(12) UK Patent (19) GB (11) 2579460 (13) B

(45) Date of B Publication 06.07.2022

(54) Title of the Invention: Operation apparatus

(51) INT CL: ***H04Q 9/00*** (2006.01) ***H05K 5/00*** (2006.01) ***H05K 5/02*** (2006.01)

(21) Application No: **2000975.9**

(22) Date of Filing: **29.08.2017**

Date Lodged: **23.01.2020**

(86) International Application Data:
PCT/JP2017/030946 Ja 29.08.2017

(87) International Publication Data:
WO2019/043789 Ja 07.03.2019

(43) Date of Reproduction by UK Office **24.06.2020**

(72) Inventor(s):
Kenichiro Okura
Yoshiteru Murata
Mitsuhiro Sugimura

(73) Proprietor(s):
Mitsubishi Electric Corporation
(Incorporated in Japan)
7-3 Marunouchi 2-chome, Chiyoda-ku,
Tokyo 1008310, Japan

(74) Agent and/or Address for Service:
Mewburn Ellis LLP
Aurora Building, Counterslip, Bristol, BS1 6BX,
United Kingdom

(56) Documents Cited:
JP 2015201788 A **JP 2014192574 A**
JP 2008224905 A **JP 2006293926 A**

(58) Field of Search:
As for published application 2579460 A viz:
INT CL **H04Q, H05K**
Other: **Jitsuoy Shinan Koho 1922-1996, Jitsuyo Shinan Toroku Koho 1996-2017, Kokai Jitsuyo Shinan Koho 1971-2017, Toroku Jitsuyo Shinan Koho 1194-2017**
updated as appropriate

