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(54) **SECONDARY BATTERY**

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(57) **ABSTRACT**

This secondary battery includes an insulating sheet that covers an electrode assembly, the electrode assembly includes a first surface, the insulating sheet includes a first region constituted of a vicinity of one end portion of the insulating sheet and a second region constituted of a vicinity of the other end portion of the insulating sheet, the first region and the second region cover the first surface, and an overlapping region in which the second region overlaps with the first region is provided, in a width direction of the electrode assembly, the overlapping region includes a central region and an end-portion region located beside each of both sides of the central region, and the central region is provided with a recess as a non-overlapping region that reduces an overlapping area of the overlapping region.

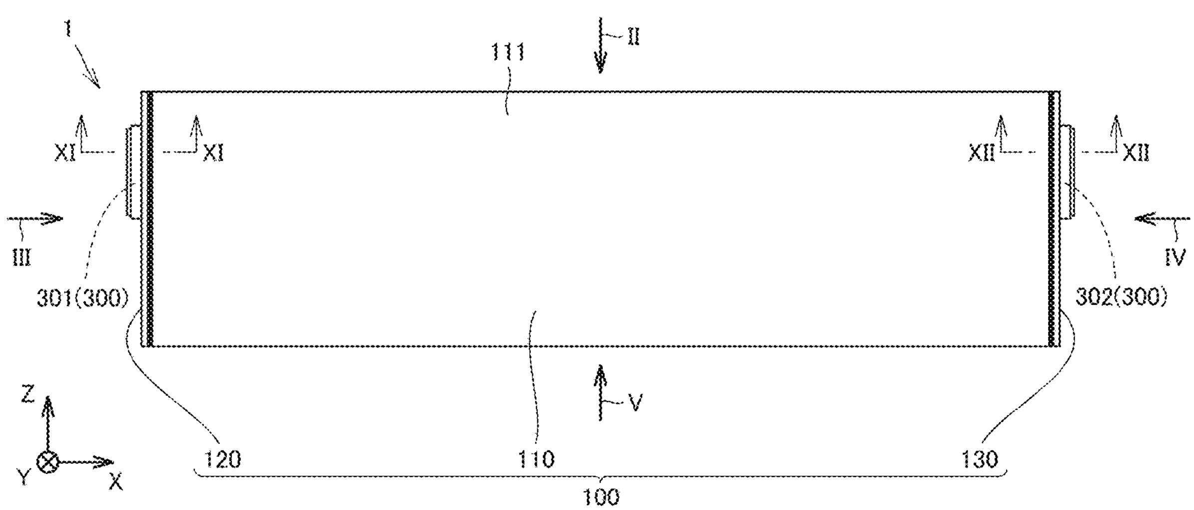


FIG.1

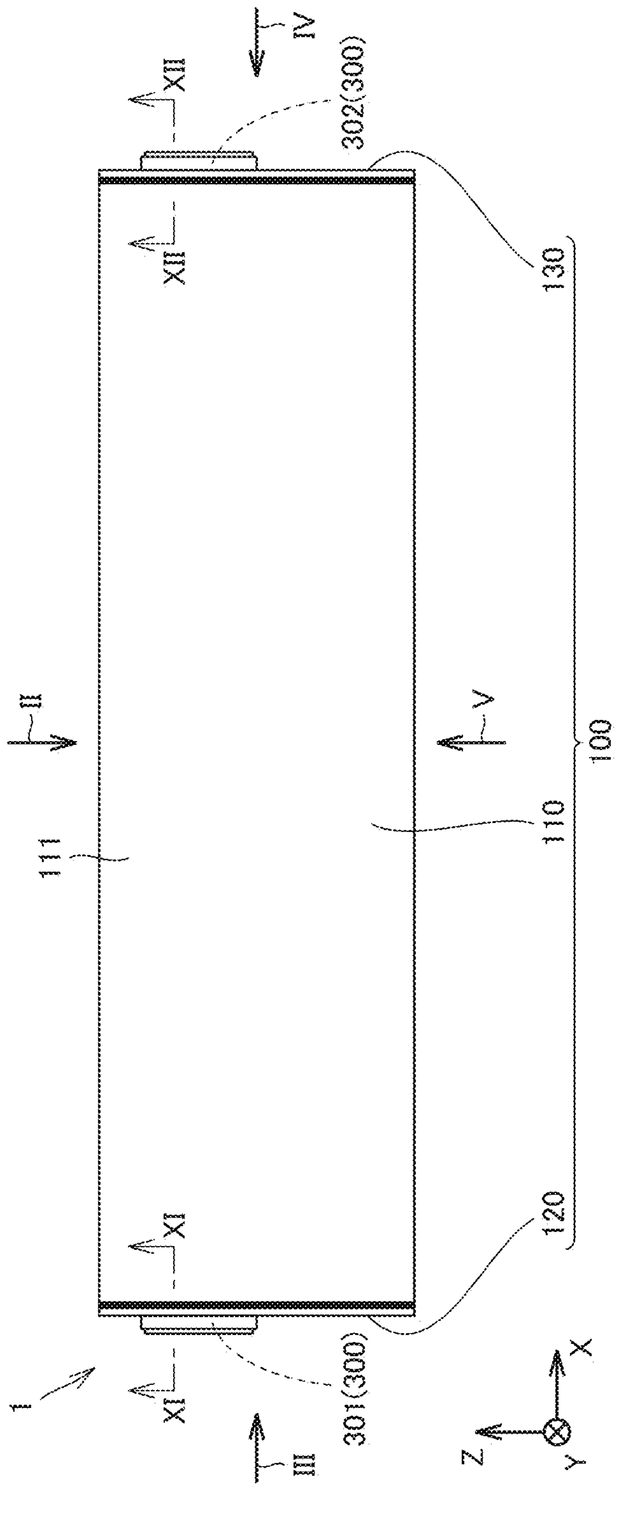


FIG.2

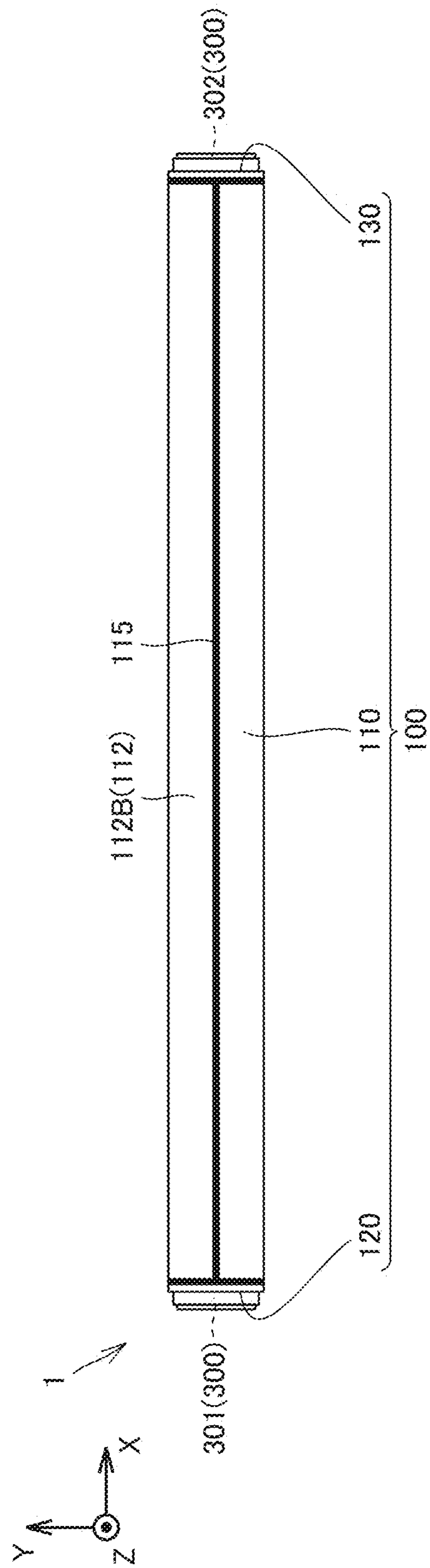


FIG.3

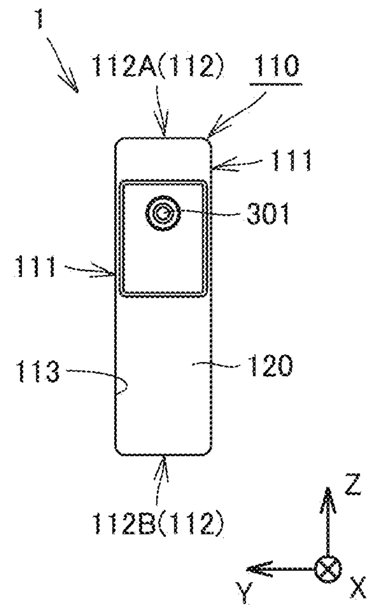

1
112A(112)
110
111
301
111
113
120
112B(112)
Z
Y
X

FIG.4

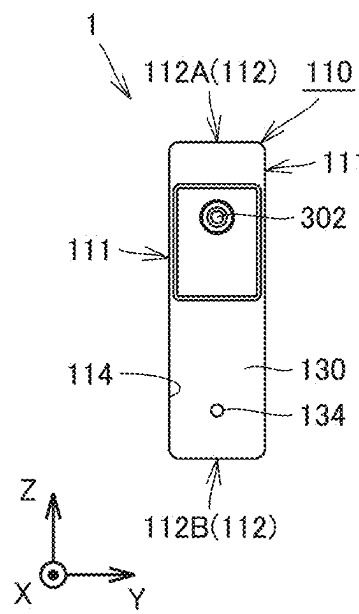

1
112A(112)
110
111
302
111
114
130
134
112B(112)
Z
X
Y

FIG.5

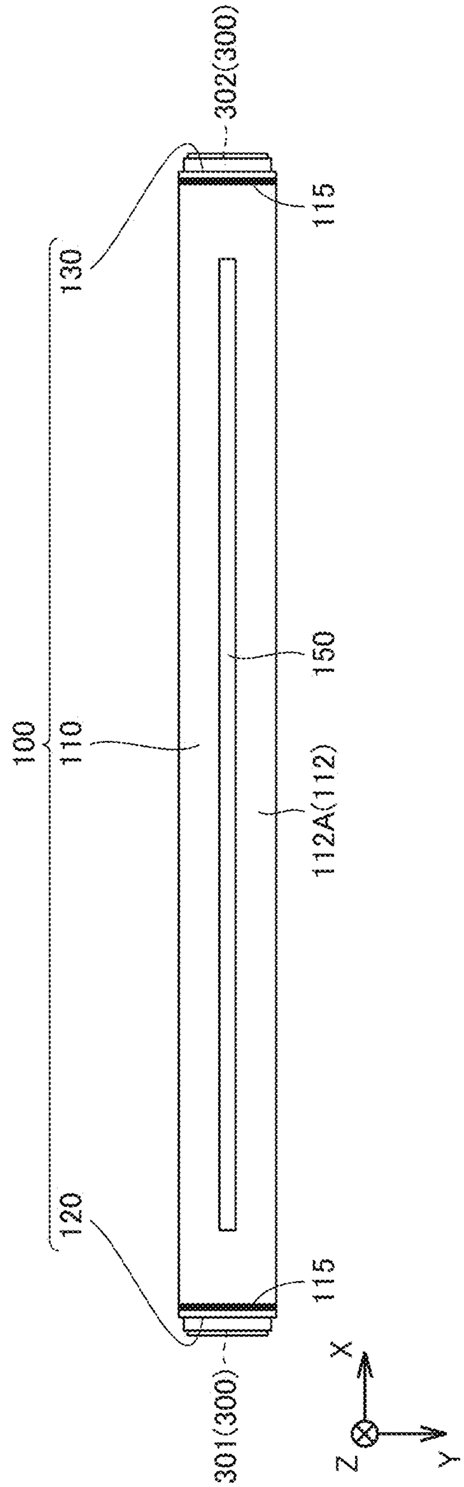


FIG.6

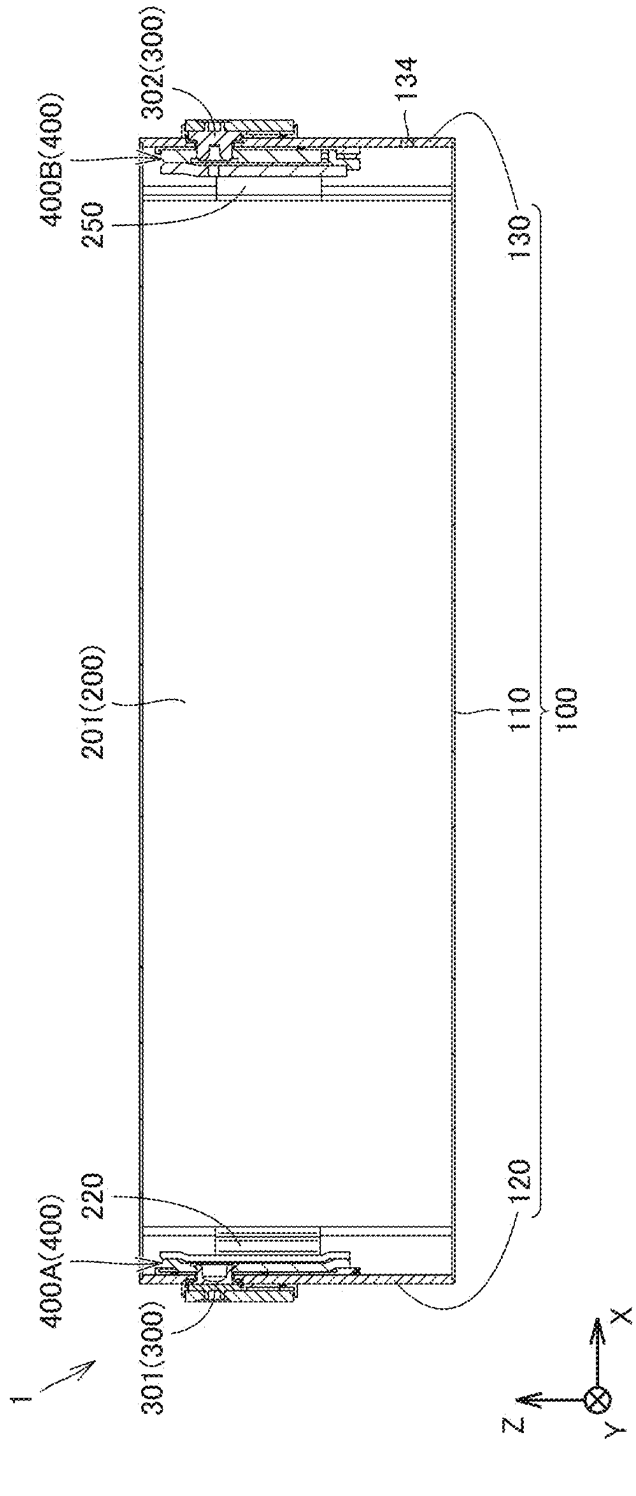

302(300)
134
400B(400)
250
130
201(200)
110
100
220
120
400A(400)
301(300)
1
X
Y
Z

FIG.7

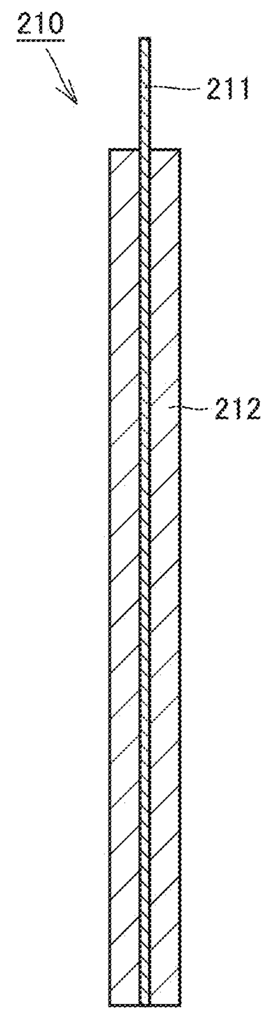


FIG.8

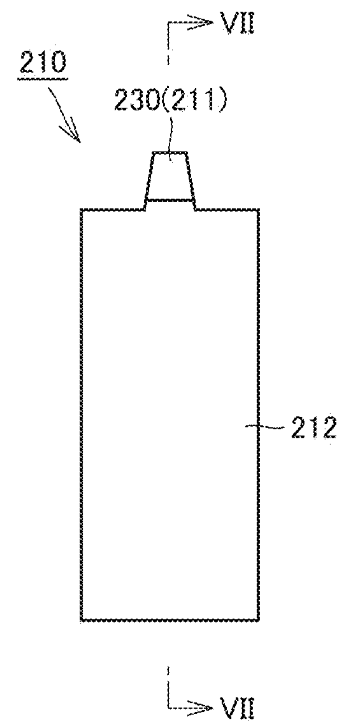


FIG.9

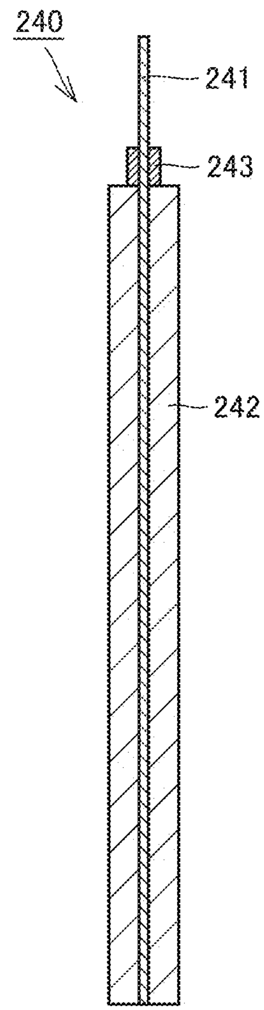
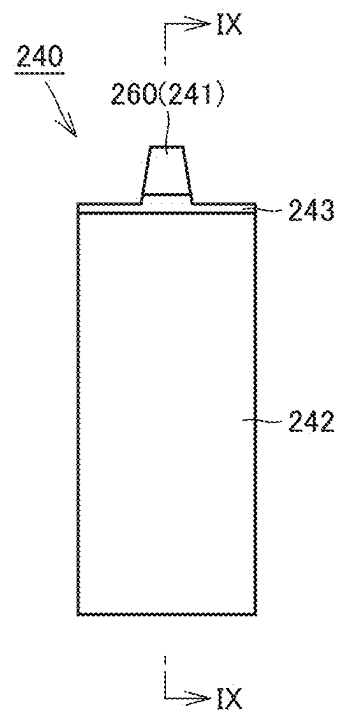
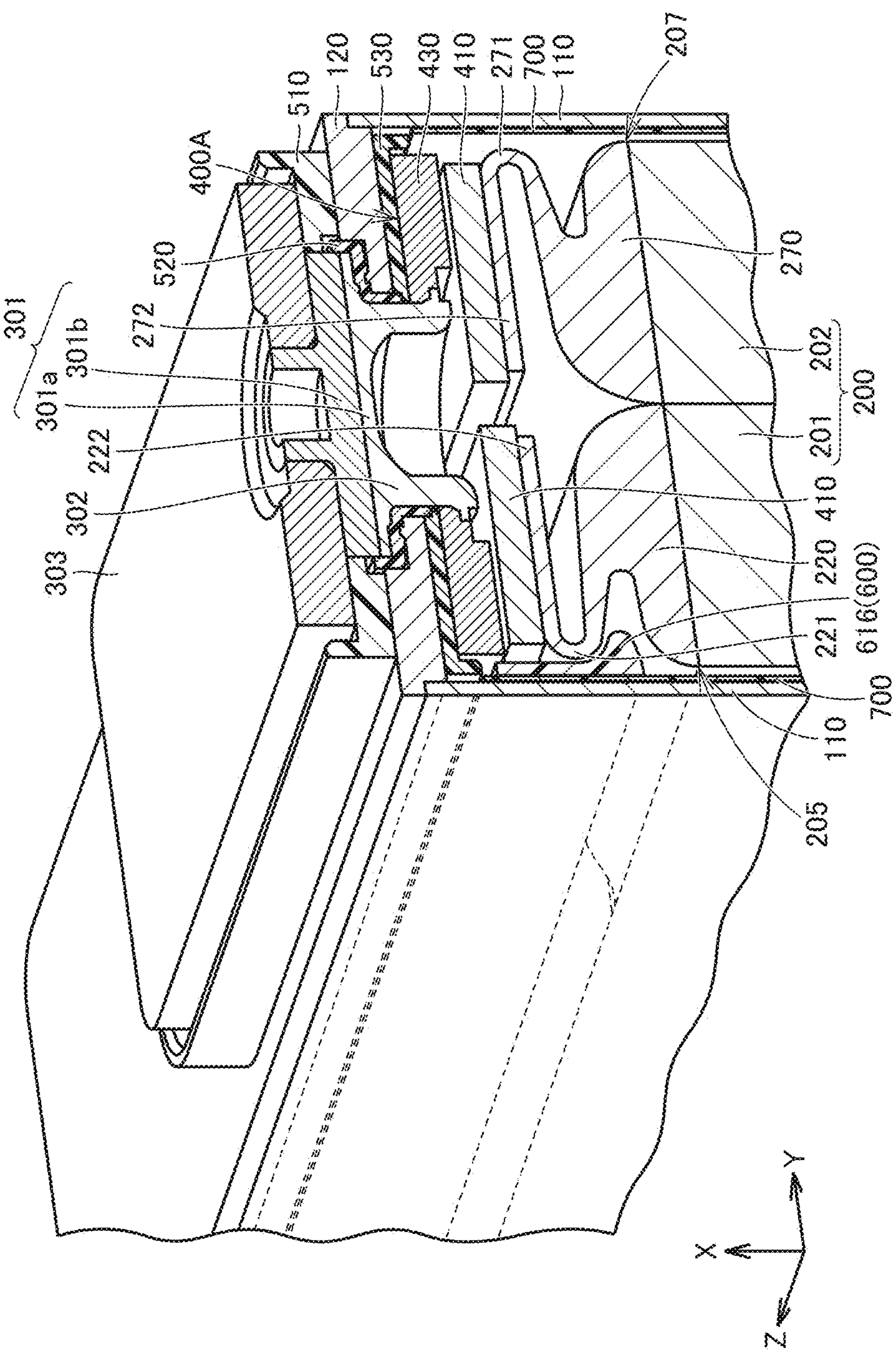


FIG.10





510
120
530
430
410
271
700
110
207
400A
520
301
301b
272
301a
222
302
303
270
202
200
201
410
220
616(600)
221
700
110
205
X
Y
Z

