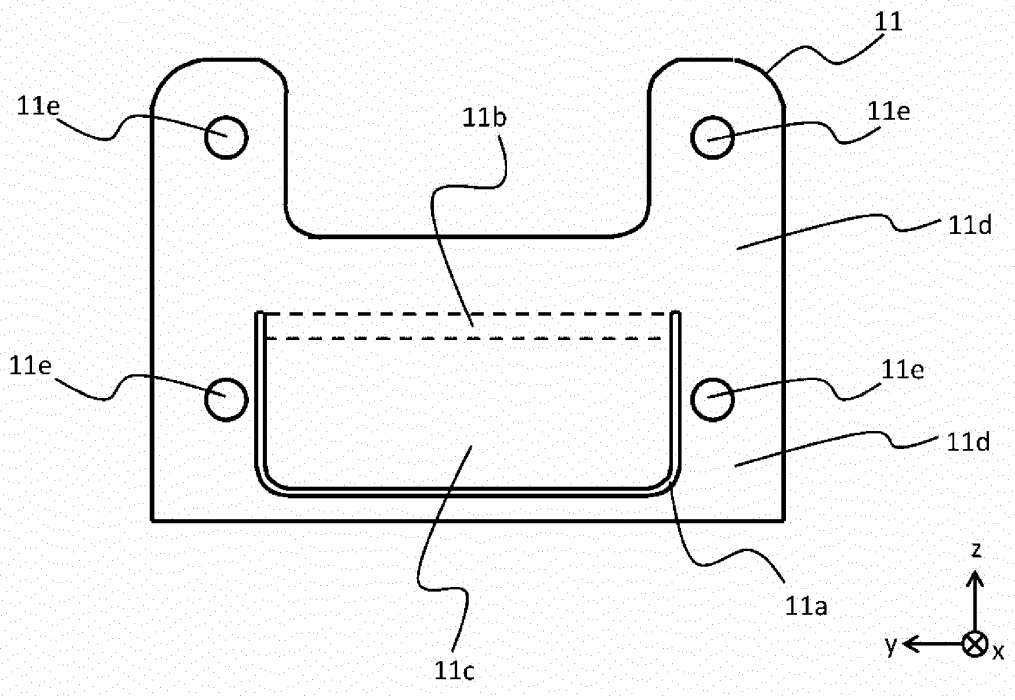
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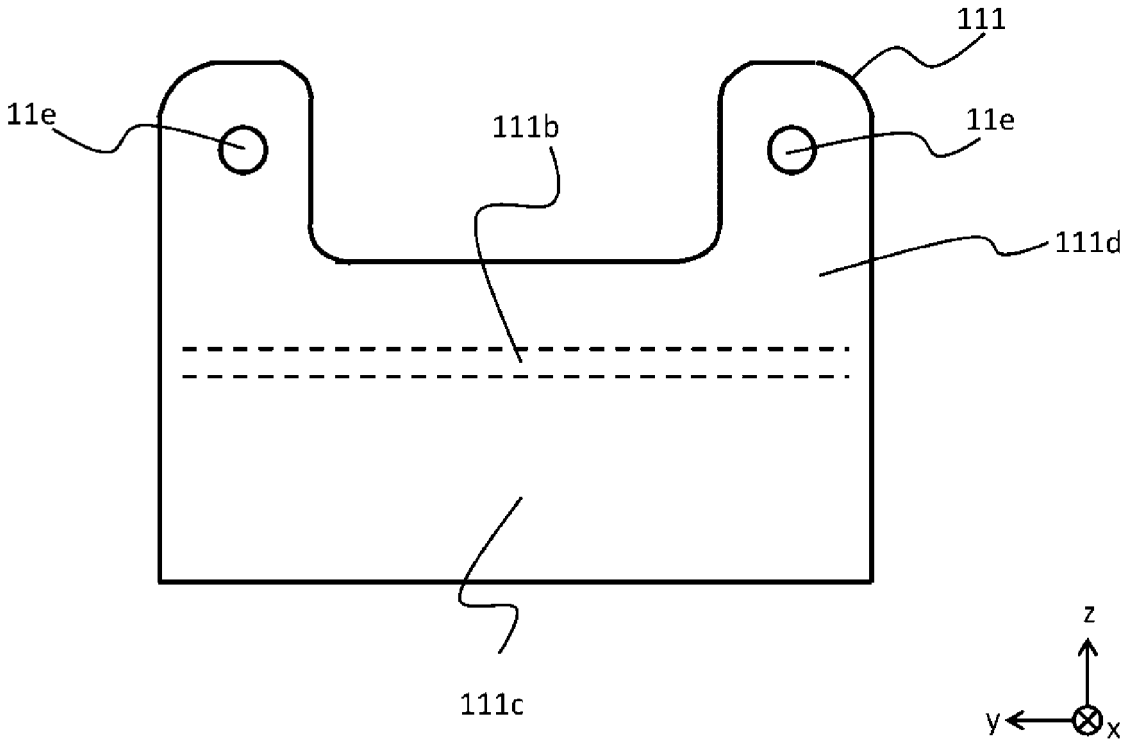
FIG. 4B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111c