Additional Fields
Other: **WPI, EPODOC**

GB 2579460 B

FIG.1

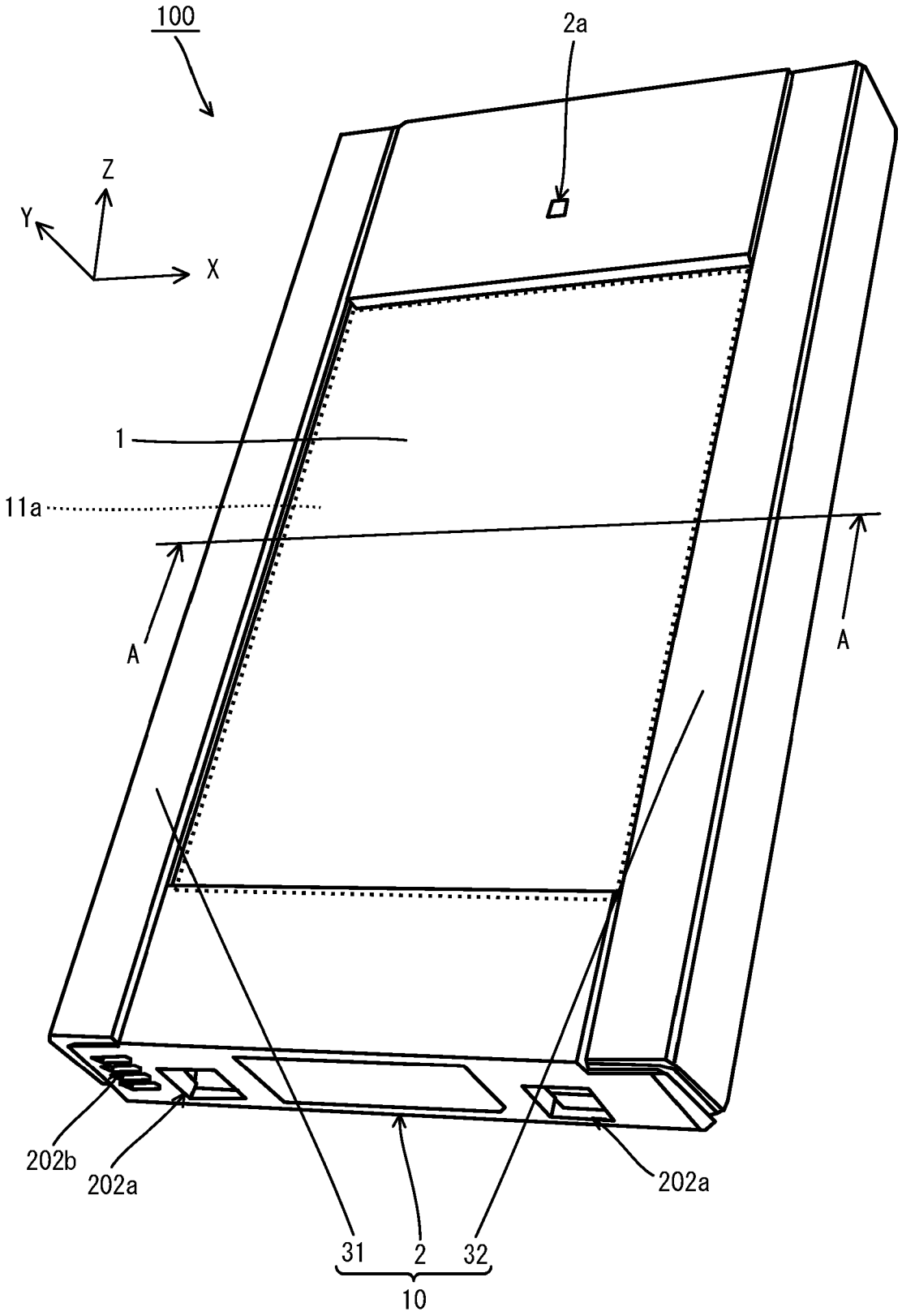


FIG.2

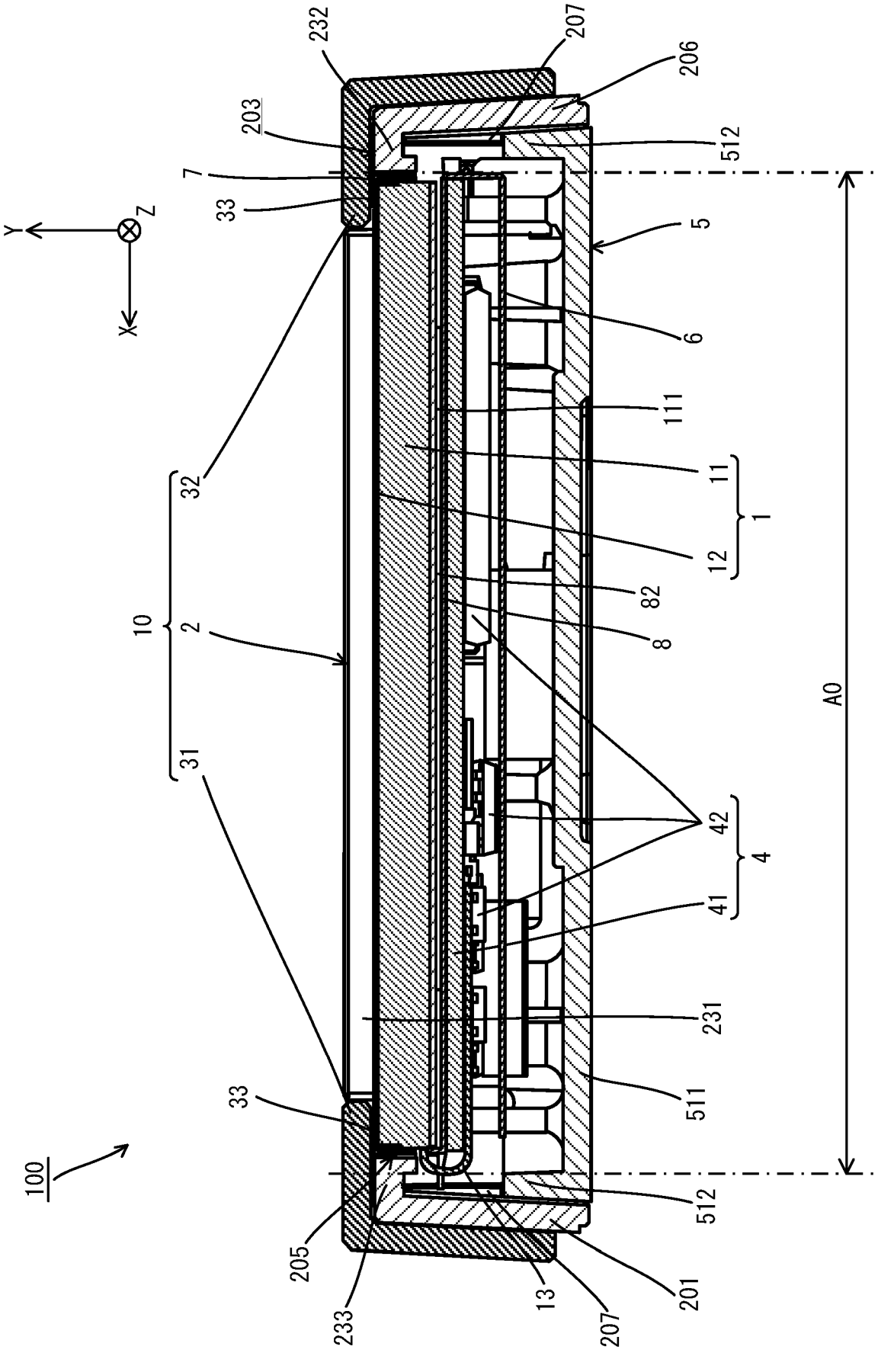

232
207
206
203
512
7
33
5
Y
Z
X
6
111
11
32
1
12
82
10
2
8
31
42
4
41
231
33
511
A0
100
512
205
13
201
233
207

FIG.3

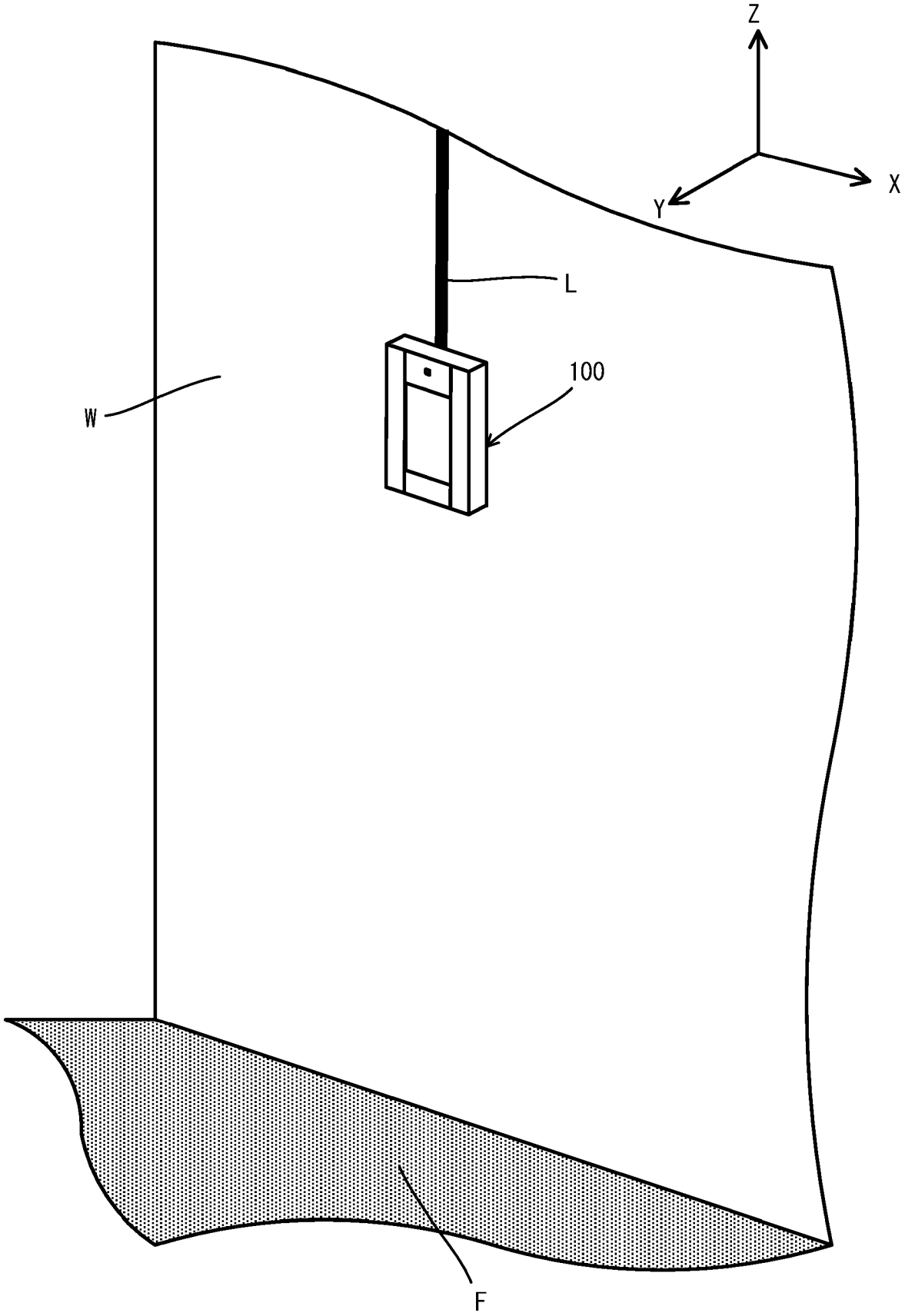


FIG.4A

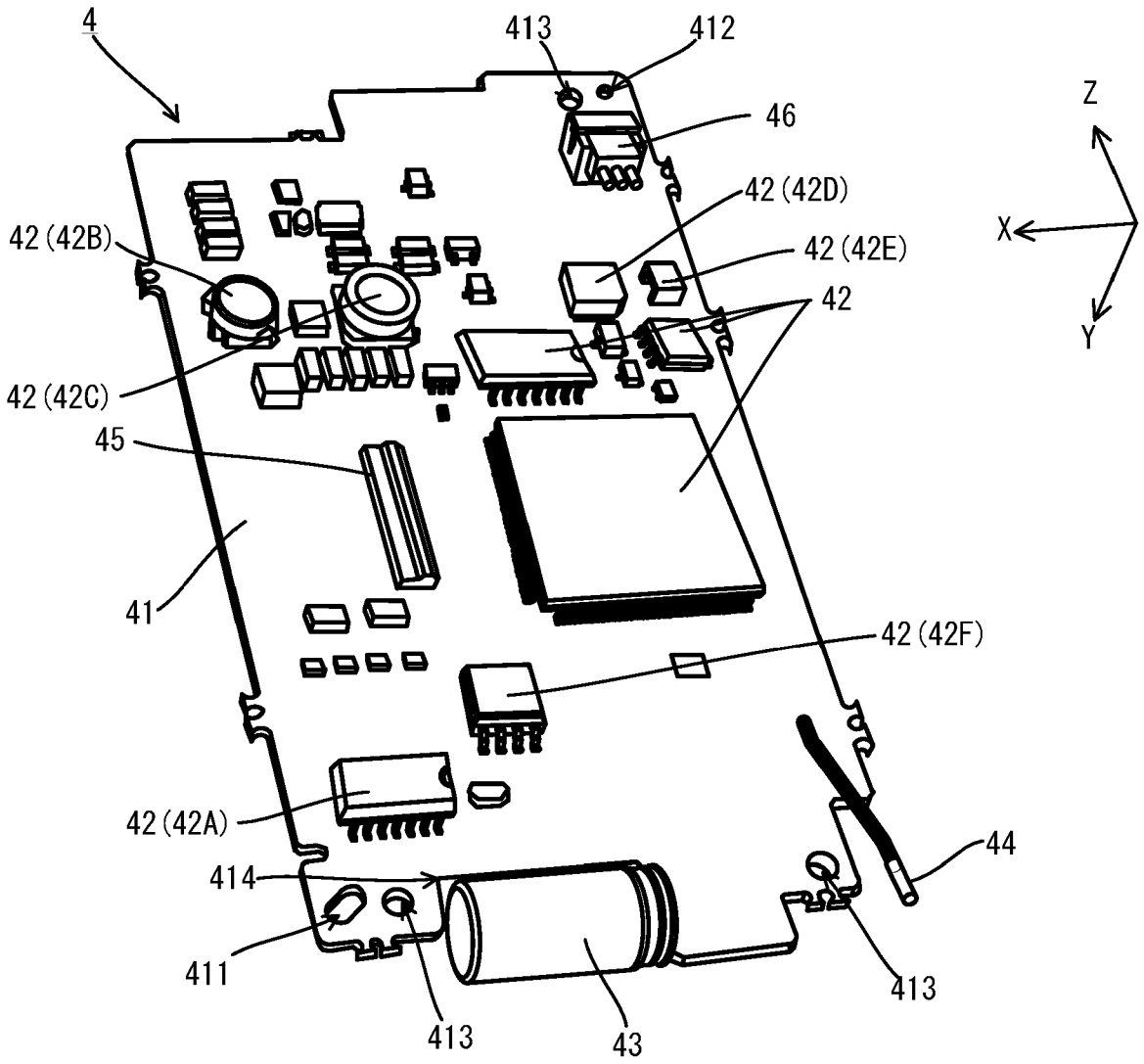

4
413
412
46
42 (42D)
42 (42B)
42 (42E)
42
42 (42C)
45
41
42 (42F)
42 (42A)
414
44
411
413
413
43
Z
X
Y

FIG.4B

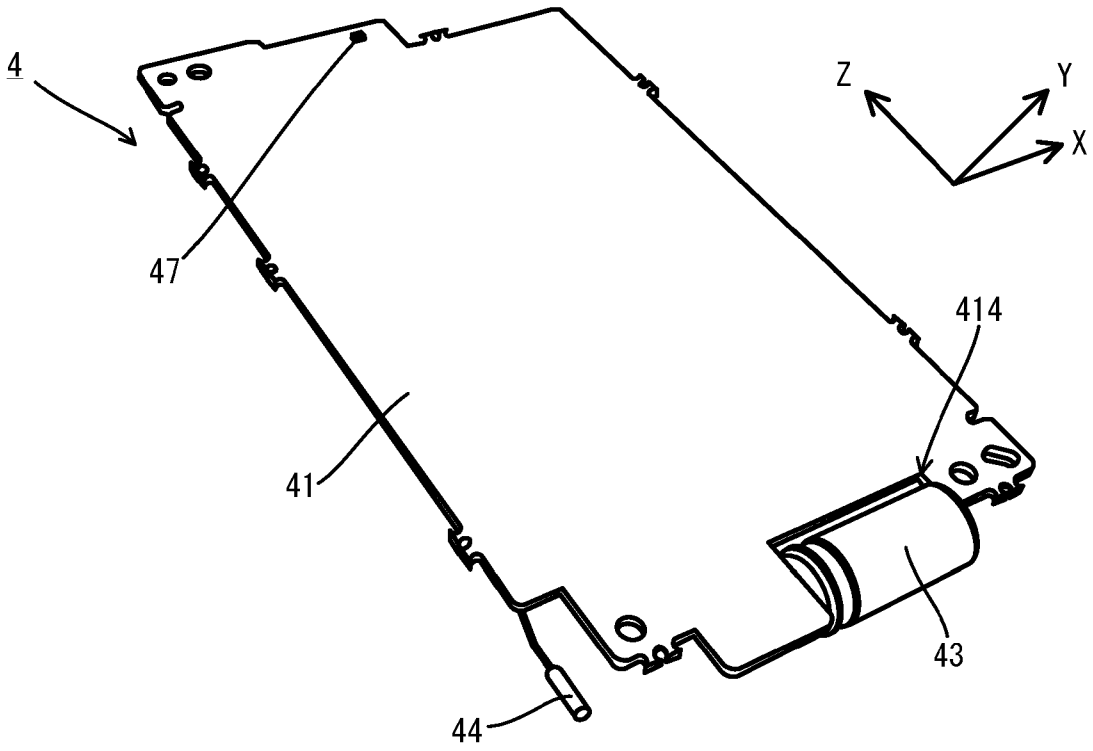


FIG.5A

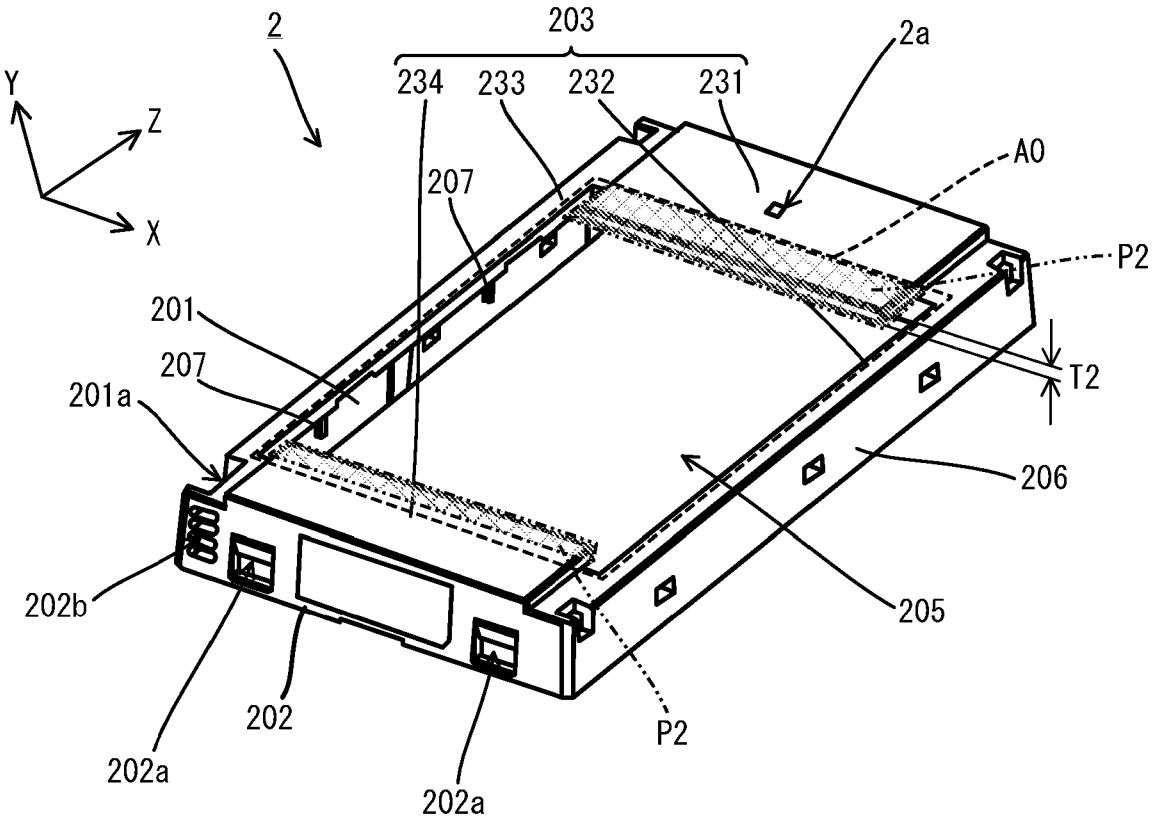

2
203
234
233
232
231
2a
Y
Z
X
207
A0
P2
201
207
T2
201a
206
205
202b
202
202a
P2
202a

FIG.5B

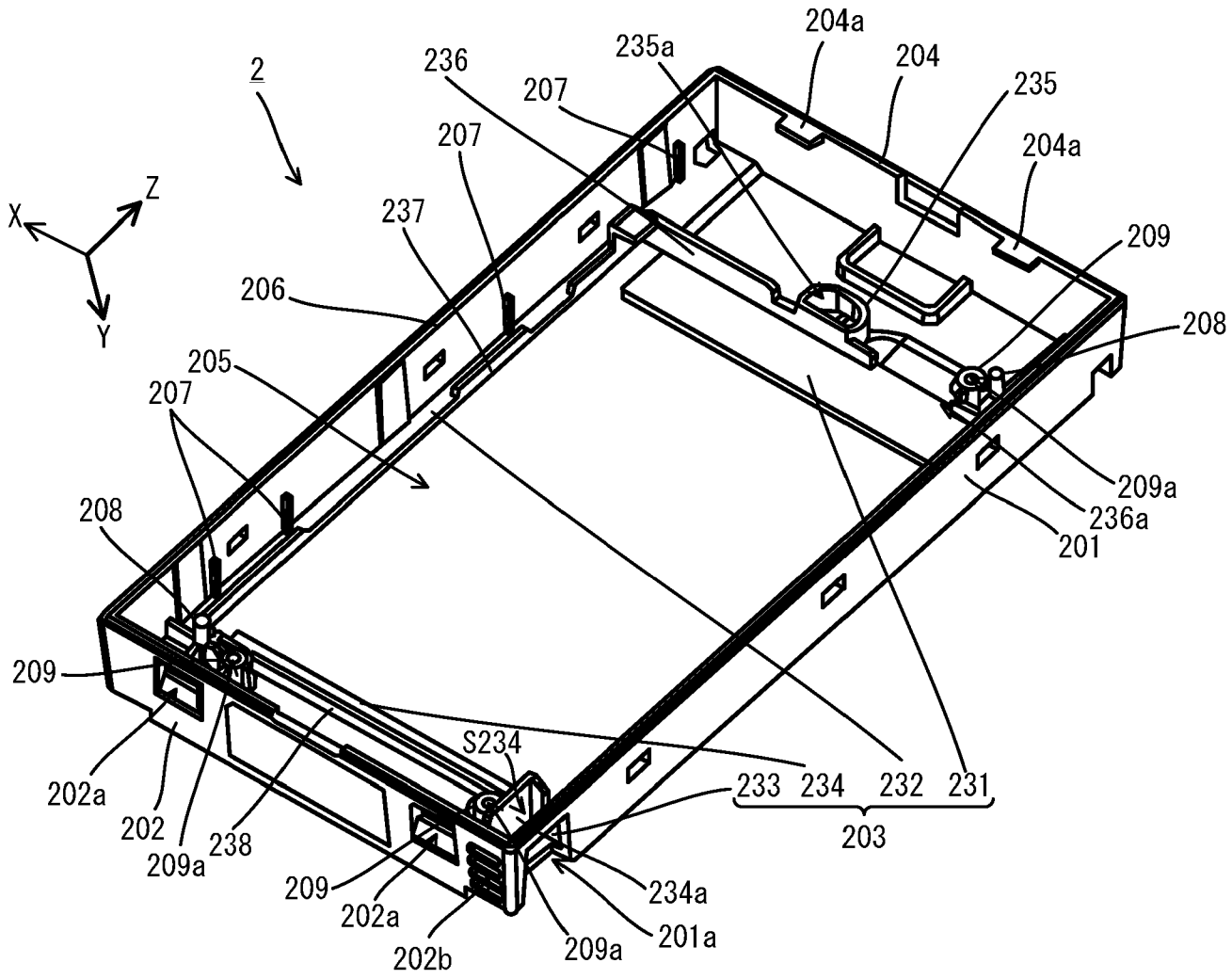

2
X
Z
Y
236
235a
204a
204
235
207
207
204a
237
209
206
208
205
207
209a
236a
208
201
209
S234
233
234
232
231
203
202a
202
209a
238
209
202a
202b
209a
234a
201a