FIG.11

FIG.12

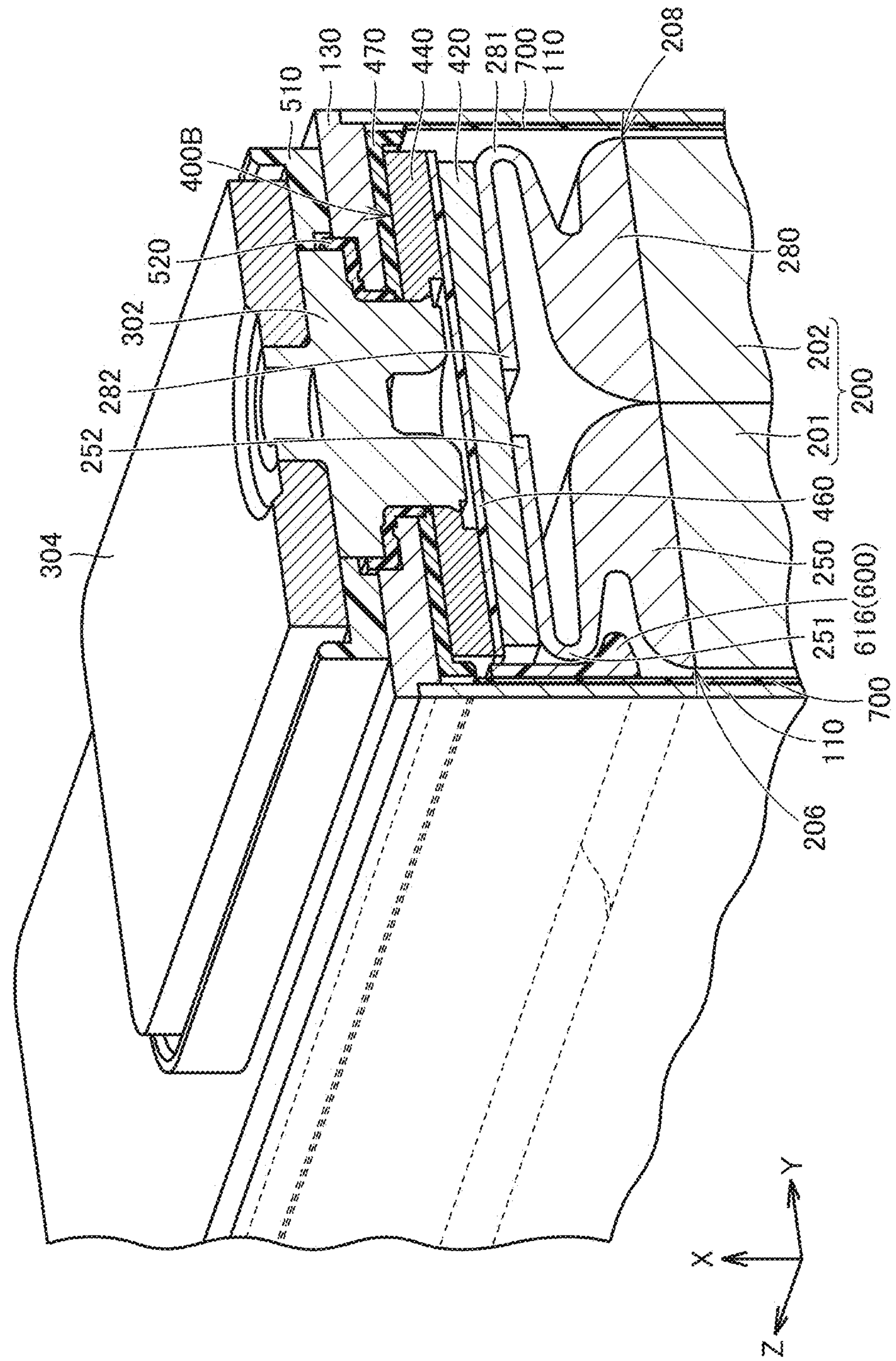

510
130
470
440
420
281
700
110
208
400B
520
302
282
252
304
280
202
200
201
460
250
616(600)
251
700
110
206
X
Y
Z

FIG.13

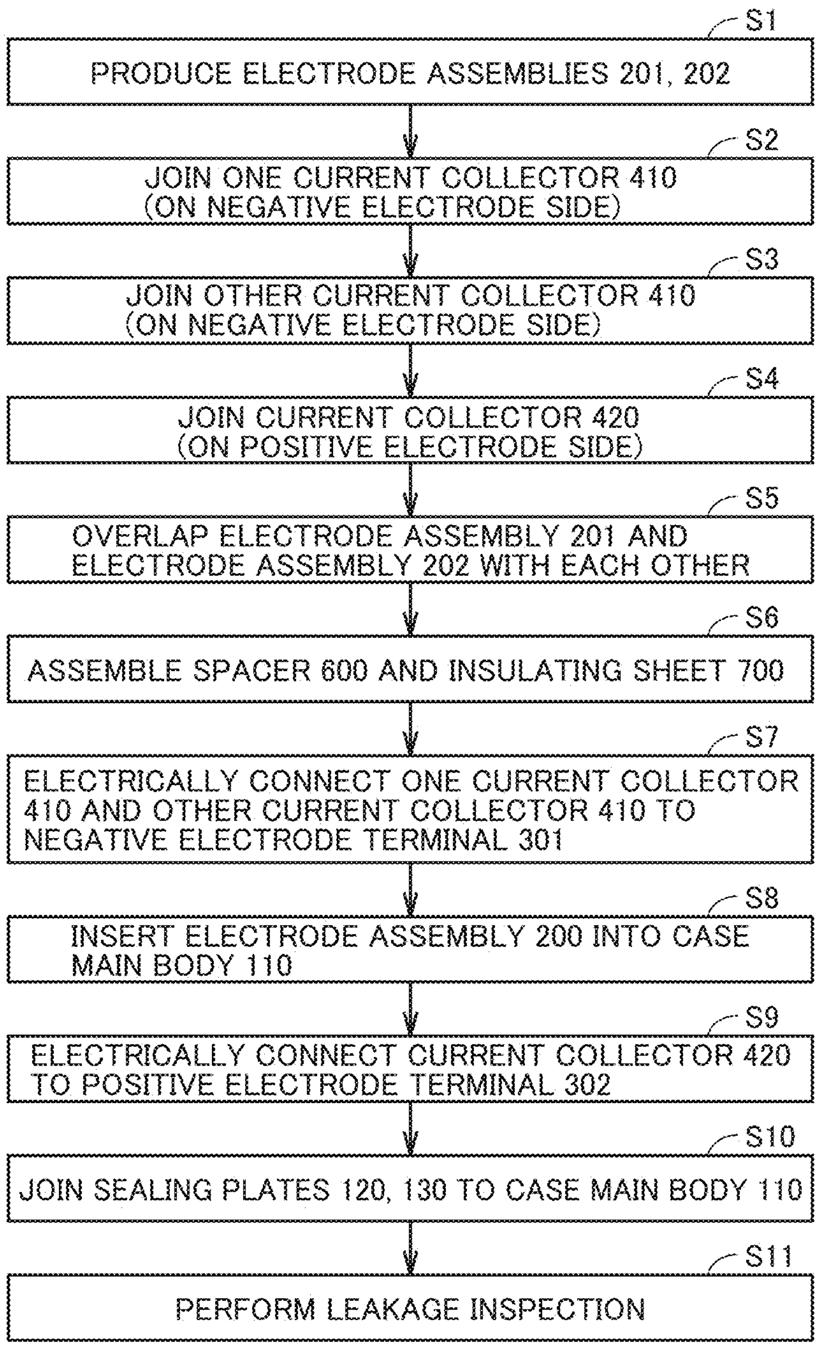

S1
PRODUCE ELECTRODE ASSEMBLIES 201, 202
S2
JOIN ONE CURRENT COLLECTOR 410 (ON NEGATIVE ELECTRODE SIDE)
S3
JOIN OTHER CURRENT COLLECTOR 410 (ON NEGATIVE ELECTRODE SIDE)
S4
JOIN CURRENT COLLECTOR 420 (ON POSITIVE ELECTRODE SIDE)
S5
OVERLAP ELECTRODE ASSEMBLY 201 AND ELECTRODE ASSEMBLY 202 WITH EACH OTHER
S6
ASSEMBLE SPACER 600 AND INSULATING SHEET 700
S7
ELECTRICALLY CONNECT ONE CURRENT COLLECTOR 410 AND OTHER CURRENT COLLECTOR 410 TO NEGATIVE ELECTRODE TERMINAL 301
S8
INSERT ELECTRODE ASSEMBLY 200 INTO CASE MAIN BODY 110
S9
ELECTRICALLY CONNECT CURRENT COLLECTOR 420 TO POSITIVE ELECTRODE TERMINAL 302
S10
JOIN SEALING PLATES 120, 130 TO CASE MAIN BODY 110
S11
PERFORM LEAKAGE INSPECTION