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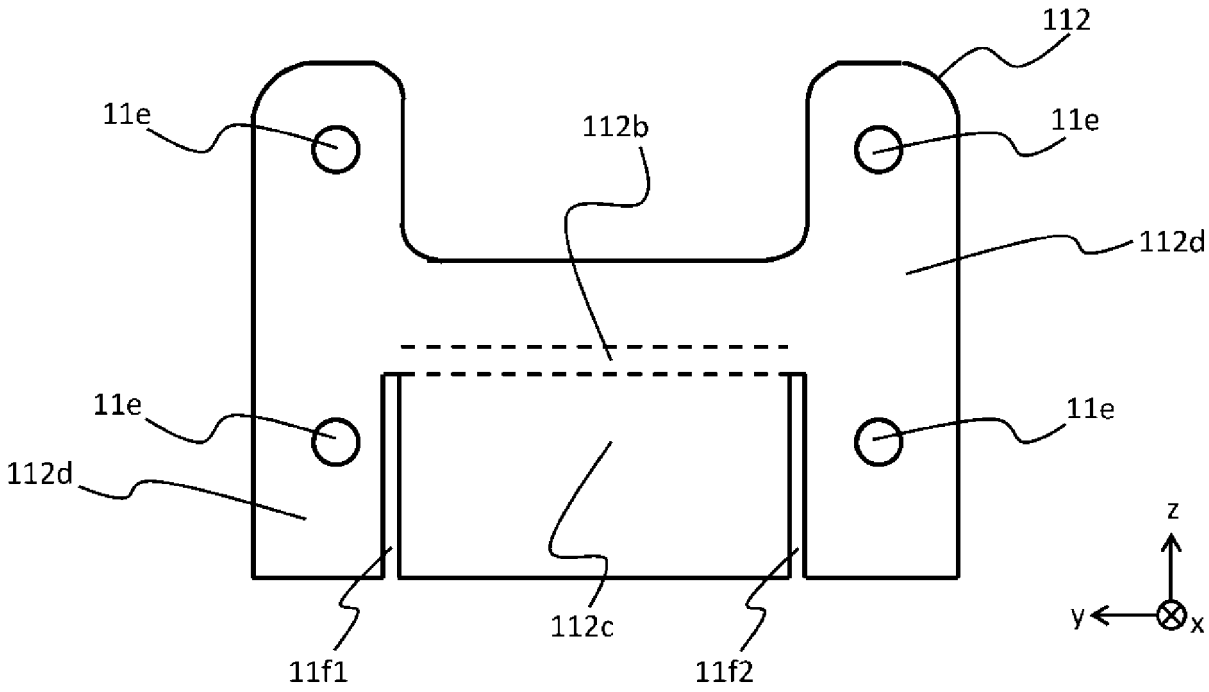
FIG. 4C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11f1
112c
11f2