FIG.6A

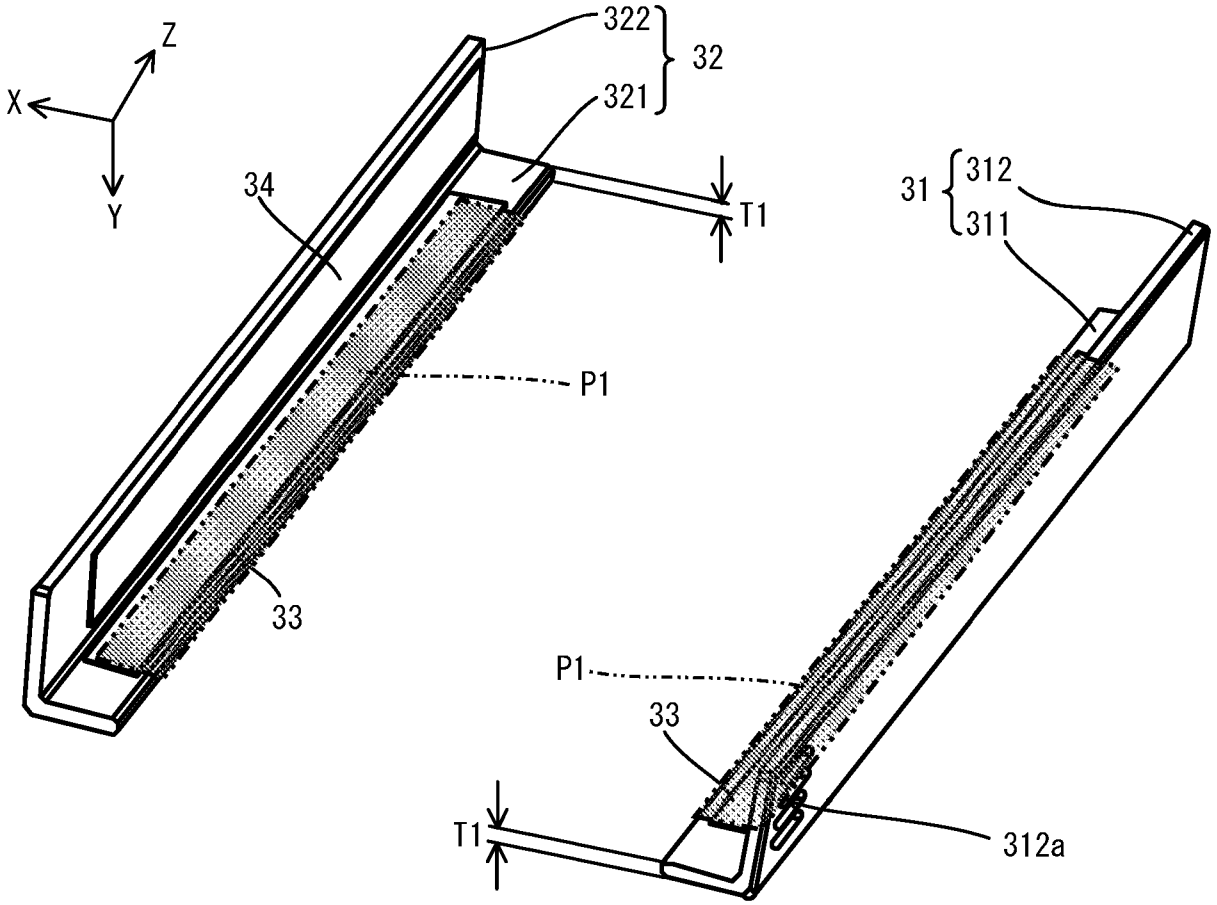


FIG.6B

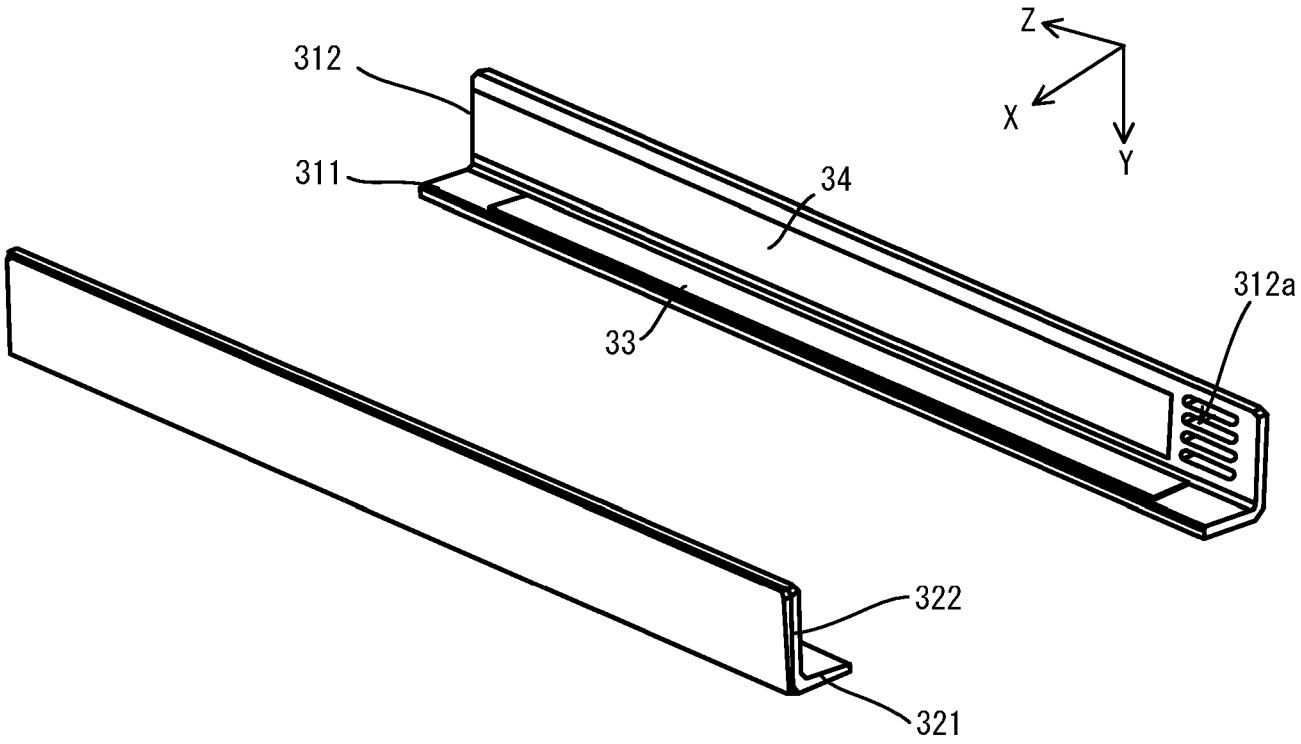


FIG.7A

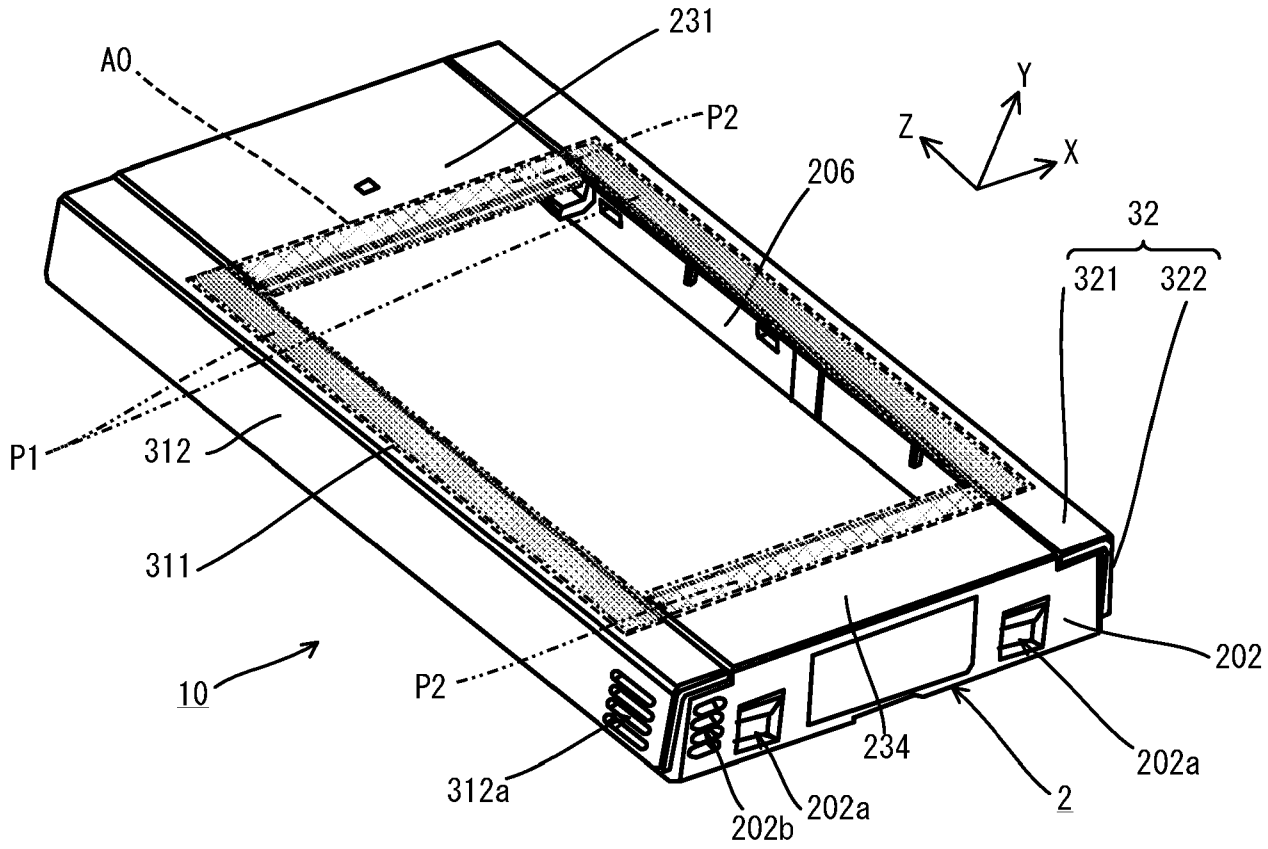

231
A0
P2
Y
Z
X
206
32
321
322
P1
312
311
10
P2
202
234
202a
312a
202b
202a
2

FIG.7B

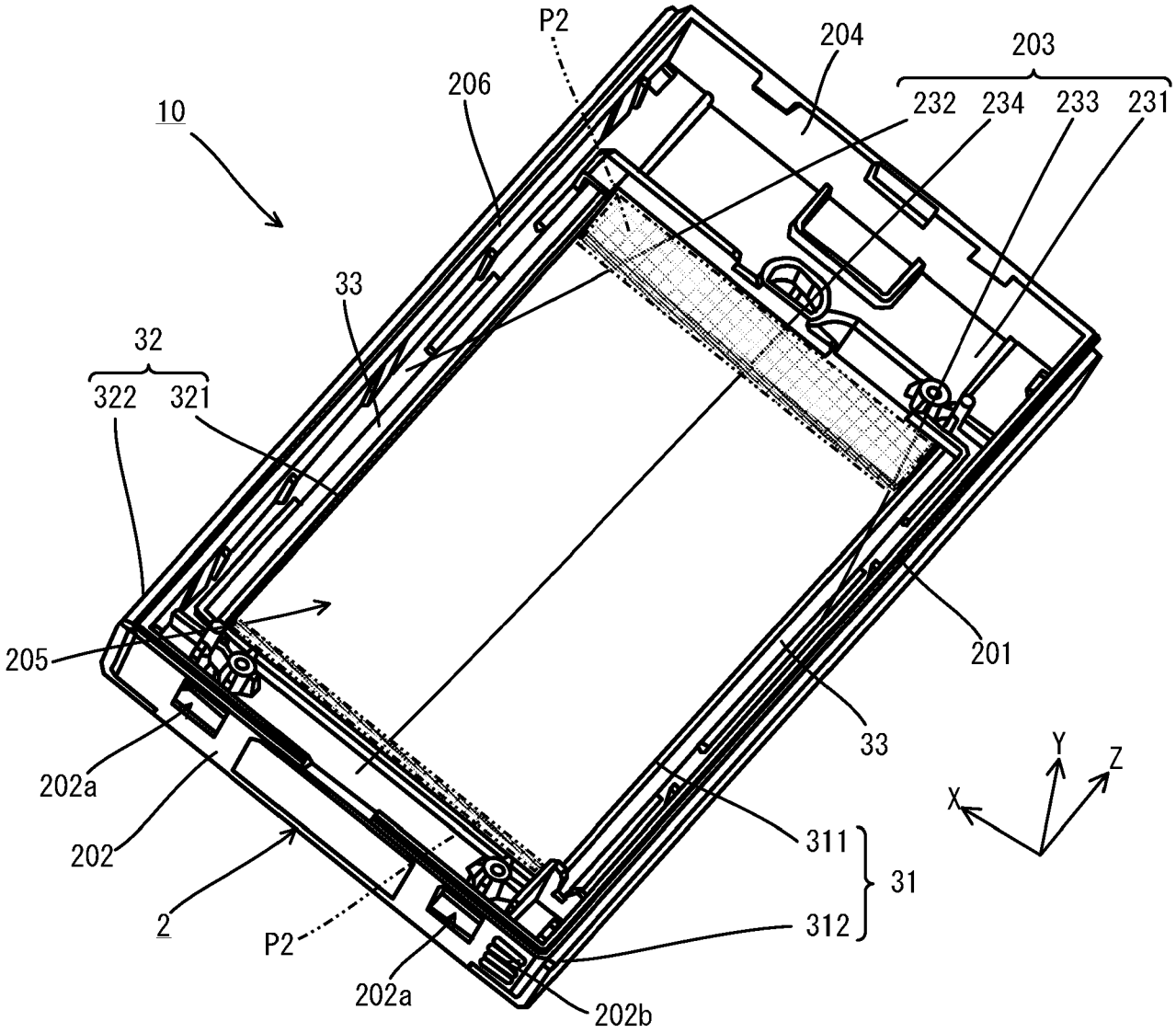

P2
204
203
206
10
232
234
233
231
33
32
322
321
205
201
33
202a
202
311
31
2
312
P2
202a
202b
Y
Z
X