FIG.14

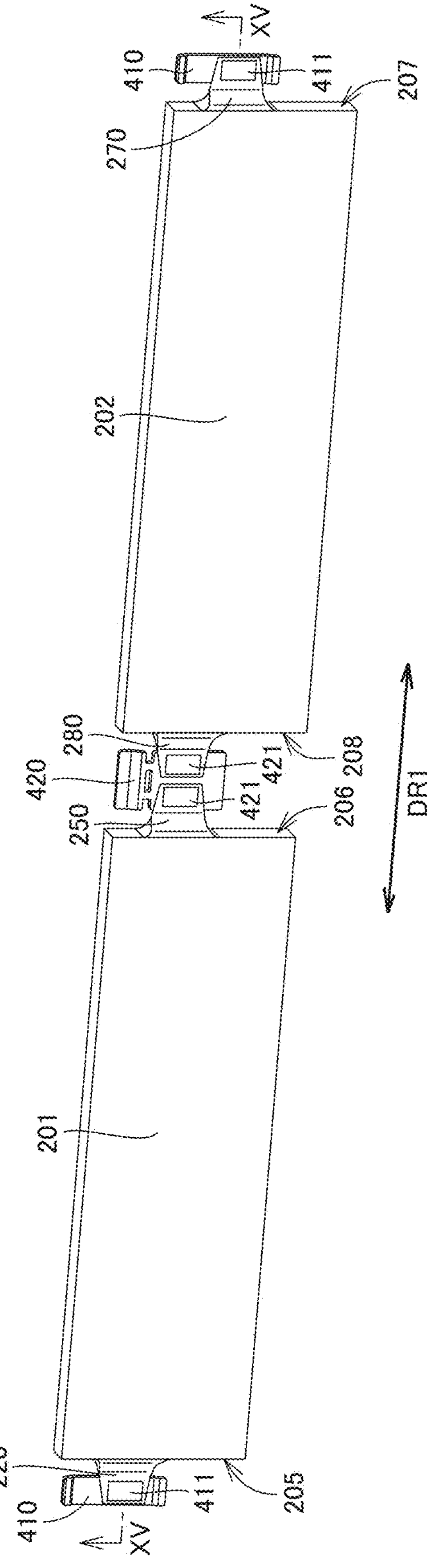

XV
410
411
207
270
202
280
420
421
421
208
206
250
DR1
201
220
205
411
410
XV

FIG.15

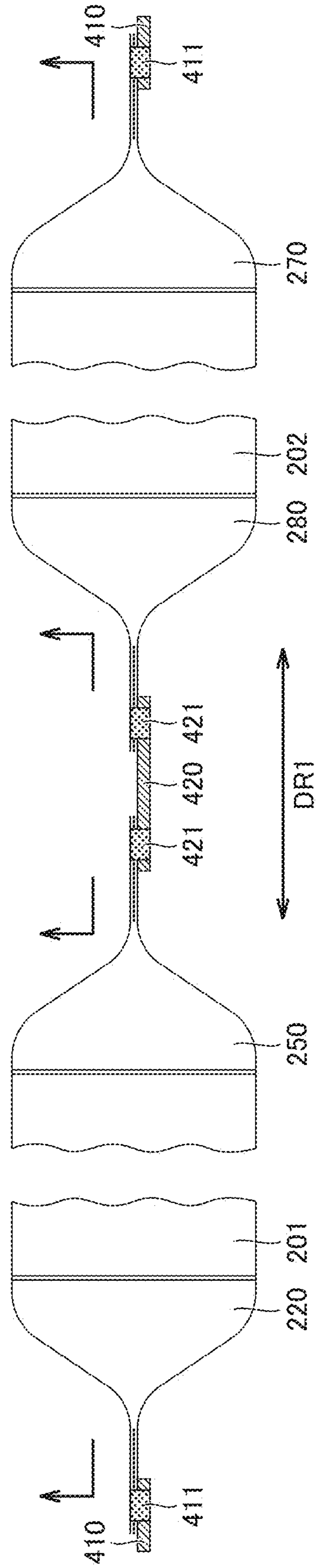


FIG.16

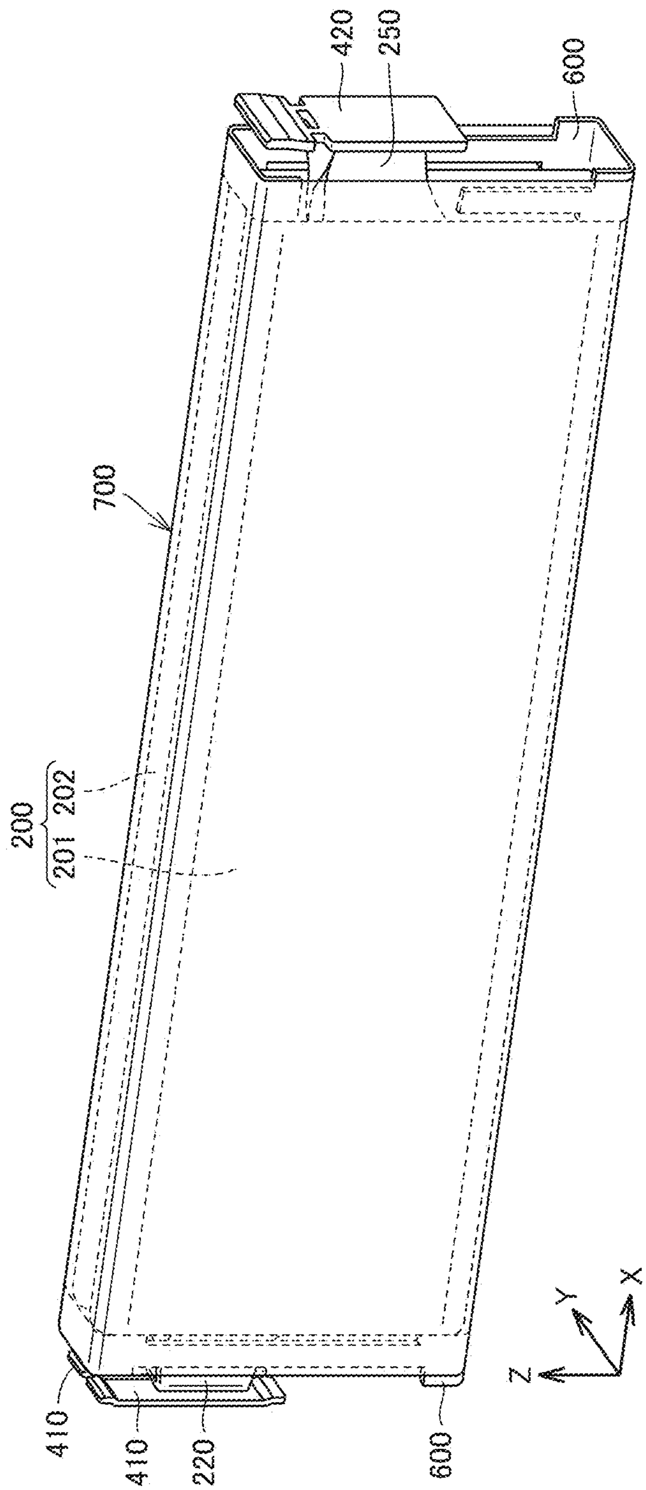
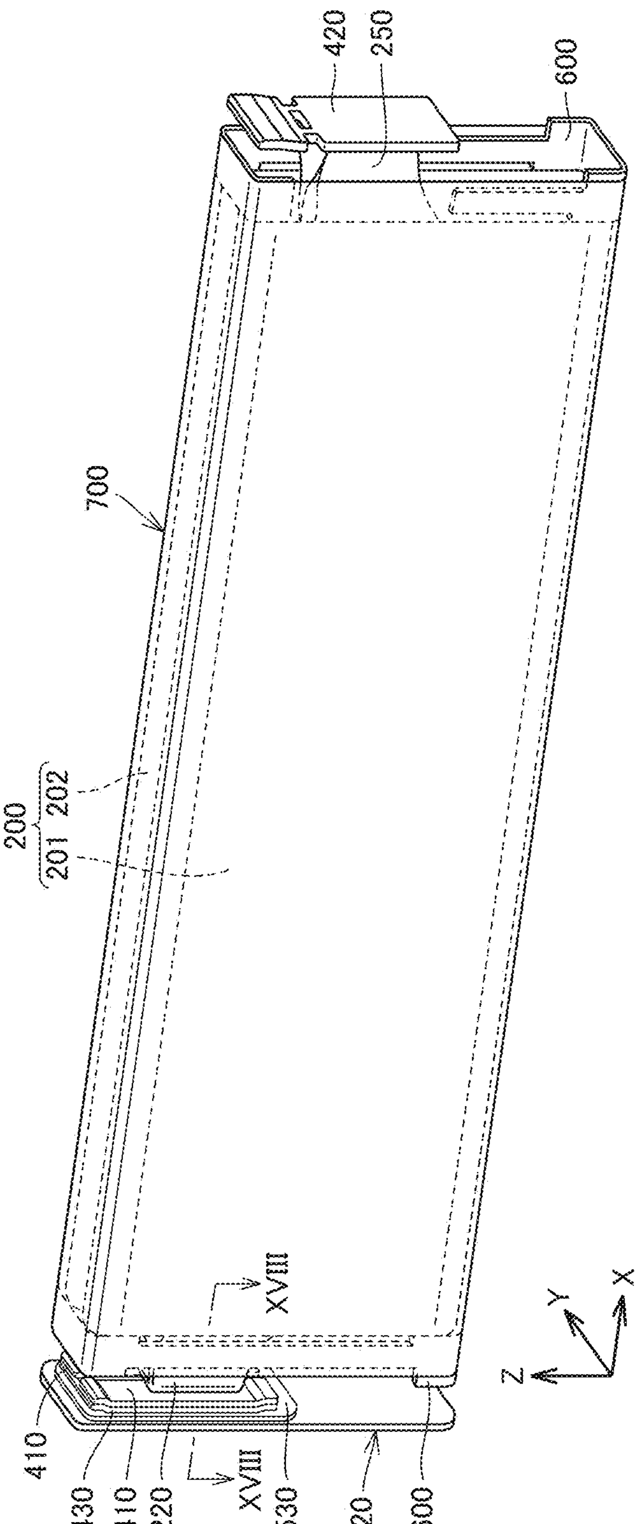