FIG. 5

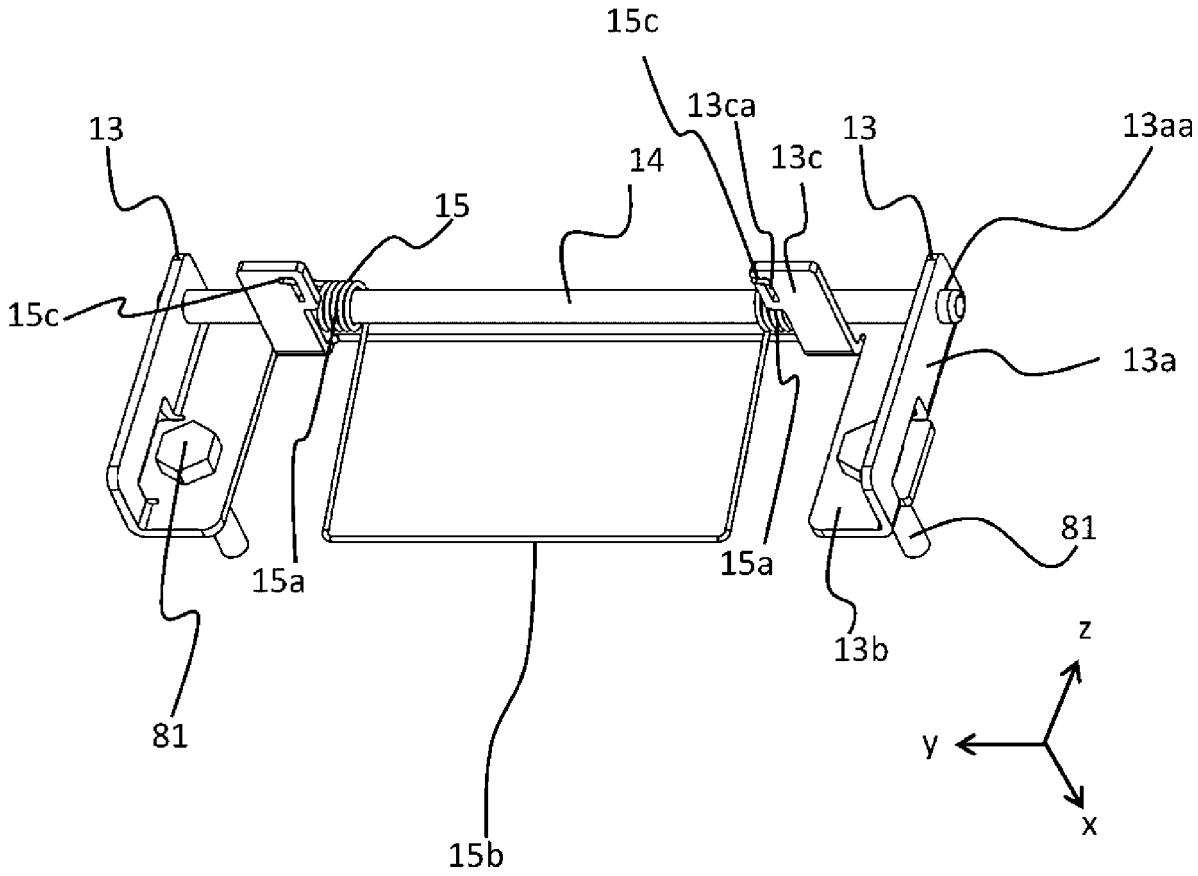
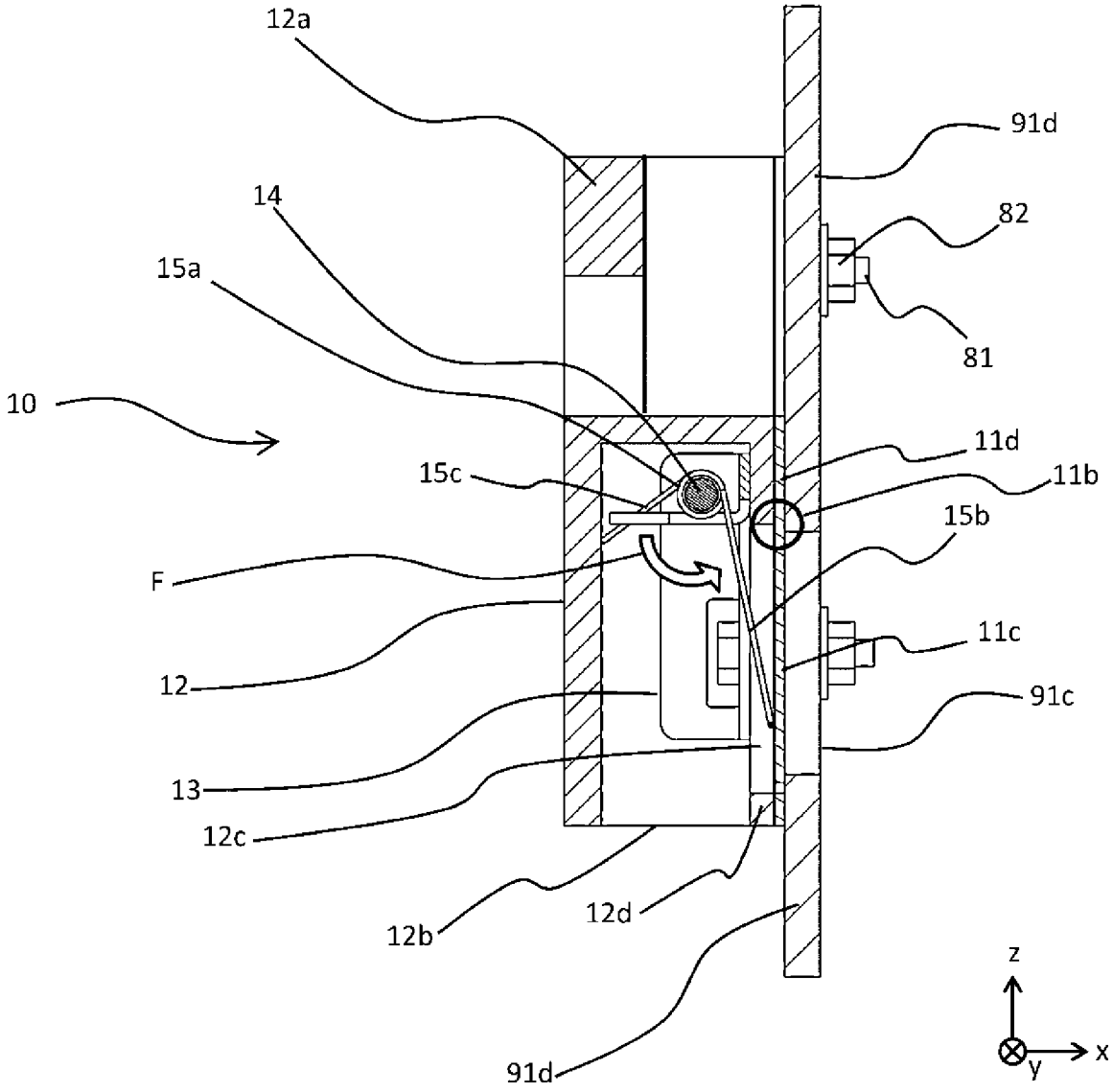