FIG.8A

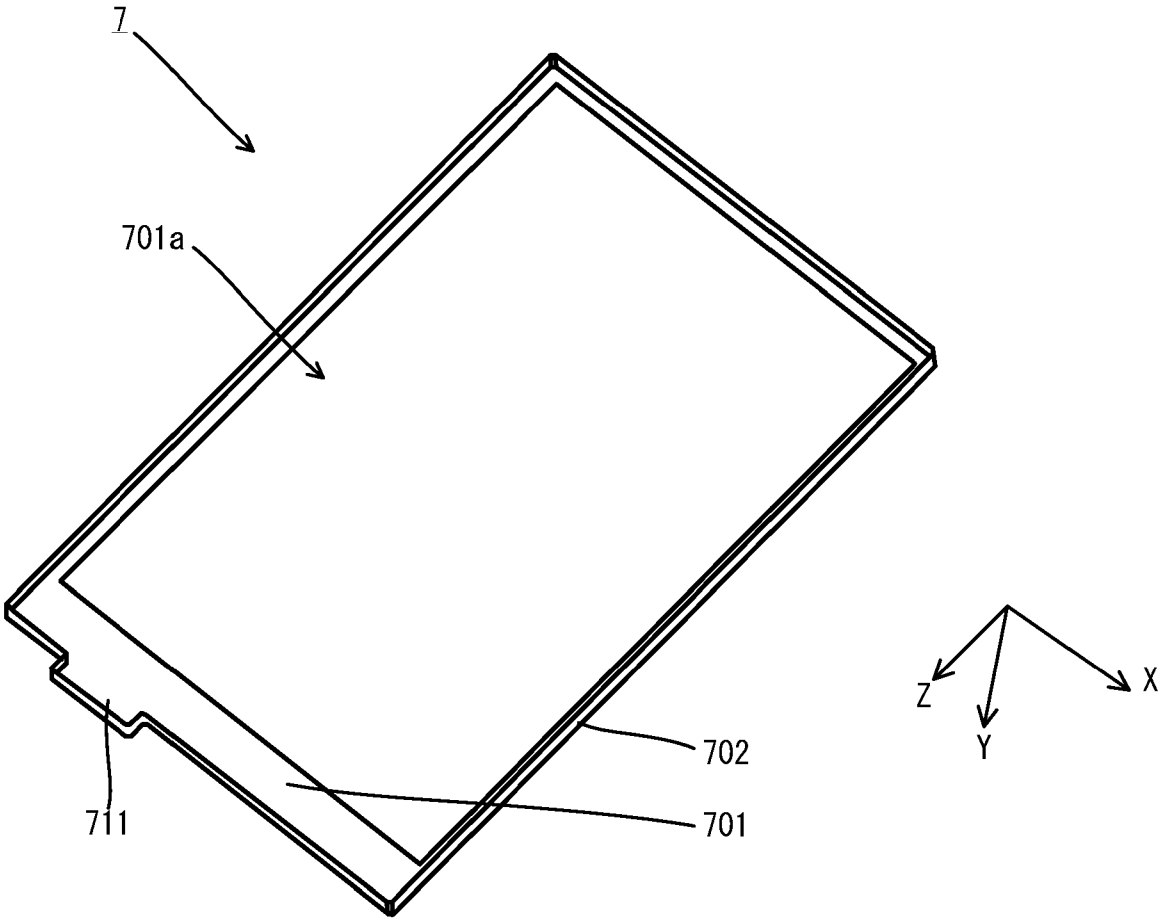


FIG.8B

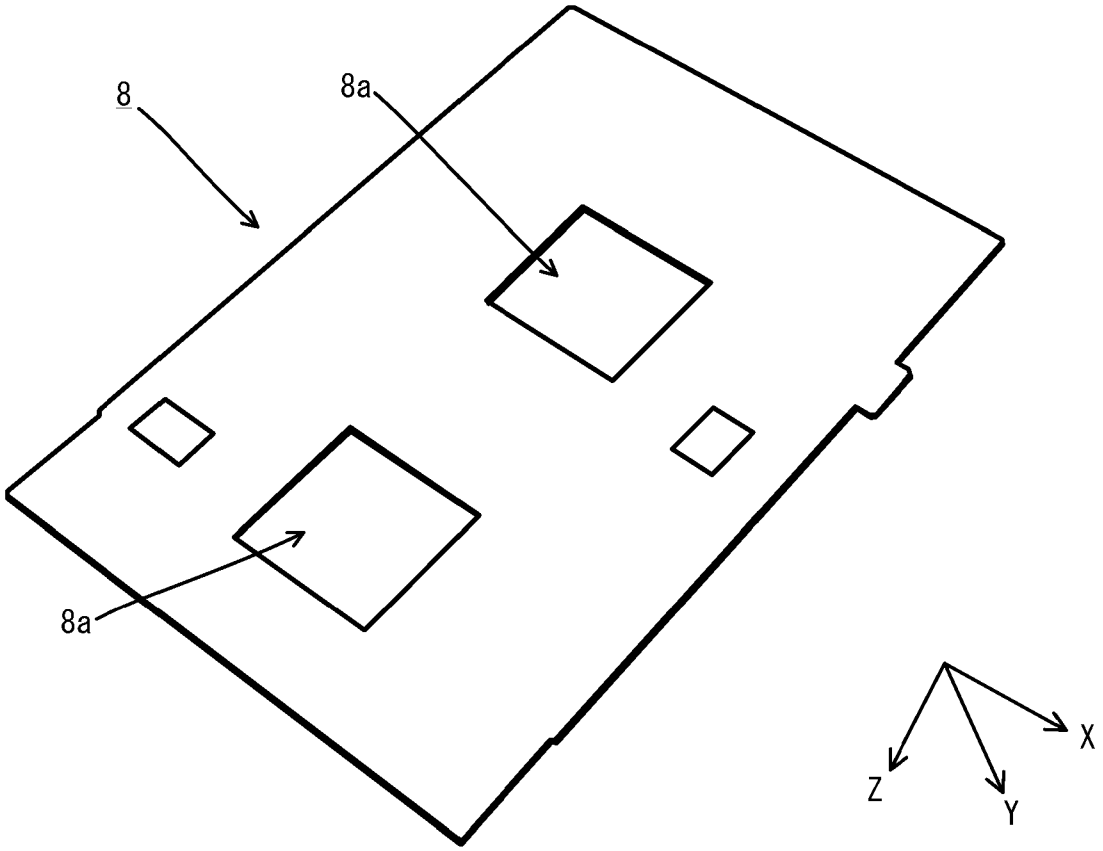


FIG.9

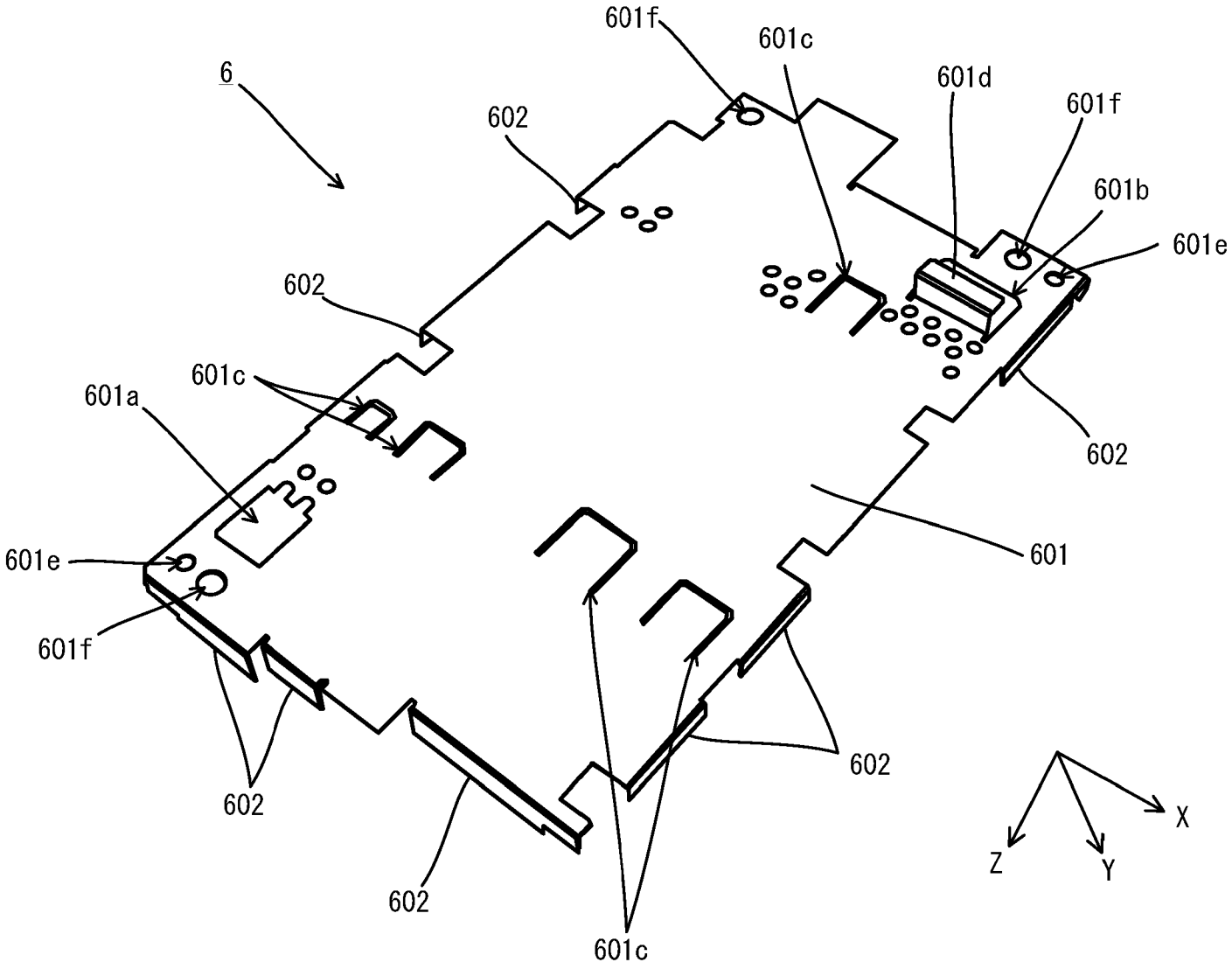

6
601f
601c
601d
601f
602
601b
601e
602
601c
601a
602
601e
601
601f
602
602
602
601c
X
Z
Y

FIG.10

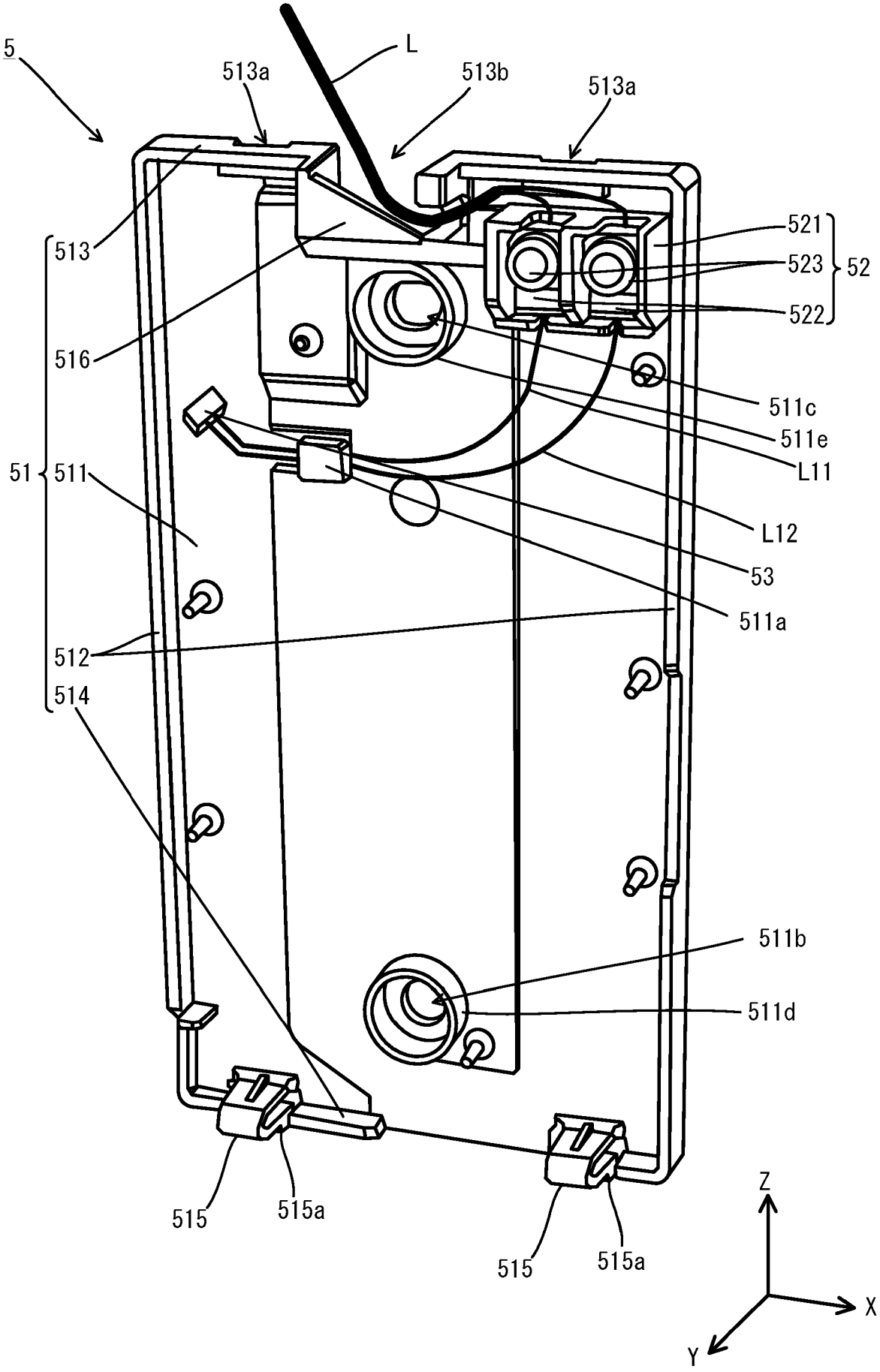

5
L
513a
513b
513a
513
521
523
52
522
516
511c
511e
L11
51
511
L12
53
511a
512
514
511b
511d
515
515a
515
515a
Z
X
Y

FIG.11

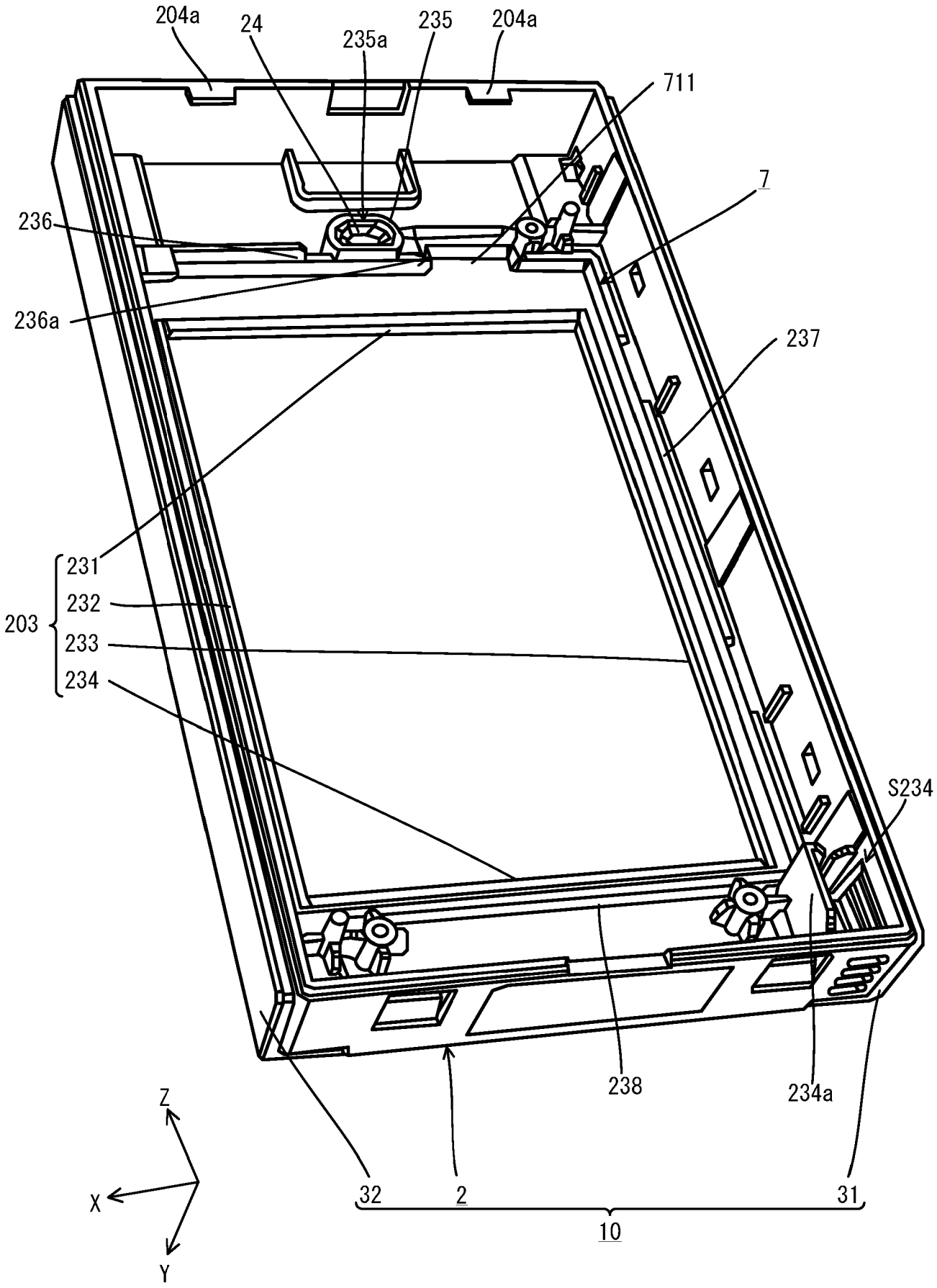

204a
24
235a
235
204a
711
7
236
236a
237
231
232
203
233
234
S234
238
234a
Z
X
Y
32
2
31
10

FIG.12

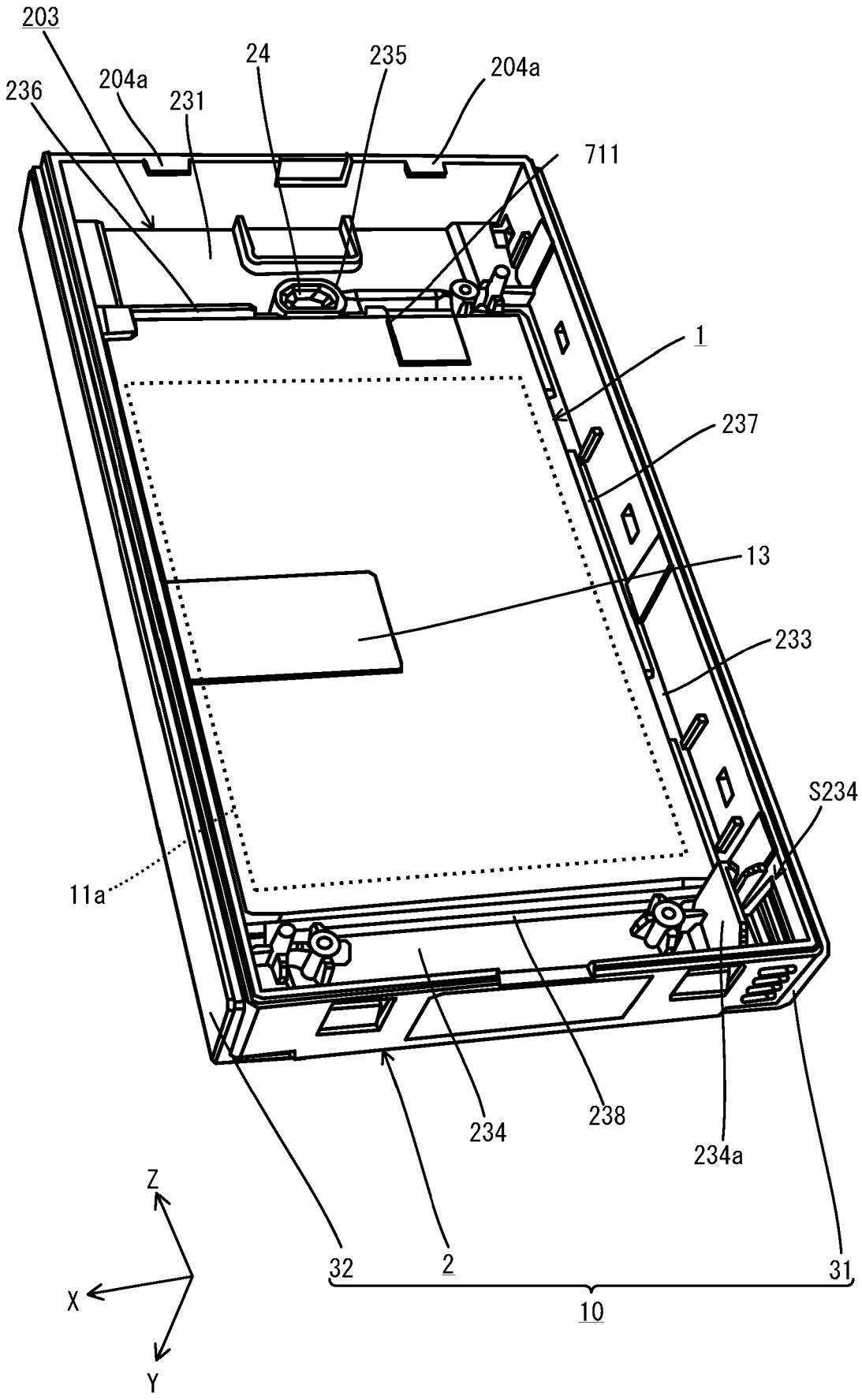

203
24
235
204a
236
204a
231
711
1
237
13
233
S234
11a
234
238
234a
Z
X
Y
32
2
31
10