FIG.17



420
250
600
700
200
201
202
XVIII
Z
Y
X
410
430
410
220
XVIII
530
120
600

FIG.18

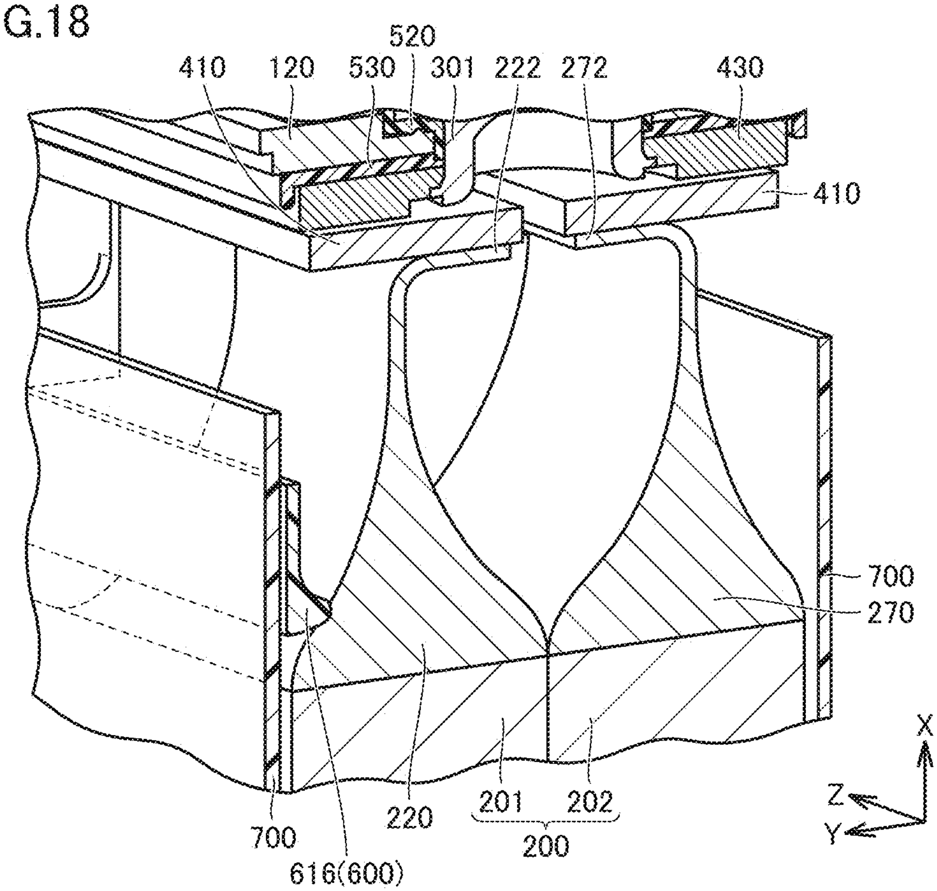

520
410
120
530
301
222
272
430
410
700
270
X
Z
Y
700
616(600)
220
201
202
200

FIG.19

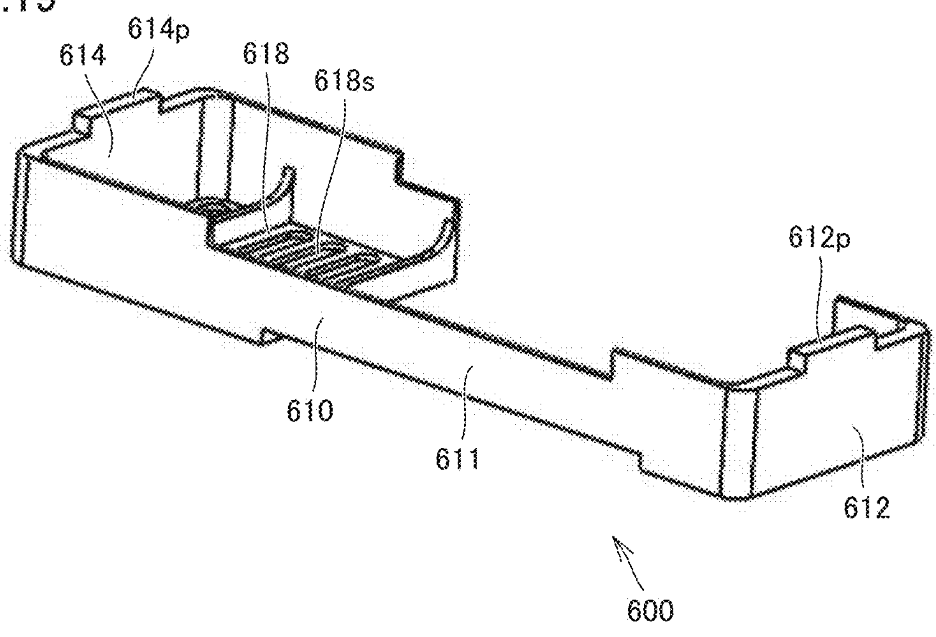

614p
614
618
618s
612p
610
611
612
600

FIG.20

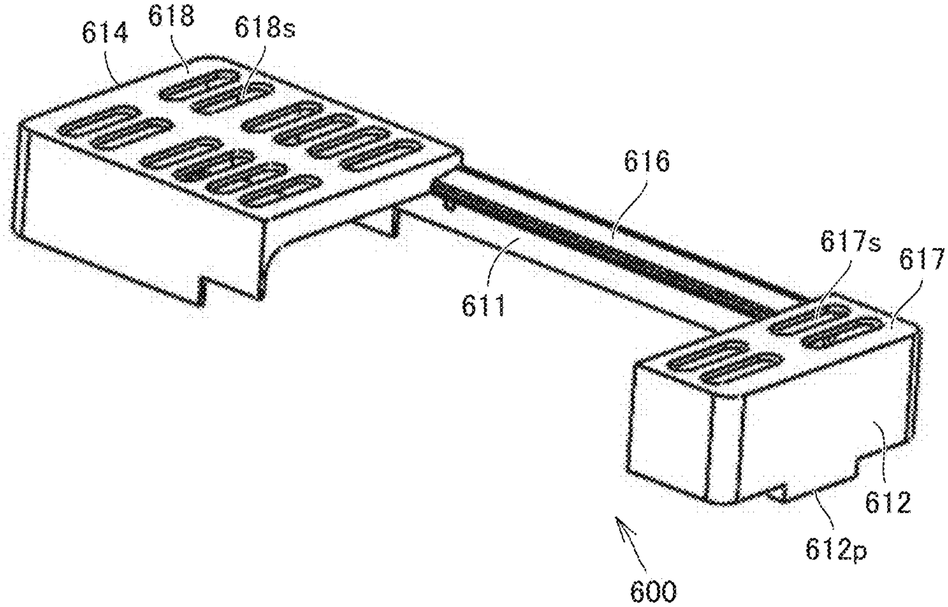
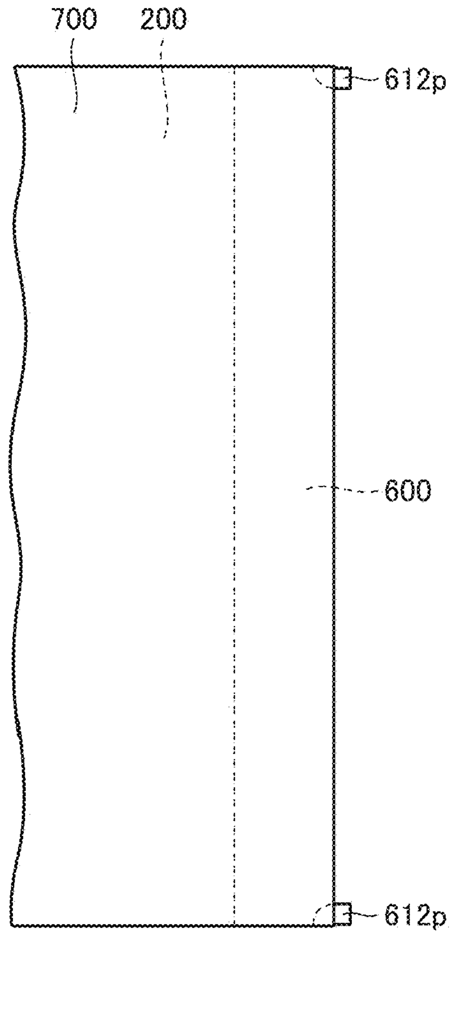