FIG. 6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91d
14
82
15a
81
10
11d
15c
11b
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F
11c
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91c
13
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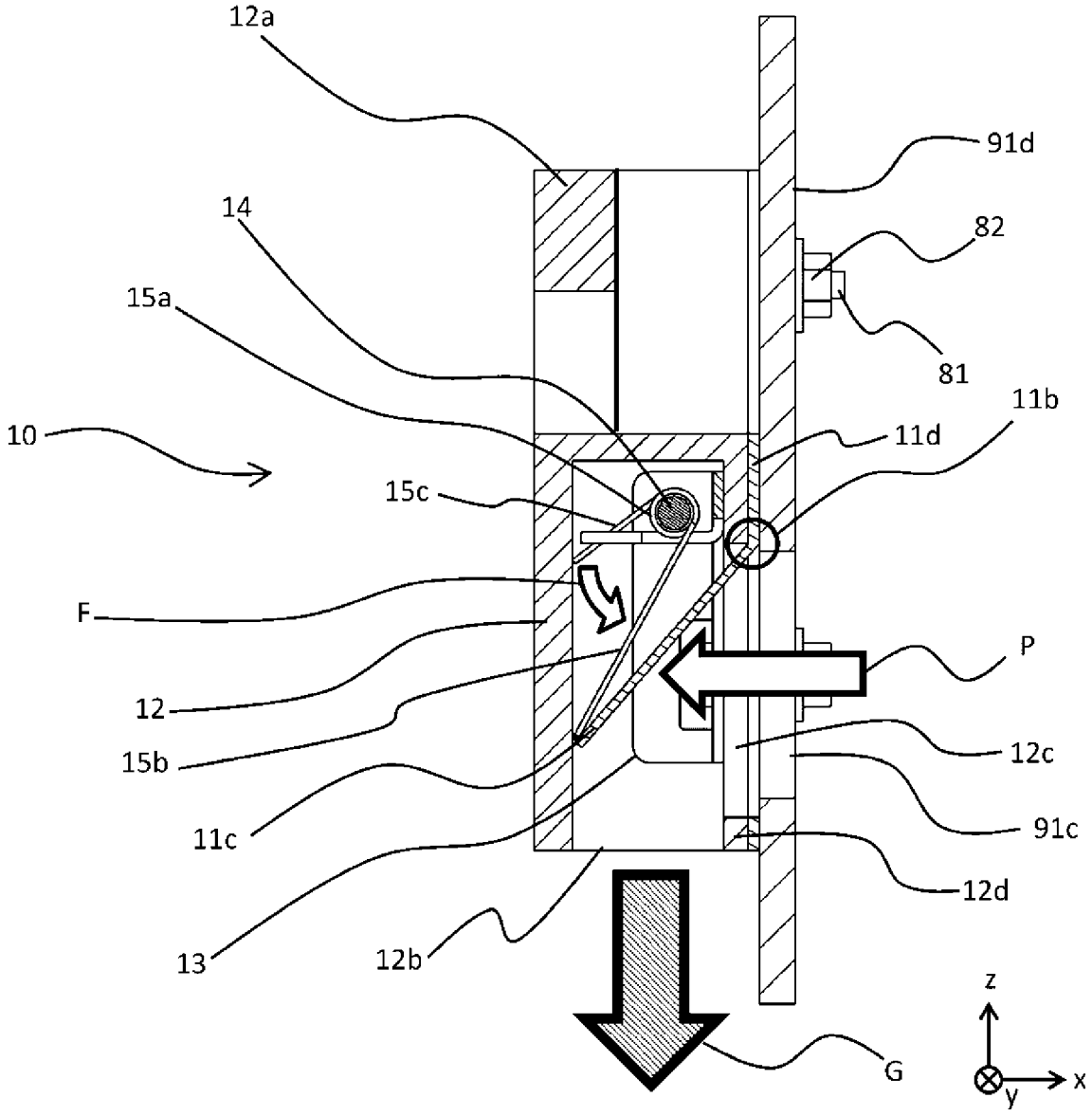
12b
12d
91d
z
x
y