FIG.13

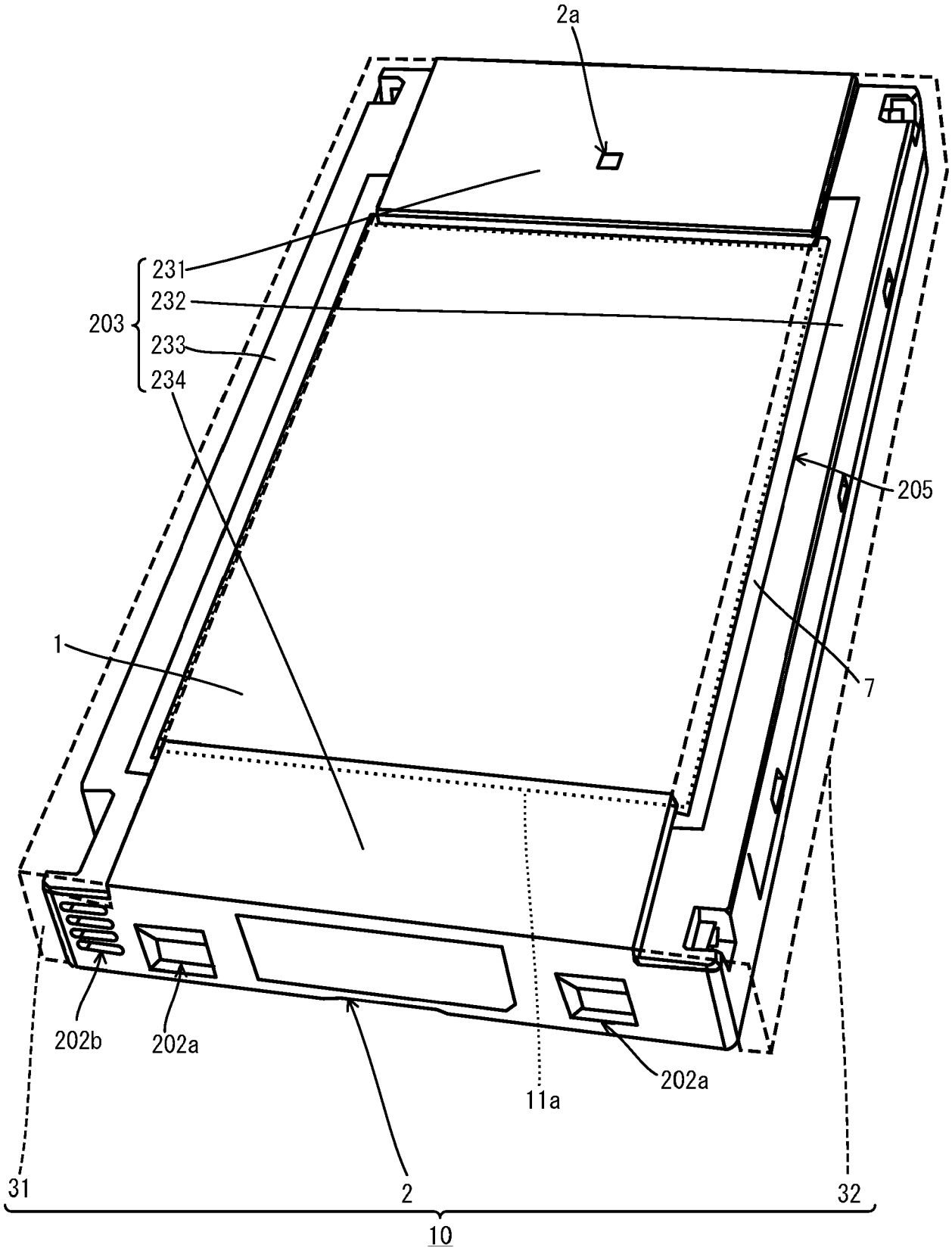


FIG.14

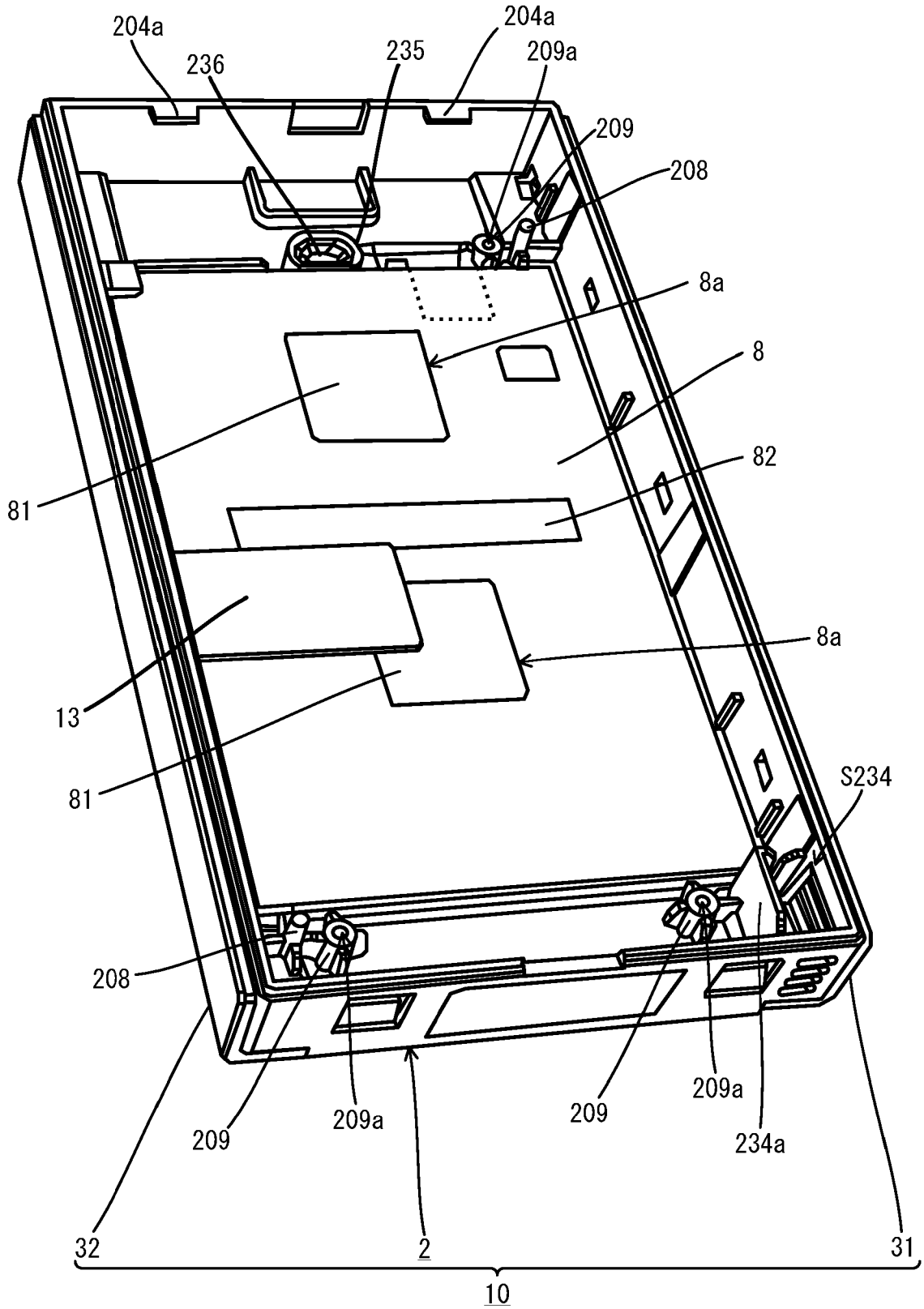

204a
236
235
204a
209a
209
208
8a
8
82
81
8a
13
81
S234
208
209
209a
209
209a
234a
32
2
31
10

FIG.15

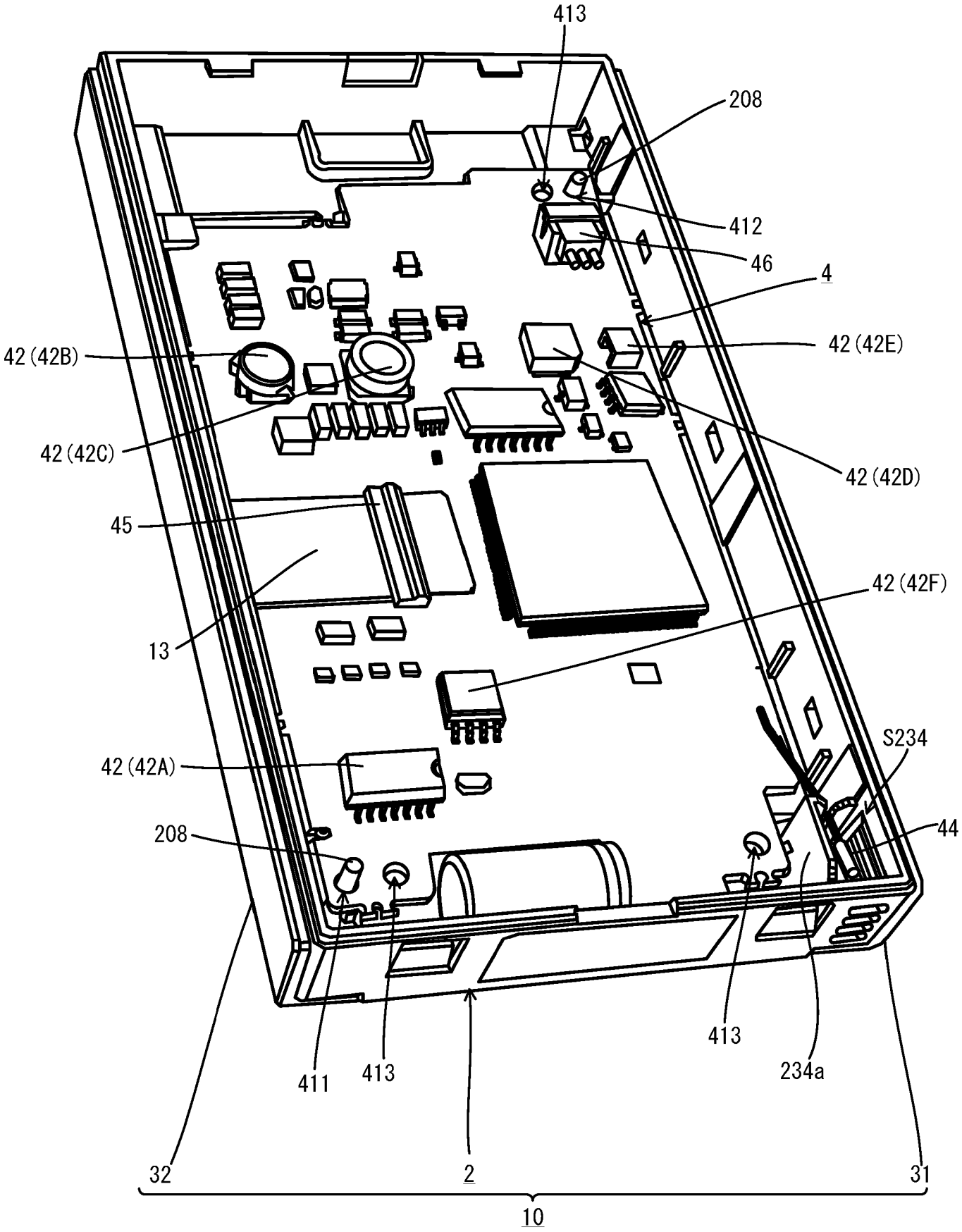

413
208
412
46
4
42 (42B)
42 (42E)
42 (42C)
42 (42D)
45
42 (42F)
13
S234
42 (42A)
44
208
413
411
413
234a
32
2
31
10

FIG.16

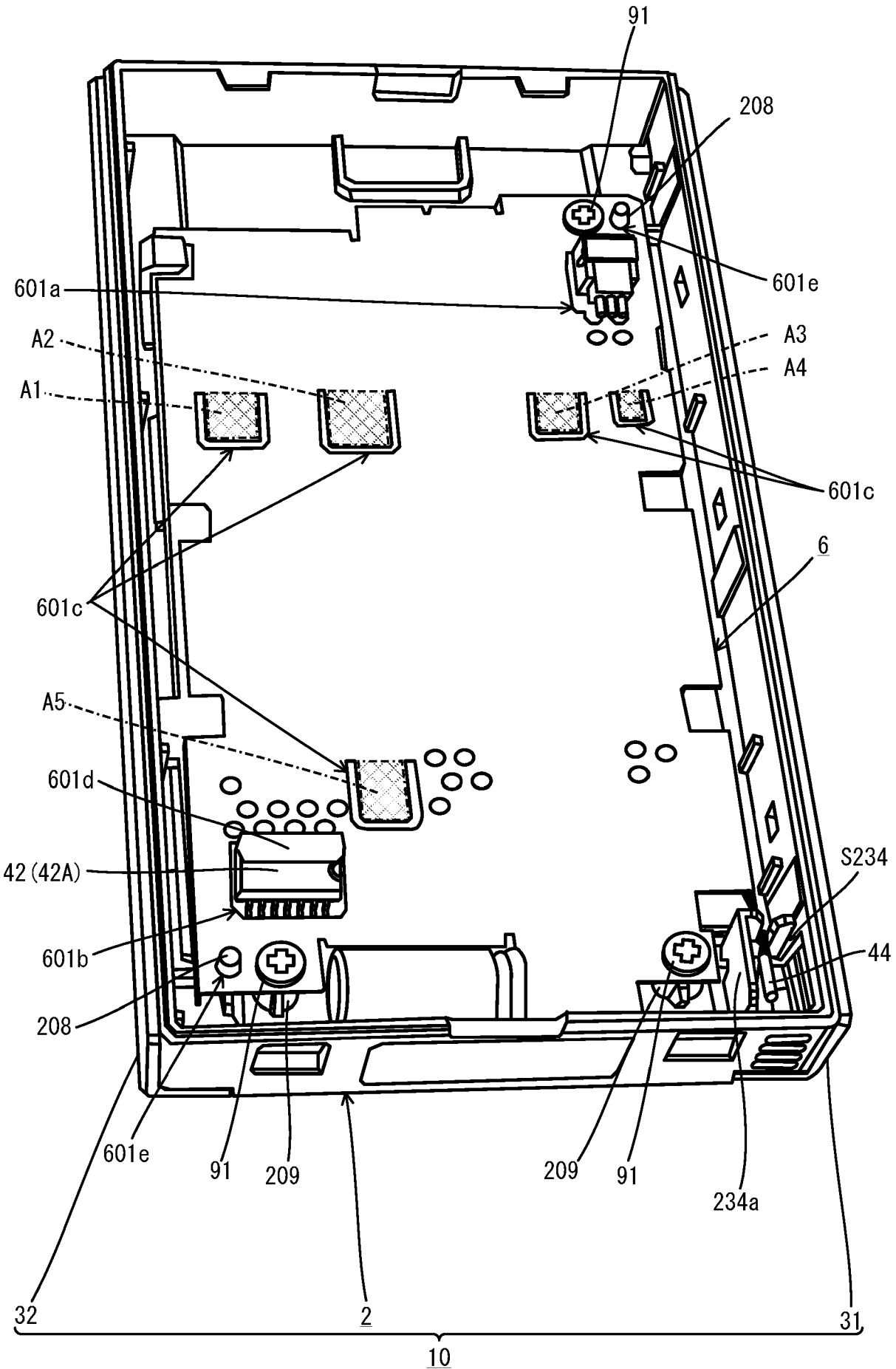

91
208
601e
601a
A2
A3
A4
A1
601c
601c
6
A5
601d
42 (42A)
S234
44
601b
208
601e
91
209
209
91
234a
32
2
31
10