614
618
618s
616
617s
617
611
612
612p
600

FIG.21


700
200
612p
600
612p

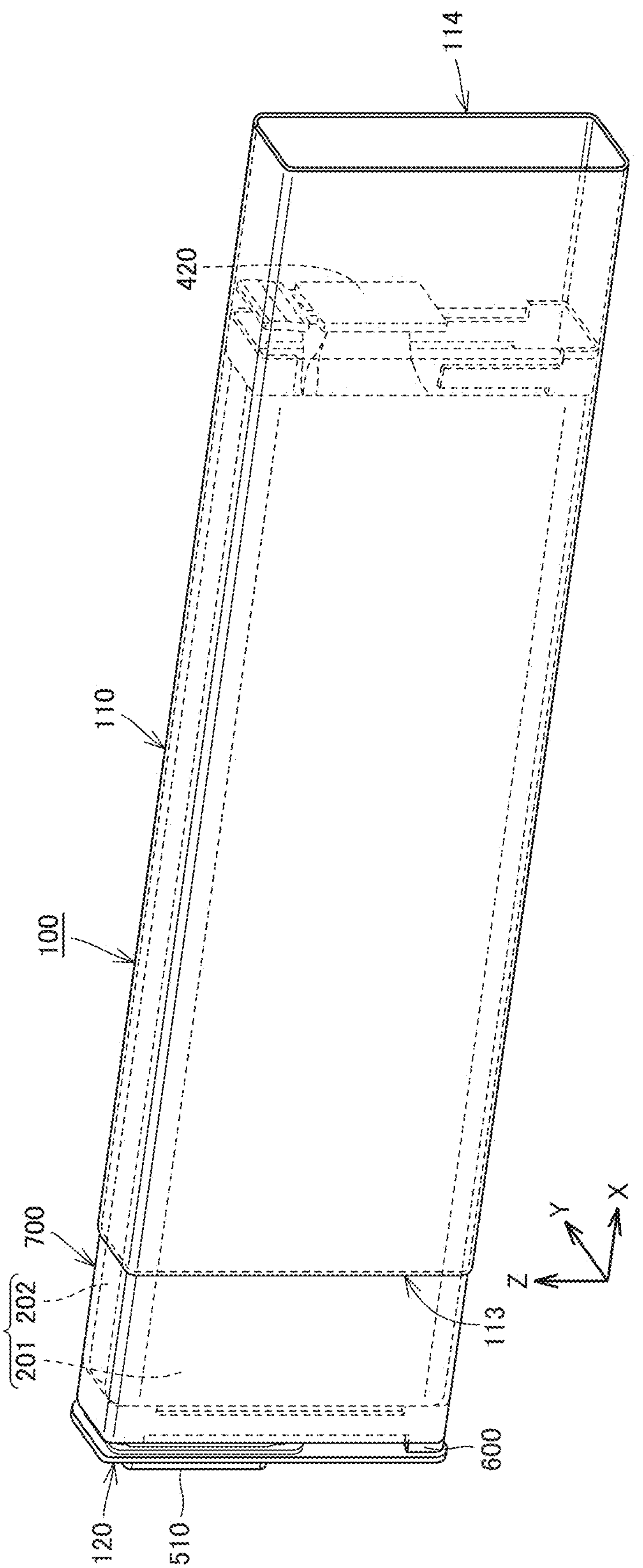


FIG.22

FIG.23

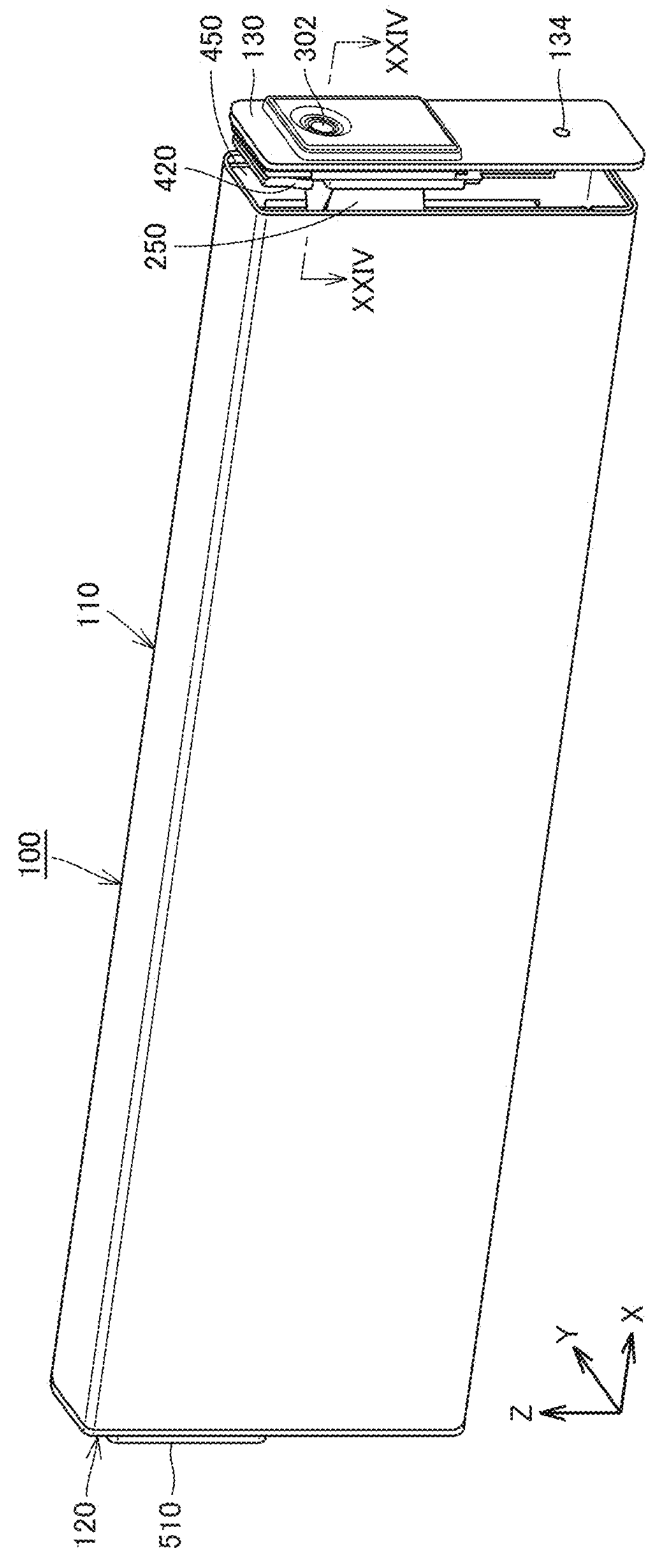


FIG.24

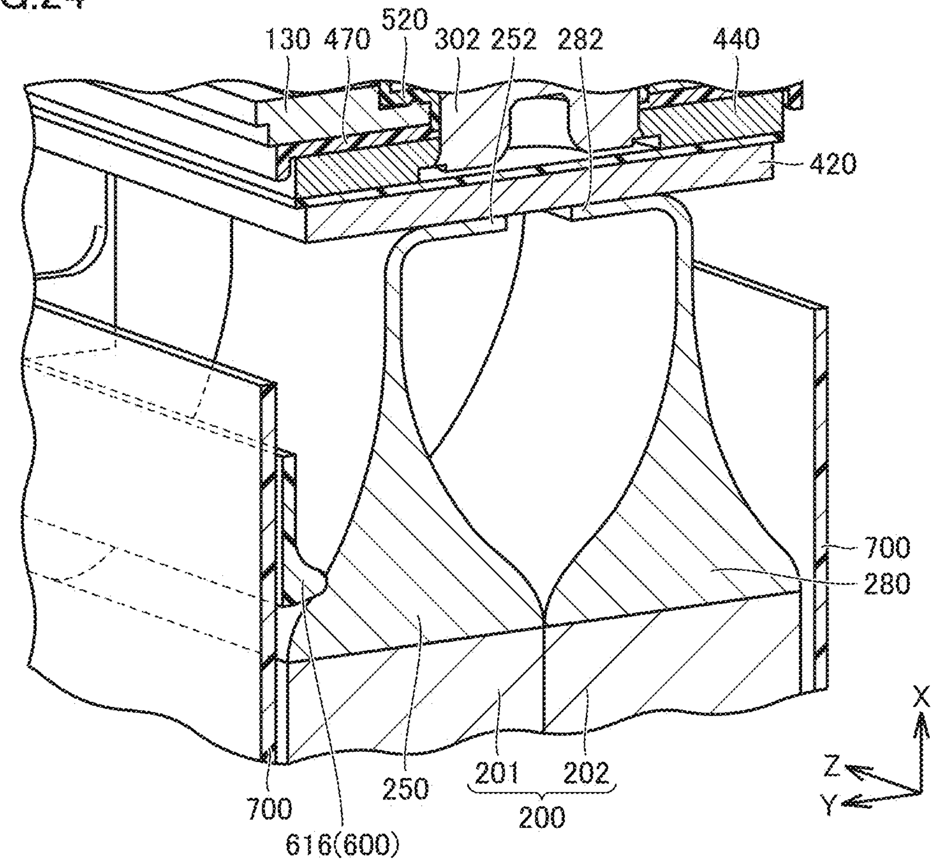