FIG. 7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13
12b
G
z
x
y

FIG. 8

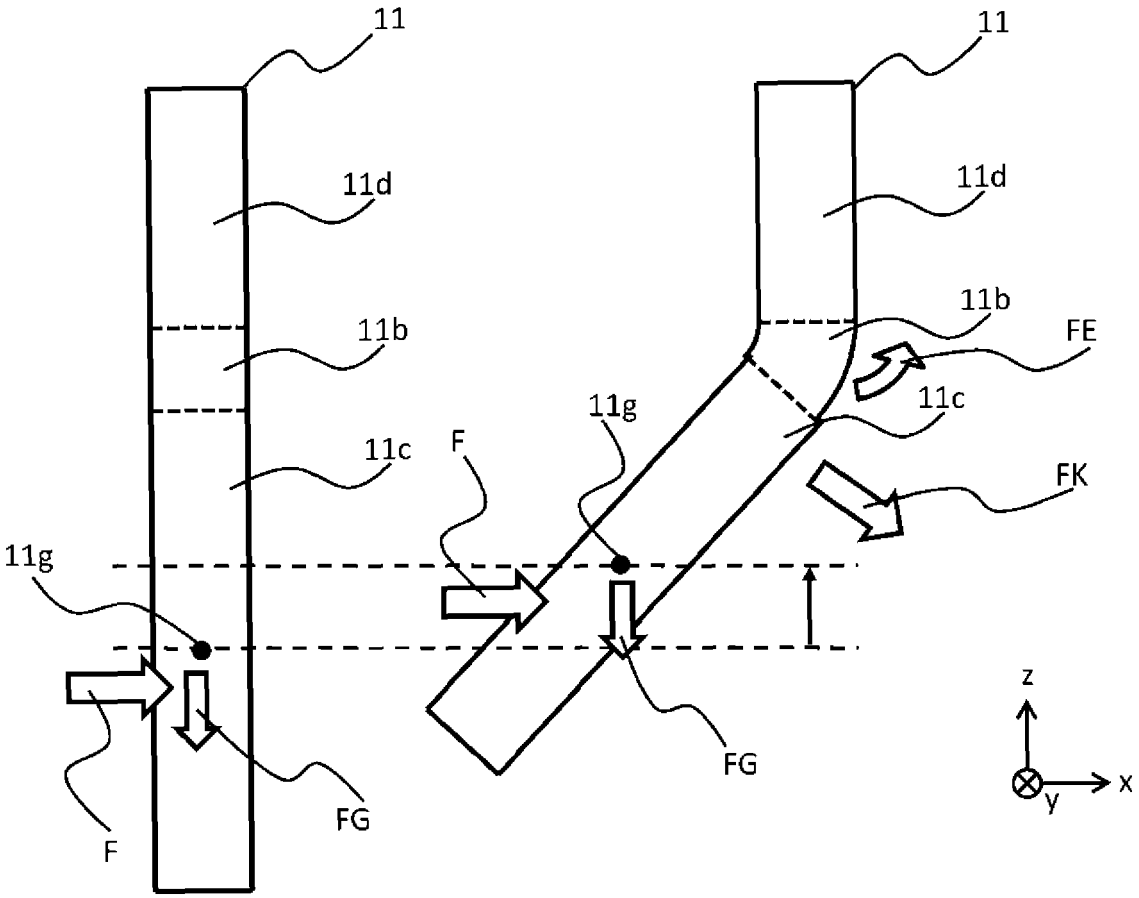
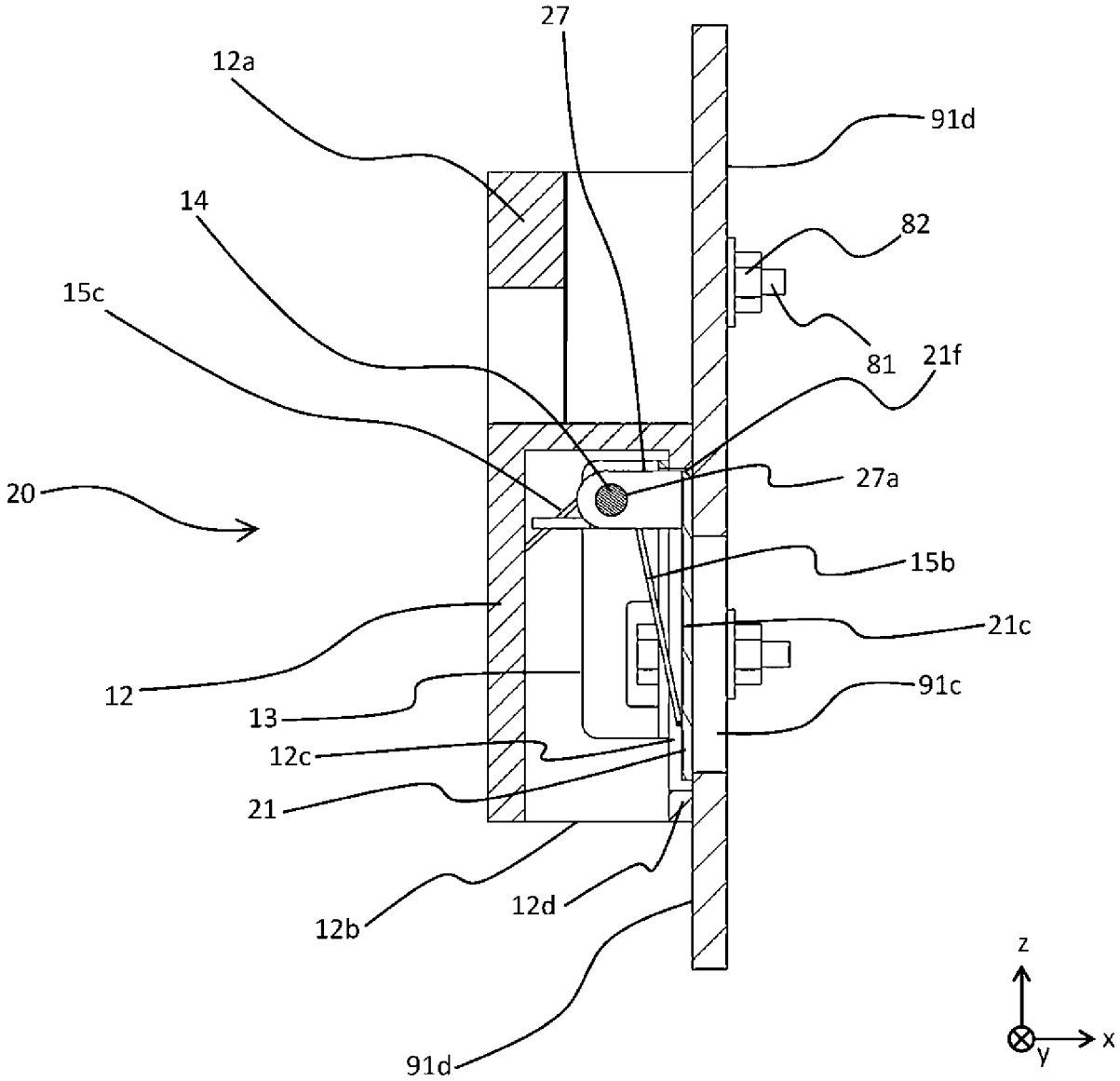