FIG.17

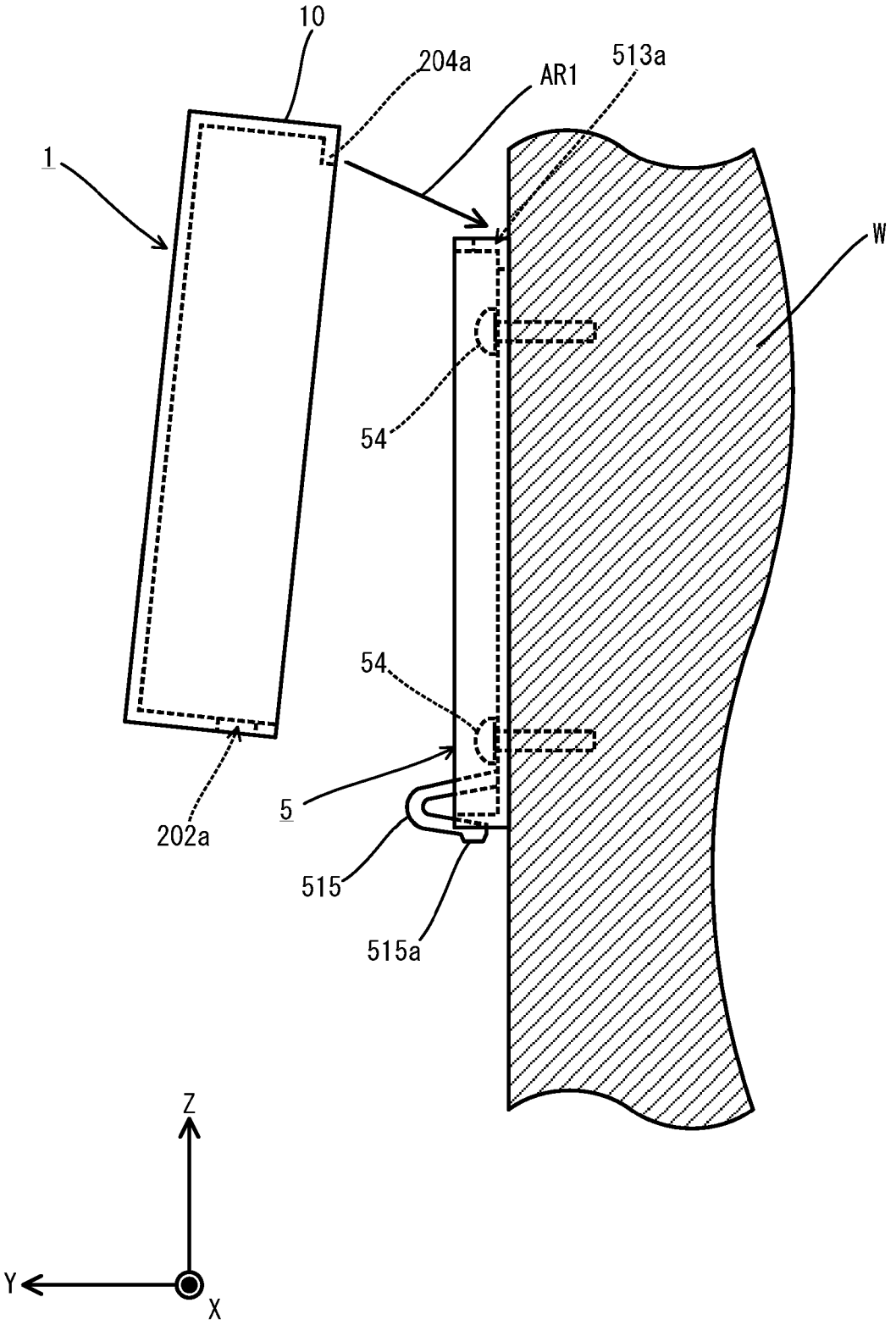


FIG.18

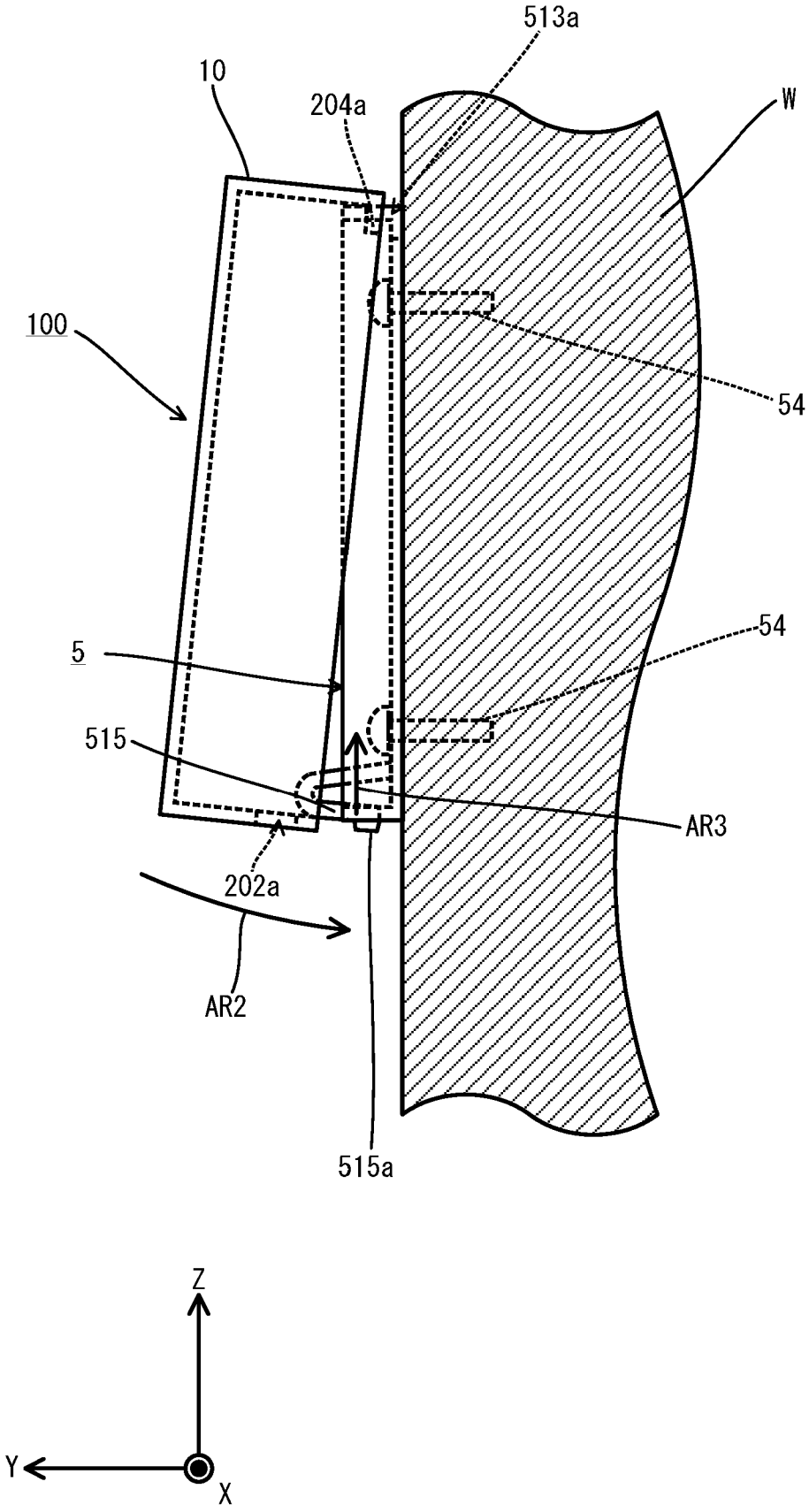
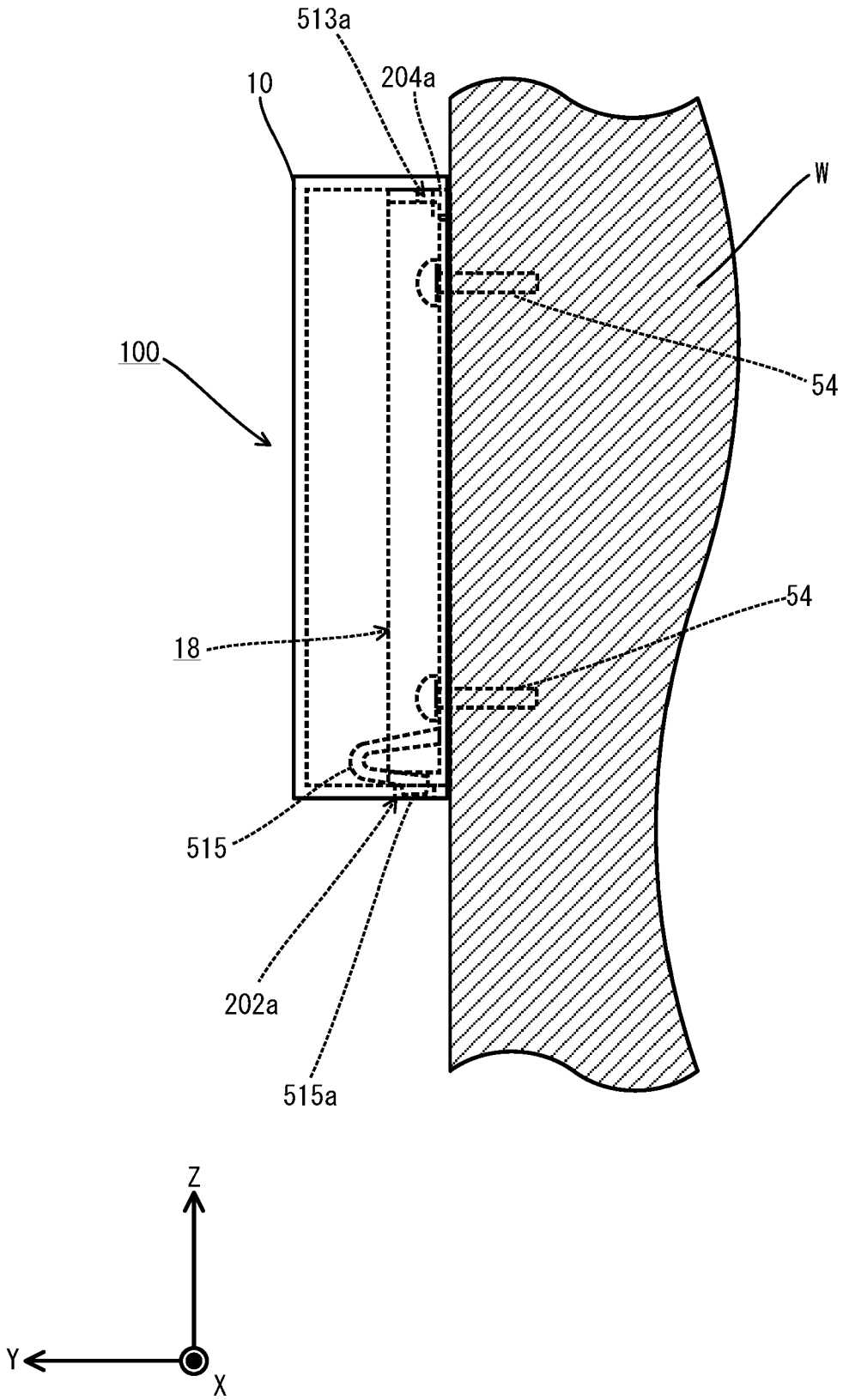


FIG.19



DESCRIPTION

Title of Invention

OPERATION APPARATUS

Technical Field

[0001] The present disclosure relates to an operation apparatus.

Background Art

[0002] Wall-mounted operation apparatuses for remote control of equipment, for example, an air conditioner, installed in a building are provided. Some of such a type of operation apparatuses include a display module that displays temperature, humidity, or the like of a room where an air conditioner is installed, a control board on which various types of electronic components are mounted to send, to the air conditioner, control information for control of the air conditioner, and an enclosure that houses the display module and the control board.

[0003] A proposed display device with a structure similar to such operation apparatuses includes a display panel and a case. The display displays an image, and the case is made of a resin material, such as AES, ABS, PP, or the like, and houses the display panel (for example, see Patent Literature 1). The case of this display device has an upper case having a frame shape and a lower case. The upper case is fastened to the lower case with screws, with annular packing disposed between the case and surrounding portions on the display panel.

Citation List

Patent Literature

[0004] Patent Literature 1: Unexamined Japanese Patent Application Kokai Publication No. 2015-191193

Summary of Invention

Technical Problem

[0005] The display device described in Patent Literature 1, however, suffers from having increased thickness and width in order to improve strength of the frame-shaped upper case since the upper case is made of the resin material. This increases a profile dimension of the upper case, which in turn results in a large profile dimension of the entire display device. The operation apparatus with a structure similar to such a display device also have a large profile dimension, and thus space for installation of the operation apparatus may be limited. In addition, the increased profile dimension of the wall-mounted operation apparatus may cause unintentional contact by a person who is present in the room where the operation apparatus is installed, thereby increasing a possibility of damage to the operation apparatus. Furthermore, with the increase in profile dimension of the operation apparatus, installation of such operation apparatuses on a limited portion of a wall becomes difficult, which may detract from appearance.

[0006] In view of the above circumstances, an objective of the present disclosure is to provide a compact operation apparatus while increasing strength.

Solution to Problem

[0007] To achieve the above objective, an operation apparatus according to claim 1 is disclosed. The present disclosure includes a user interface device, a control board on which electronic components are mounted, and an enclosure configured to house the user interface device and the control board. The control board is configured to control the user interface device and external devices. The enclosure has an enclosure body and a reinforcing member for reinforcing the enclosure body. The enclosure body is made of non-conductive resin. The reinforcing member is made of metal having a modulus of elasticity higher than that of the resin and fixed to the enclosure body, with at least one portion of the reinforcing member exposed to an exterior of the enclosure.

Advantageous Effects of Invention

[0008] According to the present disclosure, the enclosure has an enclosure body and a reinforcing member for reinforcing the enclosure. The enclosure body is made of

non-conductive resin. The reinforcing member is made of metal having a modulus of elasticity higher than that of the resin. The reinforcing member is fixed to the enclosure body, with at least one portion of the reinforcing member exposed to an exterior of the enclosure. This can achieve size reduction of the enclosure while improving the strength of the enclosure since the enclosure has improved rigidity compared with an enclosure, for example, made of only resin and having the same thickness of the surrounding walls. Thus compactness of the entire operation apparatus can be achieved, resulting from the size reduction of the enclosure.

Brief Description of Drawings

[0009] FIG. 1 is a perspective view of an operation apparatus according to an embodiment of the present disclosure;

FIG. 2 is a cross-sectional view of the operation apparatus according to the embodiment from the perspective view, taken along line A-A of FIG. 1 as viewed in the direction of the arrows;

FIG. 3 is a drawing illustrating an example of the operation apparatus according to the embodiment, mounted on a wall;

FIG. 4A is a perspective view of a control board according to the embodiment as viewed in one direction;

FIG. 4B is a perspective view of the control board according to the embodiment as viewed in another direction;

FIG. 5A is a perspective view of an enclosure according to the embodiment as viewed in one direction;

FIG. 5B is a perspective view of the enclosure according to the embodiment as viewed in another direction;

FIG. 6A is a perspective view of a metal panel according to the embodiment as viewed in one direction;

FIG. 6B is a perspective view of the metal panel according to the embodiment as

viewed in another direction;

FIG. 7A is a perspective view of the metal panel attached to the enclosure according to the embodiment as viewed in one direction;

FIG. 7B is a perspective view of the metal panel attached to the enclosure according to the embodiment as viewed in another direction;

FIG. 8A is a perspective view of an insulating member according to the embodiment;

FIG. 8B is a perspective view of an insulating sheet according to the embodiment;

FIG. 9 is a perspective view of the insulating member according to the embodiment;

FIG. 10 is a perspective view of a base member according to the embodiment;

FIG. 11 is a perspective view illustrating a state in which the metal panel and the insulating member are fixed to the enclosure according to the embodiment;

FIG. 12 is a perspective view illustrating a state in which the metal panel, the insulating member, and a user interface device are attached to the enclosure according to the embodiment;

FIG. 13 is a perspective view illustrating a state in which the insulating member and the user interface device are attached to the enclosure according to the embodiment;

FIG. 14 is a perspective view illustrating a state in which the metal panel, the insulating member, the user interface device, and a first insulating sheet are attached to the enclosure according to the embodiment;

FIG. 15 is a perspective view illustrating a state in which the metal panel, the insulating member, the user interface device, the first insulating sheet, and the control board are attached to the enclosure according to the embodiment;

FIG. 16 is a perspective view illustrating a state in which the metal panel, the insulating member, the user interface device, the first insulating sheet, the control board, and a second insulating sheet are attached to the enclosure according to the embodiment;

FIG. 17 is a schematic diagram for describing a method for attaching the operation apparatus according to the embodiment;

FIG. 18 is a schematic diagram for describing the method for attaching the operation apparatus according to the embodiment; and

FIG. 19 is a schematic diagram for describing the method for attaching the operation apparatus according to the embodiment.

Description of Embodiments

[0010] An operation apparatus according to an embodiment of the present disclosure is described hereinafter with reference to the drawings. The operation apparatus according to the embodiment is installed, for example, on a wall of a building and connected via a signal line to an operation target, such as an air conditioner (not illustrated). This operation apparatus controls the operation target by transmitting to the operation target a control signal corresponding to an operation by a user.

[0011] As illustrated in FIG. 1, an operation apparatus 100 includes a user interface device 1 and an enclosure 10. As illustrated in FIG. 2, the operation apparatus 100 also includes a control board 4 on which electronic components 42 are mounted, and a base member 5 for attachment of the enclosure 10 to a wall material (structural material). The control board 4 outputs a control signal to the user interface device 1 and the air conditioner. In addition, the operation apparatus 100 includes an insulating member (second insulating member) 7 disposed to cover a surrounding portion of the user interface device 1, an insulating sheet 8 interposed between the user interface device 1 and the control board 4, and an insulating member (third insulating member) 6 covering a side of the control board 4 opposite to the insulating sheet 8 side thereof.

[0012] The operation apparatus 100 is fixed to the wall material W, as illustrated in FIG. 3, and is installed with a signal line L connected to the operation apparatus 100 on the upper side thereof to communicate to the air conditioner. For explanation purposes, it is assumed as appropriate hereinafter that a vertically upward direction of the operation

apparatus 100 mounted on the wall material W as illustrated in FIG. 3 is a +Z direction and a vertically downward direction thereof (floor F side) is −Z direction. A direction parallel to the wall material W and orthogonal to the vertical direction is assumed to be an X direction, and a direction perpendicular to the wall material W is assumed to be a Y direction. In the following description, as appropriate, the +Y direction is used for indicating a front side, and the −Y direction is used for indicating a rear side.