130
470
520
302
252
282
440
420
700
280
700
250
201
202
200
616(600)
X
Z
Y

FIG.25

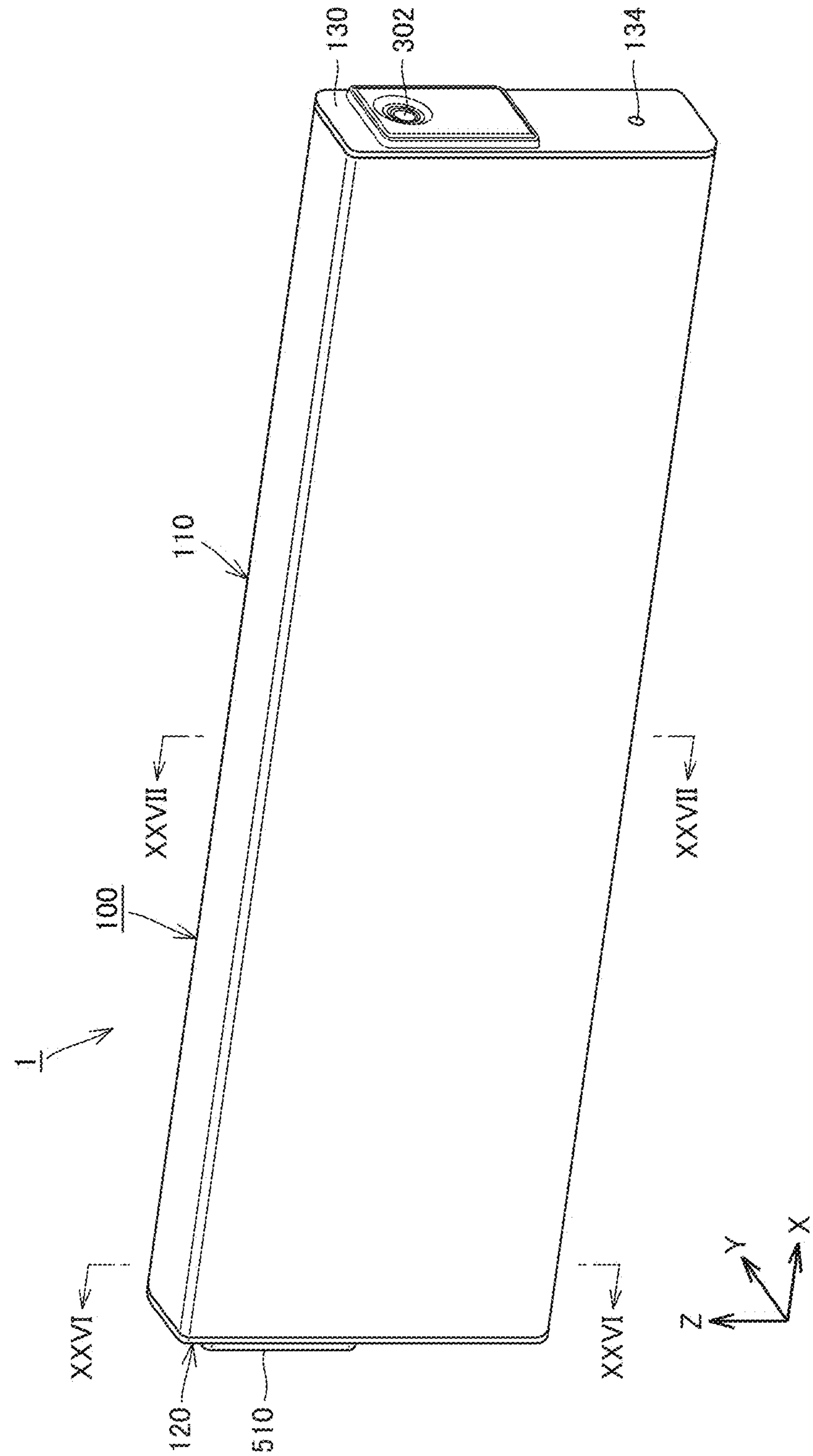


FIG.26

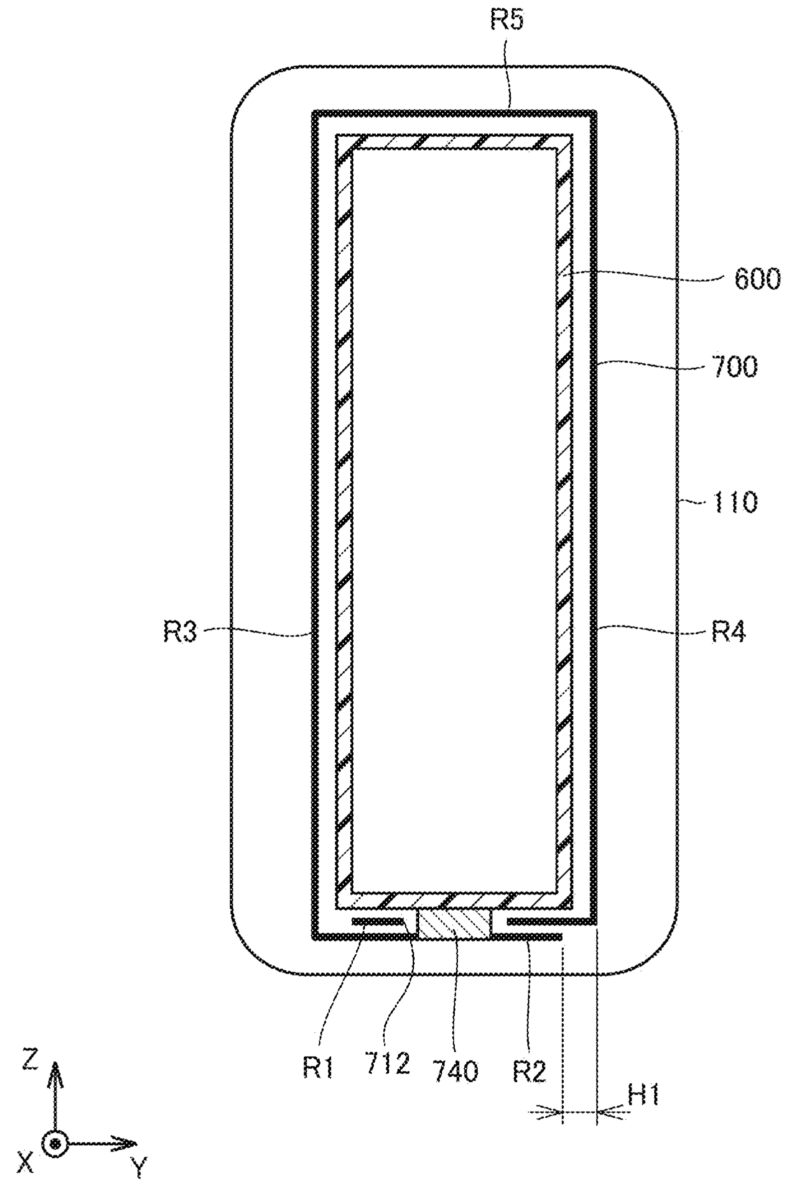


FIG.27