FIG. 9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91d
14
82
15c
81
21f
20
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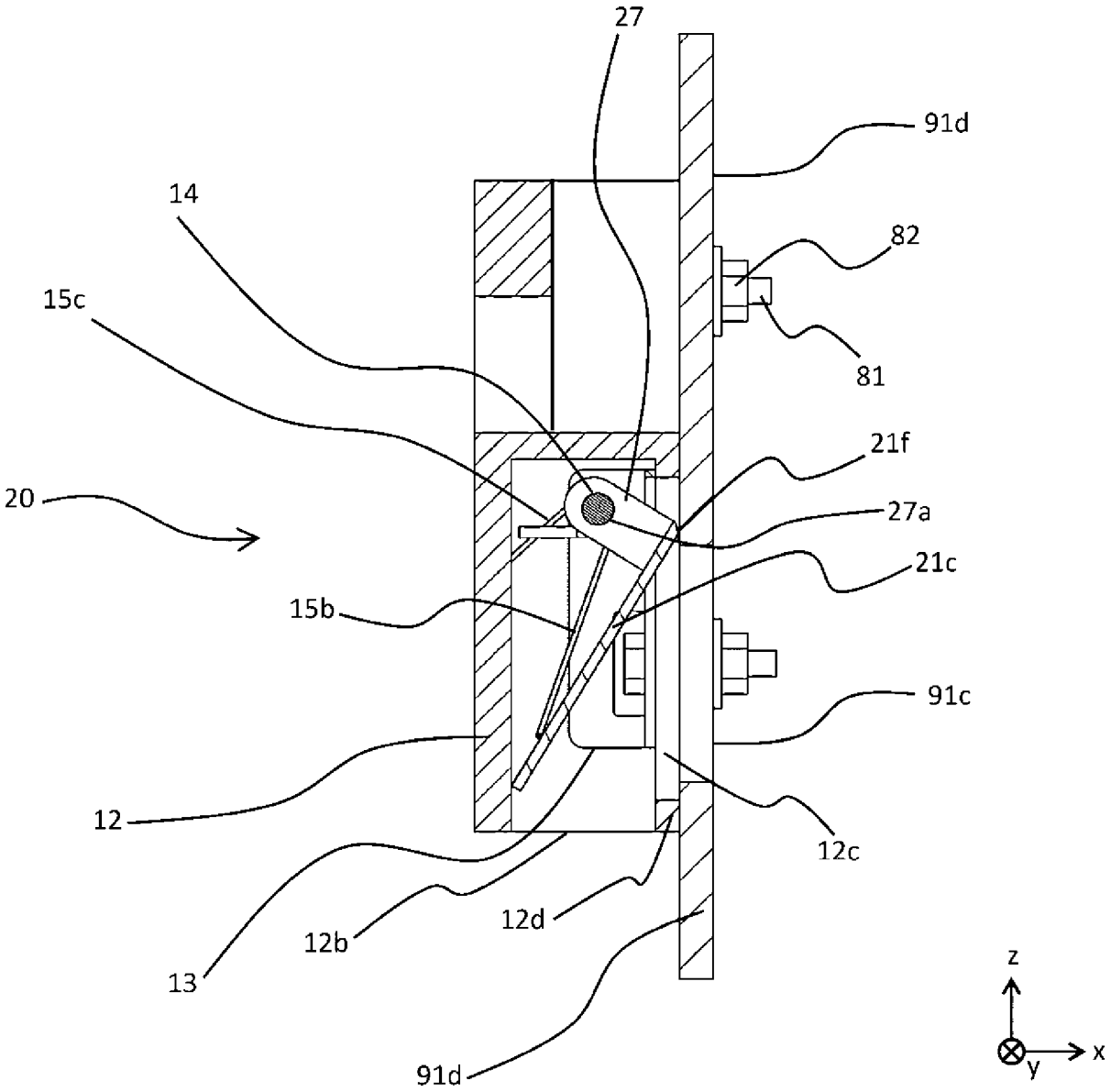
15b
21c
12
13
91c
12c
21
12b
12d
91d
z
x
y

FIG. 10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91d
14
82
15c
81
21f
20
27a
21c
15b
91c
12
12c
12b
12d
13
91d
z
x
y