[0013] The user interface device 1 includes, as illustrated in FIG. 2, a display 11 and a touch panel 12 placed over the front side of the display 11. The display 11 is flat and has, as illustrated in FIG. 1, a display portion 11a on one surface of the display 11 in the thickness direction, that is, a front side thereof. The display 11 is, for example, a liquid crystal display. The touch panel 12 is a resistive touch panel, capacitive touch panel, or the like. The user interface device 1 is connected to the control board 4 via a flexible wiring board 13, such as an FPC board. The user interface device 1 displays various types of information on the display 11 based on a control signal received from the control board 4 via the flexible wiring board 13. A reinforcing metal frame 111 is attached to the rear side of the display 11.

[0014] The control board 4 displays information on the display portion 11a of the user interface device 1 by outputting the control signal to the user interface device 1. In addition, the control board 4 generates a control signal corresponding to an operation performed by a user with respect to the user interface device 1, and outputs the control signal to the air conditioner. As illustrated in FIG. 4A, the control board 4 includes a board 41, electronic components 42 mounted on the rear side of the board 41, a capacitor 43, a thermistor 44, and a connector 46. On the front side of the control board 4, a light emitter 47, such as a light emitting diode (LED), is provided on the front side of the control board 4, as illustrated in FIG. 4B. Upon input of power to the operation apparatus 100, the control board 4 causes the light emitter 47 to turn on. Among the electronic components 42, there is an electronic component 42A having a relatively high

height. Furthermore, among the electronic components 42, there are electronic components 42B, 42C, 42D, 42E, and 42F having such a height that these components nearly reach the insulating member 6 in a state the insulating member 6 is attached to the enclosure body 2. The connector 46 is for connection to a plug 53 that is connected to tips of relay leads L11 and L12 described later. The thermistor 44 is for measurement of ambient temperature of the operation apparatus 100. The control board 4 calculates an ambient temperature of the operation apparatus 100 based on outputs of the thermistor 44. Then the control board 4 generates a control signal for displaying, on the display portion 11a of the display 11, information indicating the calculated ambient temperature, and outputs the control signal to the user interface device 1. The board 41 is made of, for example, an insulator material such as a glass epoxy resin and has a conductive pattern formed thereon. The board 41 has a cutout portion 414, through holes 411 and 412 through which ribs 208 described later are inserted, and three through holes 413 through which screws 91 described later are inserted. The capacitor 43 is electrically connected to the board 41 in a state in which the capacitor 43 is positioned in the cutout portion 414 of the board 41. The board 41 is provided with a connector 45 to which the flexible wiring board 13 of the user interface device 1 is connected. The control board 4 outputs the control signal to the user interface device 1 via the flexible wiring board 13 connected to the connector 45.

[0015] The enclosure 10 houses, as illustrated in FIG. 2, the user interface device 1 and the control board 4 therein. The enclosure 10 has the enclosure body 2 and metal panels 31 and 32 that are reinforcing members for reinforcing the enclosure body 2. The metal panels 31 and 32 are fixed to the outside of the enclosure body 2, and are exposed to the exterior of the enclosure 10. As illustrated in FIGS. 5A and 5B, the enclosure body 2 has a flat box-like shape with an open rear side that is one side in the thickness direction (Y-axis direction) thereof. The enclosure body 2 has a rectangular shape as viewed in the Y-axis direction. The enclosure body 2 is made of non-

conductive resin. The enclosure body 2 has a bottom wall 203, and side walls 201, 202, 204, and 206 that extend rearwards from the peripheral edges of the bottom wall 203. An opening 205 is formed in a portion of the bottom wall 203 that is a projection area A0 of the user interface device 1 in the thickness direction (Y-axis direction) of the enclosure 10. The side walls 201 and 206 extend rearwards from the ±X-direction peripheral edges of the bottom wall 203. The side walls 202 and 204 extend rearwards from the ±Z-direction peripheral edges of the bottom wall 203. The bottom wall 203 has a first wall 231 located in the +Y direction of the opening 205, a second wall 234 located in the −Y direction of the opening 205, a third wall 232 located in the +X direction of the opening 205, and a fourth wall 233 located in the −X direction of the opening 205. The first wall 231 has a window 2a through which light emitted from the light emitter 47 provided on the control board 4 is transmitted outwards, as illustrated in FIG. 5A. A portion on the rear side of the first wall 231 corresponding to the window 2a has a rib 235 with a recess portion 235a to be fitted with a light guide member 24 for guiding to the window 2a light emitted from the light emitter 47 described later, as illustrated in FIG. 5B. The inside of the recess portion 235a communicates with the window 2a. In addition, the rear side of the first wall 231 is provided with a rib 208 for positioning the control board 4, and a boss 209 with a screw hole 209a for use in fastening the control board 4 to the enclosure body 2. The rear side of the second wall 234 has a partition 234a arranged in an upright state for partitioning the space inside the enclosure body 2 into a space S234 for receiving the thermistor 44 described later and a space other than the space S234. The second wall 234 is also provided with a rib 208 and two bosses 209. The rear side of the bottom wall 203 is provided with ribs 236, 237, and 238 for positioning the user interface device 1. The rib 236 has a cutout portion 236a.

[0016] An opening 201a that opens over the side wall 201 and the fourth wall 233 of the bottom wall 203 is provided at a portion in the side wall 201 and a portion in the fourth wall 233 of the bottom wall 203, which correspond to the space S234. The side

wall 201 is provided with ribs 207 for positioning the base member 5 by abutting the tips of the ribs 207 against the base member 5. The side wall 204 is provided with two engagement claws 204a that engage their corresponding recesses 513a of the base member 5 described later. The side wall 202 is provided with two engagement holes 202a that engage their corresponding two hooks 515 of the base member 5 described later. A portion in the side wall 202 corresponding to the space S234 within the enclosure body 2 is provided with vent holes 202b, four in FIGS. 5A and 5B.

[0017] The metal panels 31 and 32 both are elongated metal members having an L-shaped cross section, as illustrated in FIGS. 6A and 6B, and are formed by an extrusion process, for example. The metal panels 31 and 32 are made of metal with a high modulus of elasticity compared with a resin forming the enclosure body 2. The metal panel 31 has a main piece 311 and a side piece 312, both of which have an elongated rectangular plate-like shape. The side piece 312 extends from a traverse-direction end edge of the main piece 311 in a direction intersecting the main piece 311 and is provided with vent holes 312a. The vent holes 312a are provided in a portion facing the opening 201a provided in the side wall 201 of the enclosure body 2 when the metal panel 31 is mounted on the enclosure body 2. The metal panel 32 has a main piece 321 and a side piece 322, both of which have an elongated rectangular plate-like shape. The side piece 322 extends from a traverse-direction end edge of the main piece 321 in a direction intersecting the main piece 321. The metal panels 31 and 32 each include an elongated insulating tape (first insulating member) 33 made of a non-conductive material such as a polyimide resin, and the rear side of the main piece 311 and 321 is provided with an insulating tape 33. Each of the side pieces 312 and 322 has, on a surface thereof to which the enclosure body 2 attaches, an elongated tape-like adhesive member 34.

[0018] The metal panels 31 and 32 are attached to the enclosure body 2 as illustrated in FIGS. 7A and 7B. Here, the main piece 311 of the metal panel 31 is disposed on the outer side of the fourth wall 233 of the bottom wall 203 of the enclosure

body 2 along a −X-direction side of the enclosure body 2 as viewed from a +Y side in the thickness direction of the enclosure body 2. The side piece 312 of the metal panel 31 is continuous with the main piece 311 at an edge on one −X-direction side of the enclosure body 2 in the traverse direction, and is disposed overlapping the outer side of the side wall 206 of the enclosure body 2. The main piece 321 of the metal panel 32 is disposed overlapping the outer side of the third wall 232 of the bottom wall 203 of the enclosure body 2 along an +X-direction side of the enclosure body 2 as viewed from the +Y side in the thickness direction of the enclosure body 2. The side piece 322 of the metal panel 32 is continuous with the main piece 321 on one +X-direction side of the enclosure body 2 in the traverse direction, and is disposed overlapping the outer side of the side wall 201 of the enclosure body 2. With the metal panels 31 and 32 disposed thereon, first parts P1 that are portions of the corresponding main pieces 311 and 321 of the metal panels 31 and 32 are located inside the opening 205 of the enclosure body 2, and are exposed inside the enclosure body 2 through the opening 205 of the enclosure body 2. The insulating tapes 33 are provided on portions of the corresponding first parts P1 of the metal panels 31 and 32, facing the user interface device 1. The second parts P2 in the bottom wall 203 of the enclosure body 2 adjacent to the opening 205 as illustrated in FIG. 5A have a thickness T2 that is the same as the thickness T1 of the first parts P1 of the metal panels 31 and 32 as illustrated in FIG. 6A.

[0019] As illustrated in FIG. 8A, the insulating member 7 has a bottom wall 701 with an opening 701a having a rectangular shape as viewed in plan, an extension 711 that extends from the bottom wall 701, and side walls 702 that surround peripheral edges of the bottom wall 701 and the extension 711. The insulating member 7 is made of a non-conductive material, such as a polyimide resin. The opening 701a is sized to have a dimension larger than profile dimensions of the screen display portion of the display 11 and the touch panel 12 of the user interface device 1.

[0020] The insulating sheet 8 is for electrically insulating the control board 4 from

the metal frame 111 of the user interface device 1. As illustrated in FIG. 8B, the insulating sheet 8 is rectangular sheet-like as viewed in plan and has two openings 8a for receiving cushioning members described later. The insulating sheet 8 is fixed to the metal frame 111 of the user interface device 1 with the tape-like adhesive member 82, as illustrated in FIG. 2.

[0021] The insulating member 6 is made of a non-conductive material having flexibility and covers the control board 4 from the rear side of the enclosure body 2. As illustrated in FIG. 9, the insulating member 6 has a main piece 601 and extension pieces 602 that extend from portions of the peripheral edges of the main pieces 601 toward the front side, which is the +Y direction, of the main piece 601 in the thickness direction of the main piece 601. The main piece 601 is provided with an opening 601a through which the connector 46 of the control board 4 is inserted, an opening 601b through which are inserted the electronic component 42A having a relative high height among the electronic components 42 of the control board 4, and slits 601c. A surrounding portion of the opening 601b is provided with a bent piece 601d disposed so as to cover a portion of the rearward area of the electronic component 42. The main piece 601 further has two holes 601e through which the ribs 208 of the enclosure body 2 are inserted, and three holes 601f through which the screws 91 described later are inserted. As illustrated in FIG. 2, the insulating member 6 is disposed to cover a side of the control board 4 opposite to the insulating sheet 8 side thereof.

[0022] As illustrated in FIG. 10, the base member 5 has a body 51 and a terminal mount 52. The body 51 has a bottom wall 511, side walls 512 that extend forwards from ±X-direction ends of the bottom wall 511, a side wall 513 that extends forward from the upper end (+Z-direction end), and a side wall 514 that extends forward from the lower end (−Z-direction end) of the bottom wall 511. The body 51 has a guide 516 that guides to the terminal mount 52 the signal line L introduced into the operation apparatus 100. The side wall 513 is provided with an inlet 513b for introducing the signal line L into the

operation apparatus 100, and recesses 513a in which the engagement claws 204a of the enclosure body 2 engage when the enclosure 10 is mounted on the base member 5. The guide 516 is provided so as to cover the −X-direction side, −Z-direction side, and +Y-direction side of the inlet 513b. The bottom wall 511 is provided with a clamp 511a for clamping the relay leads L11 and L12. The lower end of the bottom wall 511 is provided with two hooks 515 that engage the engagement holes 202a of the enclosure body 2. The bottom wall 511 is provided with through holes 511b and 511c into which screws (see, for example, reference numeral 54 of FIG. 17) extend through the bottom wall 511 to fix the base member 5 to the wall material W. The bottom wall 511 is also provided with ribs 511d and 511e that protrude forward to surround the through holes 511b and 511c.

[0023] The terminal mount 52 is provided at a location in the +X direction adjacent to the guide 516 on the bottom wall 511. The terminal mount 52 has a terminal mount body 521, two terminal plates 522, and screws 523 for pressing the terminal plates 522 to put the signal lines L to be held with the terminal plates 522. These two terminal plates 522 are each connected to the corresponding relay leads L11 and L12. The relay leads L11 and L12 are connected via an electrically conductive member, such as solder, a silver paste, or the like. The tips of the relay leads L11 and L12 are provided with plugs 53 to be connected to the connector 46 of the control board 4. The control board 4 receives and sends control signals from and to the air conditioner or receives power supply from the air conditioner, via the relay leads L11 and L12 and the signal line L, with the plugs 53 connected to the connector 46.

[0024] Next, a method for assembling the operation apparatus 100 according to the embodiment is described. First, as illustrated in FIGS. 7A and 7B, the metal panels 31 and 32 are placed so that their side pieces 312 and 322 overlie the side walls 201 and 206 of the enclosure body 2. Then the side pieces 312 and 322 of the metal panels 31 and 32 are pressed against the side walls 201 and 206 of the enclosure body 2, for example,

using a pressing jig. The metal panels 31 and 32 are thereby fixed to the enclosure body 2 with the adhesive member 34.

[0025] Next, as illustrated in FIG. 11, the light guide member 24 is fitted into the recess portion 235a of the rib 235. Then the insulating member 7 is placed on the inner side of the ribs 236, 237, and 238 on the rear side of the bottom wall 203 in such a way that the extension 711 of the insulating member 7 is fitted into the cutout portion 236a of the rib 236 on the bottom wall 203 of the enclosure body 2.

[0026] Next, as illustrated in FIG. 12, the user interface device 1 is placed on the rear side of the bottom wall 203. At this time, the insulating member 7 is disposed so as to cover portions of the user interface device 1 facing the first parts P1 of the metal panels 31 and 32, that is, the outer surrounding portion of the display portion 11a of the user interface device 1, as illustrated in FIG. 13. The insulating tapes 33 are disposed to overlap the insulating member 7 in a direction (Y-axis direction) in which the user interface device 1 faces the metal panels 31 and 32. Here, the user interface device 1 is housed in the enclosure 10 in a state in which the display portion 11a of the display 11 is viewable from the outside of the enclosure 10 via the opening 205 of the bottom wall 203 of the enclosure body 2 and the outer surrounding portion of the display portion 11a on the front side of the display 11 faces the first parts P1 of the metal panels 31 and 32.

[0027] Next, as illustrated in FIG. 14, the insulating sheet 8 is fixed to the user interface device 1 with the adhesive member 82. Then the cushioning member 81 is attached to the inner side of each of the two openings 8a of the insulating sheet 8.

[0028] Next, as illustrated in FIG. 15, the control board 4 is placed in the enclosure 10 in such a way that the ribs 208 of the enclosure body 2 are inserted into the through holes 411 and 412 of the control board 4. At this time, the thermistor 44 is disposed within the space S234 delimited by the partition 234a in the enclosure body 2. The control board 4 is thereby disposed in the enclosure 10, overlying the user interface device 1 via the insulating sheet 8 and the cushioning member 81. That is, the enclosure

body 2 houses the user interface device 1 and the control board 4 in a state in which the user interface device 1 is disposed closer to the bottom wall 203 of the enclosure body 2 than the control board 4.

[0029] Next, as illustrated in FIG. 16, the insulating member 6 is placed on the rear side of the control board 4 in such a way that the ribs 208 of the enclosure body 2 are inserted into the holes 601e of the insulating member 6. At this time, the connector 46 of the control board 4 is inserted through the opening 601a, and the electronic component 42A of the control board 4 is inserted through the opening 601b. Here, in a state in which the operation apparatus 100 is mounted on the wall material W, the slits 601c each extend on the vertically lower side (−Z-direction side) of the electronic component facing regions A1, A2, A3, A4, and A5 and extend, from the vertically lower side, on both of the sides thereof in a direction (X-axis direction) orthogonal to the vertical direction (Z-axis direction). Here, the electronic component facing regions A1, A2, A3, A4, and A5 are regions where the front side thereof face the electronic parts 42B, 42C, 42D, 42E, and 42F on the control board 4.

[0030] Next, the screws 91 inserted into holes 601f of the insulating member 6 and the through holes 413 of the control board 4 are screwed into the screw holes 209a of the bosses 209 of the enclosure body 2. The insulating member 7, the user interface device 1, the insulating sheet 8, the control board 4, and the insulating member 6 are thereby fastened to the enclosure body 2 by the three screws 91. Then the base member 5 is attached to the enclosure body 2 and then the operation apparatus 100 is completed.