FIG. 11

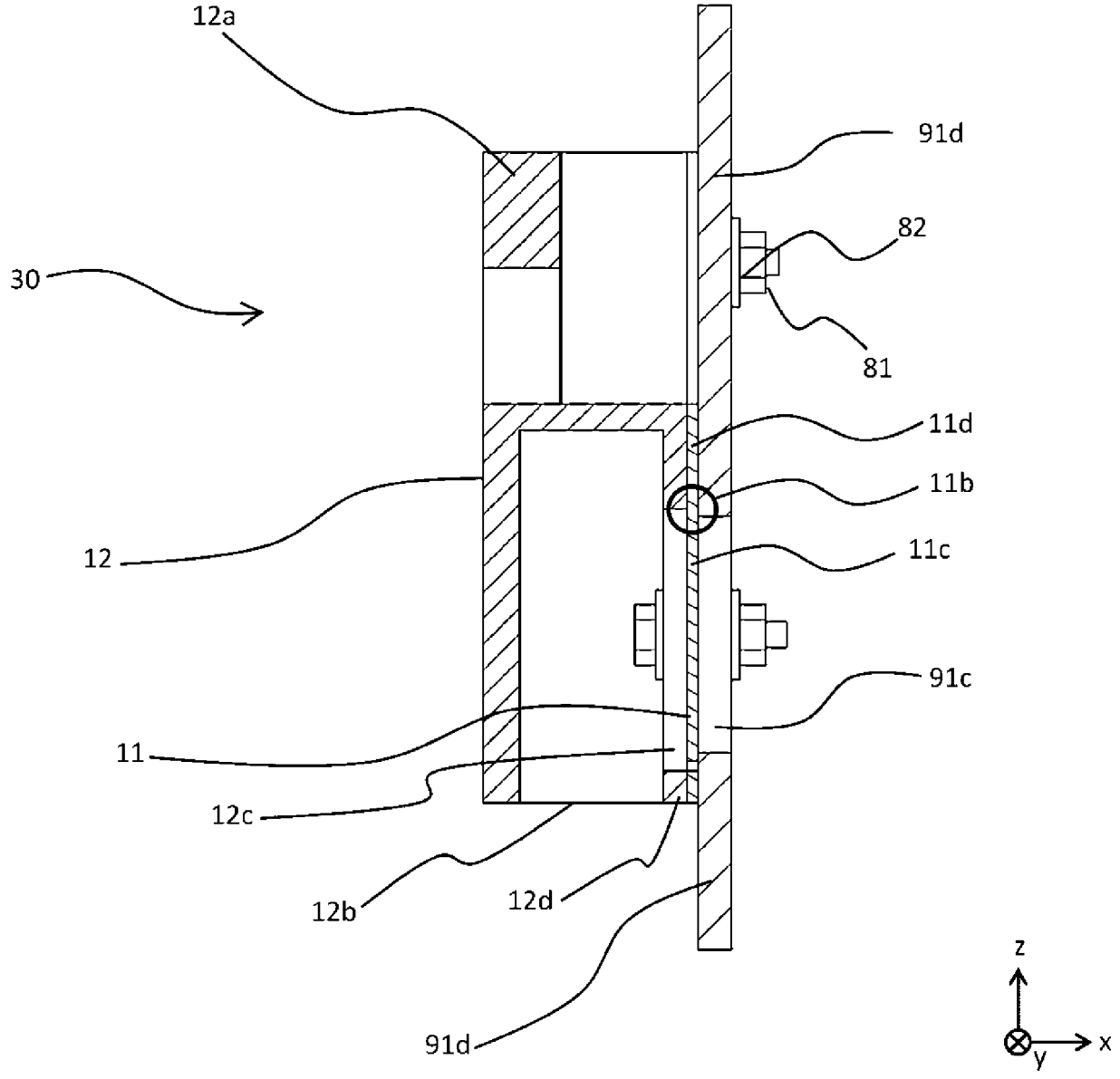
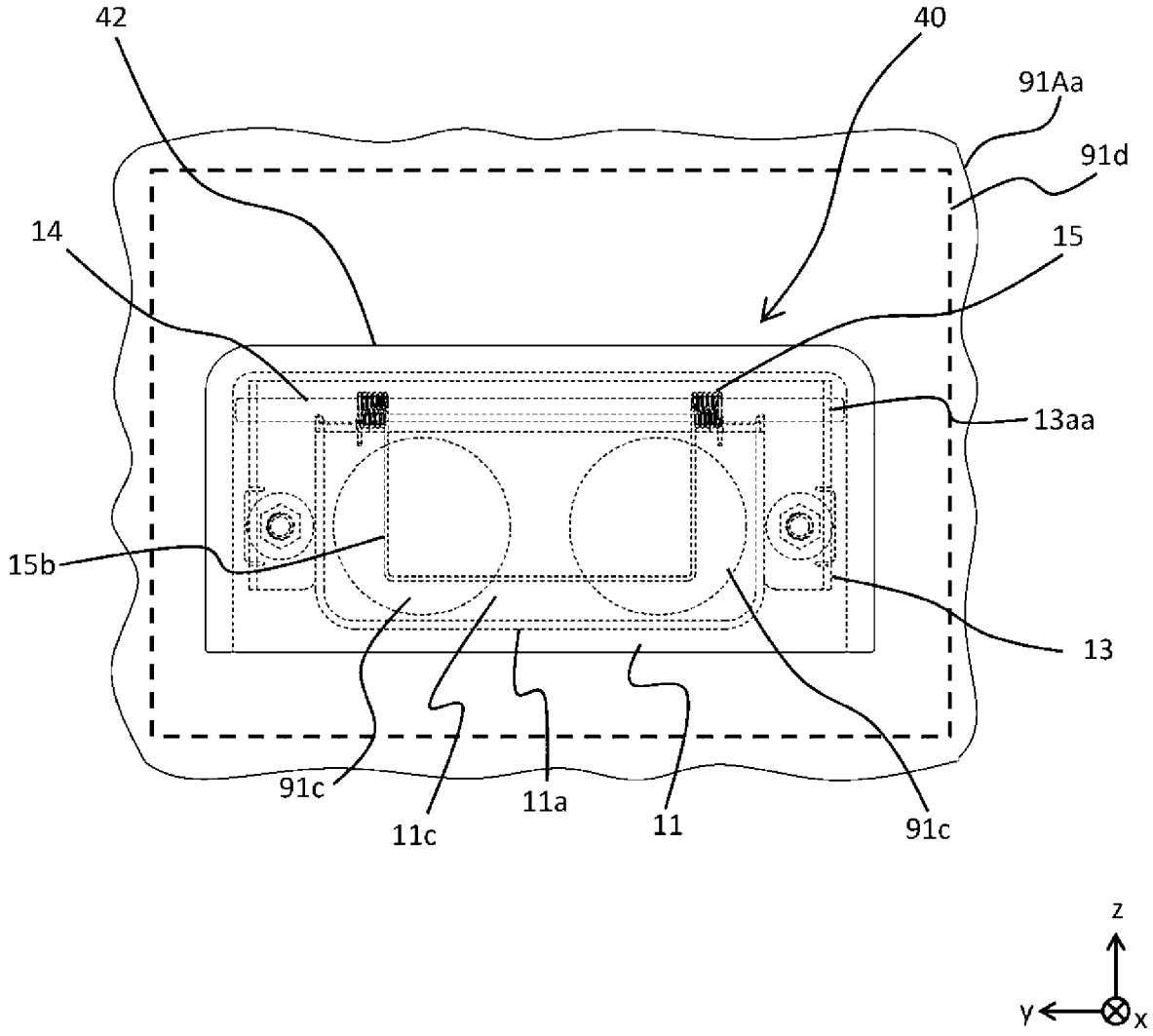