[0031] Next, a method for attaching the operation apparatus 100 according to the embodiment to the wall material W is described. For explanation purposes, the base member 5 is assumed to be removed beforehand from the operation apparatus 100. First, as illustrated in FIG. 17, the base member 5 is attached to the wall material W with the screws 54. Here, the screws 54 are inserted into the through holes 511b and 511c of the base member 5, as illustrated in FIG. 10. Then the signal line Land the relay leads

L11 and L12 are attached to the base member 5, as illustrated in FIG. 10.

[0032] Next, as indicated by an arrow AR1 in FIG. 17, the engagement claw 204a of the enclosure 10 is engaged into the recess 513a of the base member 5. This brings the enclosure 10 into a state in which the enclosure 10 is caught on the base member 5, as illustrated in FIG. 18.

[0033] Then, as indicated by an arrow AR2 in FIG. 18, the enclosure 10 is rotated aboutthe engagement claws 204a engaged into the recesses 513a of the base member 5, and then the lower end portion of the enclosure 10 abuts against the hooks 515 of the base member 5. Then further rotation of the enclosure 10 in the direction of the arrow AR2 makes the tips 515a of the hooks 515 of the base member 5 flex upwards, as indicated by an arrow AR3. Then, as illustrated in FIG. 19, engagement of the tips 515a of the hooks 515 of the base member 5 into the engagement holes 202a of the enclosure 10 makes the enclosure 10 fastened to the base member 5. In this way, the operation apparatus 100 is attached to the wall material W.

[0034] As described above, in the operation apparatus 100 according to the embodiment, the enclosure 10 has the enclosure body 2 made of a non-conductive resin and the metal panels 31 and 32 for reinforcing the enclosure 2. The metal panels 31 and 32 are made of metal having a modulus of elasticity higher than that of the resin. The metal panels 31 and 32 are fixed to the enclosure body, with one portion of the metal panels 31 and 32 exposed to the exterior of the enclosure 10, and reinforce the enclosure 2. This can achieve size reduction of the enclosure 10 while improving the strength of the enclosure 10 since the enclosure 10 has improved rigidity compared with an enclosure, for example, made of only the resin and having the same thickness of the surrounding walls. Thus due to size reduction of the enclosure 10, compactness of the entire operation apparatus 100 can be achieved.

[0035] In the operation apparatus 100 according to the embodiment, the control board 4 is disposed in the enclosure 10, overlying the user interface device 1 via the

insulating sheet 8 and the cushioning member 81. Thus when the operation apparatus 100 is externally impacted, for example, during shipment of the operation apparatus 100 or attachment of the operation apparatus 100 to the wall material W while the operation apparatus 100 is being held, the impact is absorbed by the cushioning member 81. Thus damage of the user interface device 1 due to external impact can be reduced.

[0036] The operation apparatus 100 according to the embodiment further includes the insulating member 6 that covers the rear side of the control board 4. This can prevent a worker from unintentionally contacting the control board 4 when installing the operation apparatus 100 onto the wall material W. Thus, for example, this can prevent damage of the control board 4 by surge current flowing through the control board 4 caused due to static built on clothes of the worker.

[0037] The control board 4 according to the embodiment has the cutout portion 414. The capacitor 43 is positioned in the cutout portion 414. This positioning enables the control board 4 to be thinned by the thickness of the control board 4, for example compared with a configuration in which the capacitor 43 is mounted on one surface of the board 41. Such a reduced thickness of the control board 4 enables the thickness of the enclosure 10 to be reduced, which results in reduction in a thickness of the operation apparatus 100.

[0038] The enclosure 10 according to the embodiment has the first parts P1 of the metal panels 31 and 32 exposed inside the enclosure 10. As illustrated in FIG. 7B, the insulating tapes 33 are provided on portions, facing the user interface device 1, of the corresponding first parts P1 of the metal panels 31 and 32. As illustrated in FIG. 13, the insulating member 7 covers the outer surrounding portion of the display portion 11a facing the first parts P1 of the metal panels 31 and 32 of the user interface device 1. The insulating tapes 33 are disposed to overlap the insulating member 7 in the Y-axis direction. This provides electrical insulation between the metal frame 111 of the user interface device 1 and the metal panels 31 and 32, which can reduce occurrences of

malfunctioning of the operation apparatus 100 due to breakdown of insulation between the metal frame 111 and the metal panels 31 and 32.

[0039] The Electrical Appliance and Material Safety Law requires that the user interface device 1 satisfies the requirements that two or more sheet-like insulating members are interposed between the metal frame 111 of the user interface device 1 and the metal panels 31 and 32, and that a breakdown voltage of each insulating member is at least a prescribed voltage defined in the law. With respect to such requirements, the enclosure 10 according to the embodiment has the insulating tape 33 and the insulating member 7 between the first part P1 of each of the metal panels 31 and 32 and the outer surrounding portion of the display portion 11a facing the first parts P1 in the user interface device 1. In addition, the breakdown voltages of the insulating tape 33 and the insulating member 7 are at least a prescribed voltage defined in the Electrical Appliance and Material Safety Law. Thus since the operation apparatus 100 satisfies the requirements defined in the Electrical Appliance and Material Safety Law, a user can use the operation apparatus 100 safely.

[0040] The enclosure body 2 according to the embodiment has a flat box-like shape with an open side in the thickness direction thereof. The opening 205 is formed in a portion of the bottom wall 203 that is a projection area A0 of the user interface device 1 in the thickness direction (Y-axis direction) of the enclosure body 2. The metal panels 31 and 32 are disposed on the outer side of the enclosure body 2. The second parts P2 of the enclosure body 2 illustrated in FIG. 5A have a thickness T2 that is the same as the thickness T1 of the first parts P1 of the metal panels 31 and 32 as illustrated in FIG. 6A. This enables the thickness of the enclosure 10 to be reduced, thereby achieving thinning of the operation apparatus 100.

[0041] Moreover, the insulating member 7 according to the embodiment covers the display 11 from the outer surrounding portion of the display portion 11a on the front side of the display 11 to the peripheral surfaces of the display 11. This can lengthen a

creepage distance between the metal frame 111 of the display 11 and the metal panels 31 and 32, thereby advantageously providing higher electrical insulation between the metal frame 111 and the metal panels 31 and 32. In the meantime, for example when an installation worker unintentionally drops the operation apparatus 100 down to a floor F while installing the operation apparatus 100 onto the wall material W, the operation apparatus 100 is often externally impacted in the X-axis direction or the Z-axis direction. With respect to such impact, the operation apparatus 100 according to the embodiment covers the side surfaces of the display 11 with the insulating member 7, which reduces the impact applied to the display 11 in the X-axis direction or the Z-axis direction, thereby reducing damage to the display 11.

[0042] The metal panels 31 and 32 according to the embodiment each have an L-shaped cross section as illustrated in FIGS. 6A and 6B. Since the metal panels 31 and 32 have rigidity higher than a flat-shaped metal panel, the metal panels 31 and 32 can improve strength of the enclosure 10, for example compared with a configuration in which the flat-shaped metal panels are attached to the bottom wall 203 or the side walls 201 and 206 of the enclosure body 2.

[0043] The insulating member 6 according to the embodiment has a plurality of slits 601c. In a state in which the operation apparatus 100 is mounted on the wall material W, the slits 601c each extend on the vertically lower side (−Z-direction side) of the electronic component facing regions A1, A2, A3, A4, and A5 and extend, from the vertically lower side, on both of the sides thereof in a direction (X-axis direction) orthogonal to the vertical direction (Z-axis direction). Then the electronic component facing regions A1, A2, A3, A4, and A5 flex backwards respectively when the electronic components 42B, 42C, 42D, 42E, and 42F of the control board 4 abut against the electronic component facing regions A1, A2, A3, A4, and A5 of the insulating member 6. With the insulating member 6 attached on the rear side of the control board 4, stresses applied on the electronic components 42B, 42C, 42D, 42E, and 42F by the insulating

member 6 are thereby reduced while the exposed areas of the electronic components 42B, 42C, 42D, 42E, and 42F toward the rear side are reduced. Thus damage to the electronic components 42B, 42C, 42D, 42E, and 42F and the board 41 is reduced while attachment of foreign objects to the electronic components 42B, 42C, 42D, 42E, and 42F is reduced. In addition, no slit 601c is formed in the insulating member 6 vertically above from each of the electronic component facing regions A1, A2, A3, A4, and A5 in the state in which the operation apparatus 100 is mounted on the wall material W. This makes droplets of water less likely to flow into an area in front of the insulating member 6, for example, even when condensation occurs on the rear side of the insulating member 6 and droplets of water enter the electronic component facing regions A1, A2, A3, A4, and A5 vertically downwardly from the upper side of the insulating member 6. Thus the occurrence of malfunctioning of the operation apparatus 100 due to attachment of droplets of water to the control board 4 can be reduced.

[0044] Although embodiments of the present disclosure are described above, the present disclosure is not limited to the aforementioned embodiments. For example, the insulating member 7 may have a sheet-like shape having a size larger than a profile dimension as viewed in plan of the user interface device 1 and having, in the central portion thereof, an opening 701a having a rectangular shape as viewed in plan. In this case, the insulating member 7 can be placed over the front side of the user interface device 1 and then a portion extending out of the outer periphery of the user interface device 1 can be bent backwards along the side surfaces of the user interface device 1. Then with the insulating member 7 covering the user interface device 1, the insulating member 7 can be placed on the inner side of the ribs 236, 237, and 238 on the rear side of the bottom wall 203 of the enclosure body 2. Alternatively, with the insulating member 7 resting on the bottom wall 203 of the enclosure body 2, the user interface device 1 is pushed therein from the rear side, and then a portion of the insulating member 7 extending out of the user interface device 1 can be cut out. Such a configuration can

advantageously simplify the shape of the insulating member 7.

[0045] In the embodiment, an example of the operation apparatus 100 is described that includes the enclosure 10 with the metal panels 31 and 32 exposed inside the enclosure 10, but the structure of the enclosure is not limited thereto. For example, the operation apparatus 100 may include an enclosure having a configuration in which the metal panels 31 and 32 are provided on the outer walls of the resin enclosure body 2 and the metal panels 31 and 32 are not exposed inside the enclosure body 2. Since the insulating tape 33 and the insulating member 7 can be omitted in this configuration, the structure of the operation apparatus can be simplified thanks to the reduced number of components.

[0046] In embodiments, design surfaces of the metal panels 31 and 32 that are exposed outwards in a state where the metal panels 31 and 32 are fitted to the enclosure body 2 may be subjected to hairline processing in the longitudinal direction for improved decorative purposes. The metal panels 31 and 32 may be anodized for rust prevention and decoration of the metal panels 31 and 32. In the anodizing treatment, the metal panels 31 and 32 can be dyed, and for example, the metal panels 31 and 32 may be dyed in, for example, a silver based color, a gold based color, black, or the like.

[0047] In the embodiment, an example of the metal panels 31 and 32 having an L-shaped cross section is described, but the shape of the metal panels is not limited thereto and may be, for example, flat-shaped.

[0048] In the embodiment, an example of the operation apparatus for an air conditioner is described, but an operation target of the operation apparatus is not limited to the air conditioner but may be other household equipment.

[0049] The foregoing describes some example embodiments for explanatory purposes. Although the foregoing discussion has presented specific embodiments, persons skilled in the art will recognize that changes may be made in form and detail without departing from the broader scope of the invention. Accordingly, the

specification and drawings are to be regarded in an illustrative rather than a restrictive sense. This detailed description, therefore, is not to be taken in a limiting sense, and the scope of the invention is defined only by the included claims, along with the full range of equivalents to which such claims are entitled.

Industrial Applicability

[0050] The present disclosure is used with advantage for an operation apparatus to be used in a state in which the operation apparatus is attached to a structural material.

Reference Signs List

[0051]

1	User interface device
2	Enclosure body
2a	Window
4	Control board
5	Base member
6, 7	Insulating member
8	Insulating sheet
8a, 201a, 205, 601a, 601b, 701a	Opening
10	Enclosure
11	Display
11a	Display portion
12	Touch panel
13	Flexible wiring board
24	Light guide member
31, 32	Metal panel
33	Insulating tape
34, 82	Adhesive member
41	Board
42, 42A, 42B, 42C, 42D, 42E, 42F	Electronic component

43 Capacitor

44 Thermistor

45, 46 Connector

47 Light emitter

51 Body

52 Terminal mount

53 Plug

54, 91, 523 Screw

81 Cushioning member

100 Operation apparatus

111 Metal frame

201, 202, 204, 206, 512, 513, 514, 702 Side wall

202a Engagement hole

202b, 312 Vent hole

203, 511, 701 Bottom wall

204a Engagement claw

207, 208, 235, 236, 237, 238, 511d, 511e Rib

209 Boss

209a Screw hole

231 First wall

232 Third wall

233 Fourth wall

234 Second wall

234a Partition

235a Recess portion

236a, 414 Cutout portion

311, 321, 601 Main piece

312, 322 Side piece

411, 412, 413, 511b, 511c Through hole

511a Clamp

513a Recess

513b Inlet

515 Hook

515a Tip

516 Guide

521 Terminal mount

522 Terminal plate

601c Slit

601d Bent piece

601e, 601f Hole

602 Extension piece

711 Extension

A0 Projection area

A1, A2, A3, A4, A5 Electronic component facing region

F Floor

L Signal line

L11, L12 Relay lead

P1 First part

P2 Second part

S234 Space

W Wall material

CLAIMS

1. An operation apparatus comprising:

a user interface device;

a control board on which electronic components are mounted, the control board being configured to output a control signal to the user interface device and an operation target; and

an enclosure that houses the user interface device and the control board therein, wherein

the enclosure has an enclosure body made of non-conductive resin and a reinforcing member for reinforcing the enclosure body, the reinforcing member being made of metal having a modulus of elasticity higher than that of the resin and fixed to the enclosure body, with at least one portion of the reinforcing member exposed to an exterior of the enclosure,

the enclosure body has a flat box-like shape with an open side in a thickness direction thereof, the enclosure body having an opening in a portion of a bottom wall of the enclosure body, the portion of the bottom wall being a projection area of the user interface device in a thickness direction of the enclosure, and

the reinforcing member is fixed to the enclosure body in such a way that the reinforcing member covers only a portion of an outer surrounding portion of the opening, on an outer side of the bottom wall.

2. The operation apparatus according to claim 1, wherein

the enclosure body has a box-like shape that is flat and is rectangular as viewed in

a thickness direction of the enclosure body, and

the reinforcing member has an L-shaped cross section, the reinforcing member having

a main piece having an elongated plate-like shape and disposed on an outer side of the bottom wall of the enclosure body along a side of the enclosure body as viewed from a thickness direction of the enclosure body, and

a side piece having an elongated plate-like shape, being continuous with the main piece at an edge on the side of the enclosure body in a traverse direction of the main piece, and disposed on an outer side of a side wall of the enclosure body.

3. The operation apparatus according to claim 1, wherein

the enclosure body has a box-like shape that is flat and is rectangular as viewed in a thickness direction of the enclosure body, and

the reinforcing member has an elongated flat shape and is disposed on an outer side of the bottom wall of the enclosure body along a side of the enclosure body as viewed from a thickness direction of the enclosure body.

4. The operation apparatus according to any one of claims 1 to 3, wherein

the reinforcing member has a design surface that is elongated and exposed outwards in a state where the reinforcing member is fitted to the enclosure body, and

the design surface is subjected to hairline processing in a longitudinal direction of the reinforcing member.

5. The operation apparatus according to any one of claims 1 to 4, wherein

the reinforcing member has a design surface that is exposed outwards in a state where the reinforcing member is fitted to the enclosure body, and

the design surface is anodized.

6. The operation apparatus according to claim 5, wherein

the reinforcing member is a member dyed when being anodized.

7. The operation apparatus according to any one of claims 1 to 6, wherein

the enclosure body has a box-like shape with an open side, and the enclosure body houses the user interface device and the control board in a state in which the user interface device is disposed closer to the bottom wall of the enclosure body than the control board,

the operation apparatus further comprises a third insulating member made of a non-conductive material having flexibility and covers the control board from the open side of the enclosure body, and

the third insulating member has a slit that extends on a vertically lower side of an electronic component facing region that faces a corresponding one of the electronic components on the control board and extends, from the vertically lower side, on both of sides thereof in a direction perpendicular to a vertical direction in a state in which the operation apparatus is mounted on a wall material.