FIG. 12



INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2022/006520

A. CLASSIFICATION OF SUBJECT MATTER

H01H 33/53(2006.01)i; ***H01H 33/575***(2006.01)i; ***H02B 13/025***(2006.01)i; ***H02B 1/28***(2006.01)i
FI: H02B1/28 G; H01H33/53 A; H01H33/575 Z; H02B13/025 A

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)

H01H33/53; H01H33/575; H02B13/025; H02B1/28

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

Published examined utility model applications of Japan 1922-1996
Published unexamined utility model applications of Japan 1971-2022
Registered utility model specifications of Japan 1996-2022
Published registered utility model applications of Japan 1994-2022

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

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	JP 2005-129347 A (TOKO ELECTRIC CORP) 19 May 2005 (2005-05-19) paragraphs [0025], [0026], fig. 1, 2	1
Y		2-5, 7, 10, 13, 14
A		6, 8, 9, 11, 12
Y	US 6407331 B1 (EATON CORPORATION) 18 June 2002 (2002-06-18) fig. 2	2-5, 7, 10, 13, 14
Y	JP 54-003241 A (MEIDENSHA ELECTRIC MFG CO LTD) 11 January 1979 (1979-01-11) publication gazette, p. 2, upper left column, line 15 to lower right column, line 4, fig. 3	4-7, 10, 13, 14
Y	JP 40-028109 Y1 (HITACHI LTD, HITACHI ENGINEERING CO., LTD.) 27 September 1965 (1965-09-27) publication gazette, p. 1, right column, lines 18-21, fig. 1, 2	5-7, 10, 13, 14
Y	Microfilm of the specification and drawings annexed to the request of Japanese Utility Model Application No. 018290/1987 (Laid-open No. 127205/1988) (MITSUBISHI ELECTRIC CORP.) 19 August 1988 (1988-08-19), fig. 2	6, 7, 10, 13, 14

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

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

Date of the actual completion of the international search	Date of mailing of the international search report
08 April 2022	**19 April 2022**
Name and mailing address of the ISA/JP **Japan Patent Office (ISA/JP)** **3-4-3 Kasumigaseki, Chiyoda-ku, Tokyo 100-8915** **Japan**	Authorized officer Telephone No.

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INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2022/006520

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	Microfilm of the specification and drawings annexed to the request of Japanese Utility Model Application No. 114105/1979 (Laid-open No. 032905/1981) (MEIDENSHA ELECTRIC MFG CO LTD) 31 March 1981 (1981-03-31), fig. 2-4	10, 13, 14
A	JP 2014-165984 A (TOSHIBA CORP) 08 September 2014 (2014-09-08) entire text, all drawings	1-14
A	Microfilm of the specification and drawings annexed to the request of Japanese Utility Model Application No. 188231/1985 (Laid-open No. 098402/1987) (NISSIN ELECTRIC CO LTD) 23 June 1987 (1987-06-23), entire text, all drawings	1-14
A	Microfilm of the specification and drawings annexed to the request of Japanese Utility Model Application No. 039441/1982 (Laid-open No. 145001/1983) (HITACHI LTD) 29 September 1983 (1983-09-29), entire text, all drawings	1-14
A	Microfilm of the specification and drawings annexed to the request of Japanese Utility Model Application No. 015094/1979 (Laid-open No. 115214/1980) (MEIDENSHA ELECTRIC MFG CO LTD) 14 August 1980 (1980-08-14), entire text, all drawings	1-14
A	JP 2003-263944 A (ENERGY SUPPORT CORP) 19 September 2003 (2003-09-19) entire text, all drawings	1-14

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INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/JP2022/006520

Patent document cited in search report	Publication date (day/month/year)	Patent family member(s)	Publication date (day/month/year)
JP 2005-129347 A	19 May 2005	(Family: none)	
US 6407331 B1	18 June 2002	CA 2377835 A1	
JP 54-003241 A	11 January 1979	(Family: none)	
JP 40-028109 Y1	27 September 1965	(Family: none)	
JP 63-127205 U1	19 August 1988	(Family: none)	
JP 56-032905 U1	31 March 1981	(Family: none)	
JP 2014-165984 A	08 September 2014	(Family: none)	
JP 62-098402 U1	23 June 1987	(Family: none)	
JP 58-145001 U1	29 September 1983	(Family: none)	
JP 55-115214 U1	14 August 1980	(Family: none)	
JP 2003-263944 A	19 September 2003	(Family: none)	

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REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- JP 2003263944 A **[0003]**