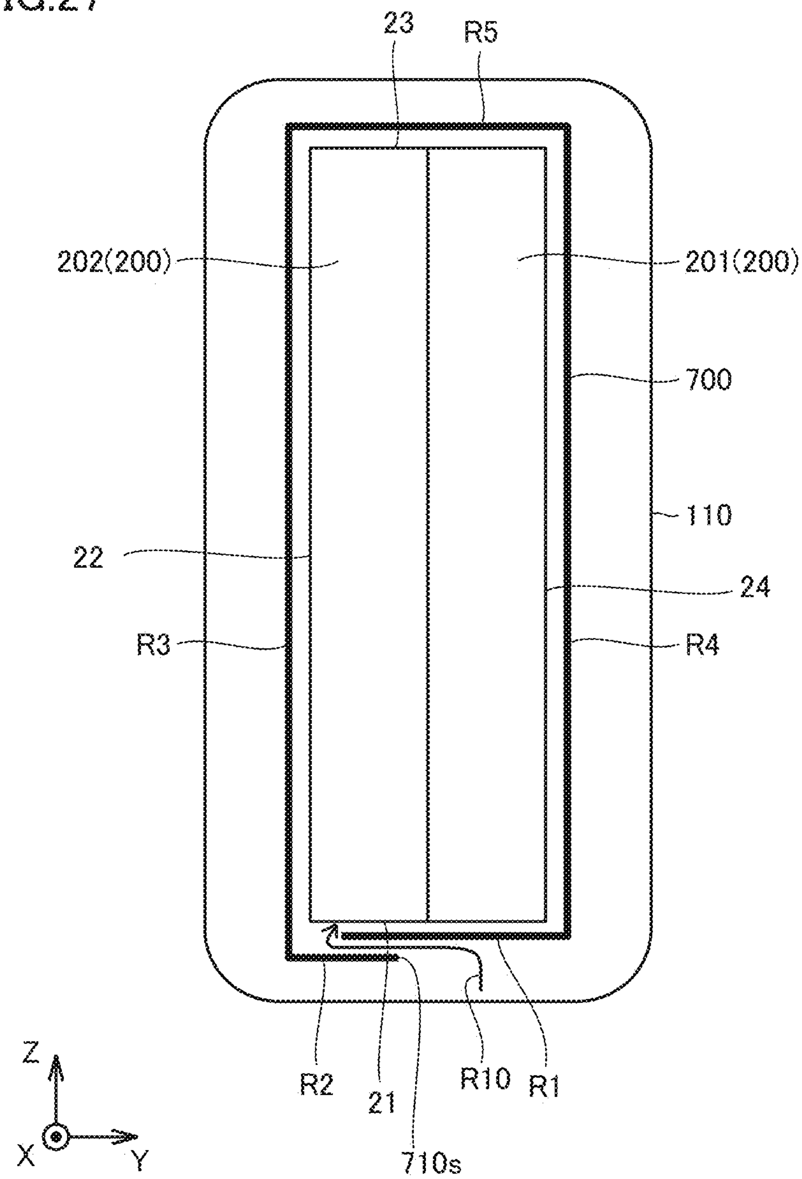
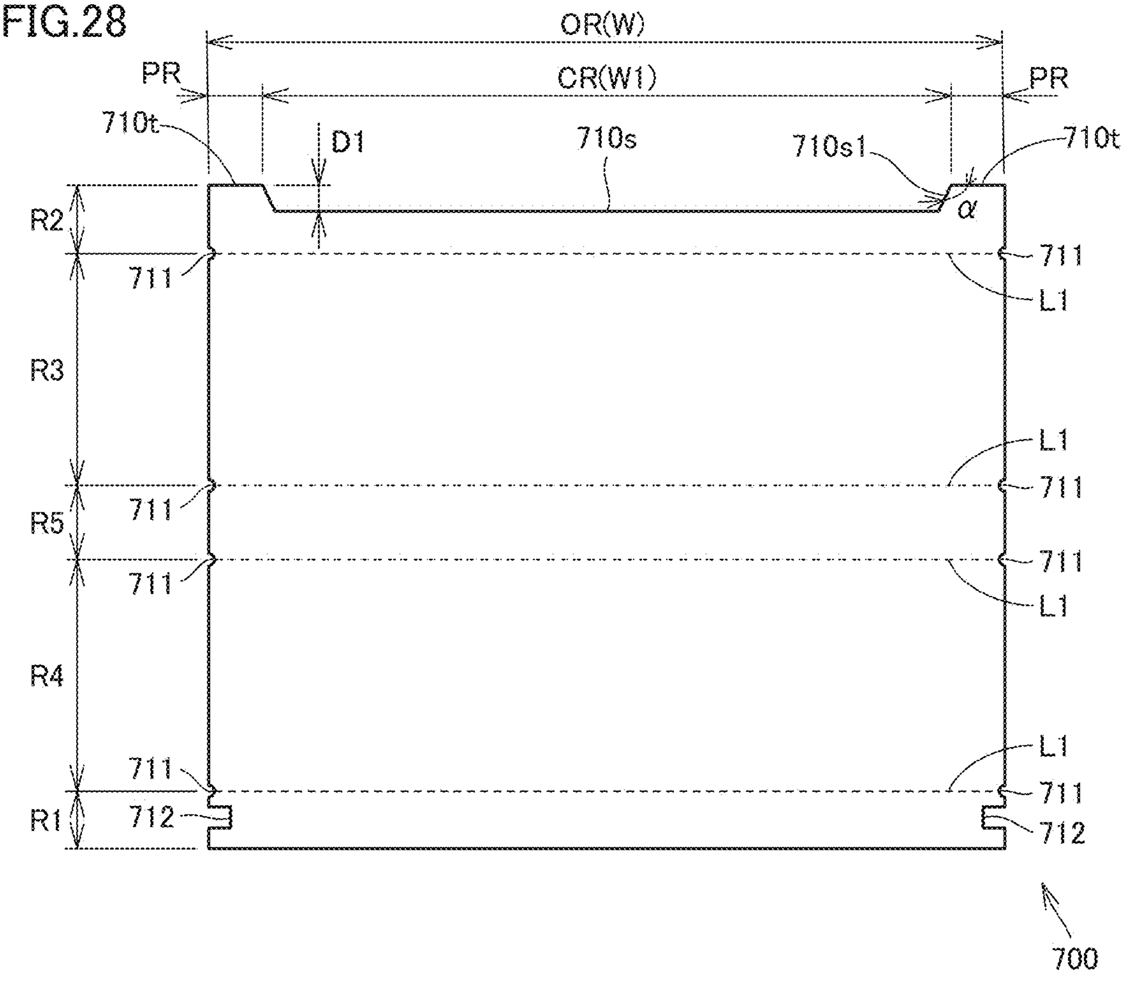


FIG.28



OR(W)
PR
CR(W1)
PR
710t
D1
710s
710s1
710t
α
R2
711
711
L1
R3
L1
711
R5
711
711
711
L1
R4
711
L1
711
R1
712
712
700

FIG.29

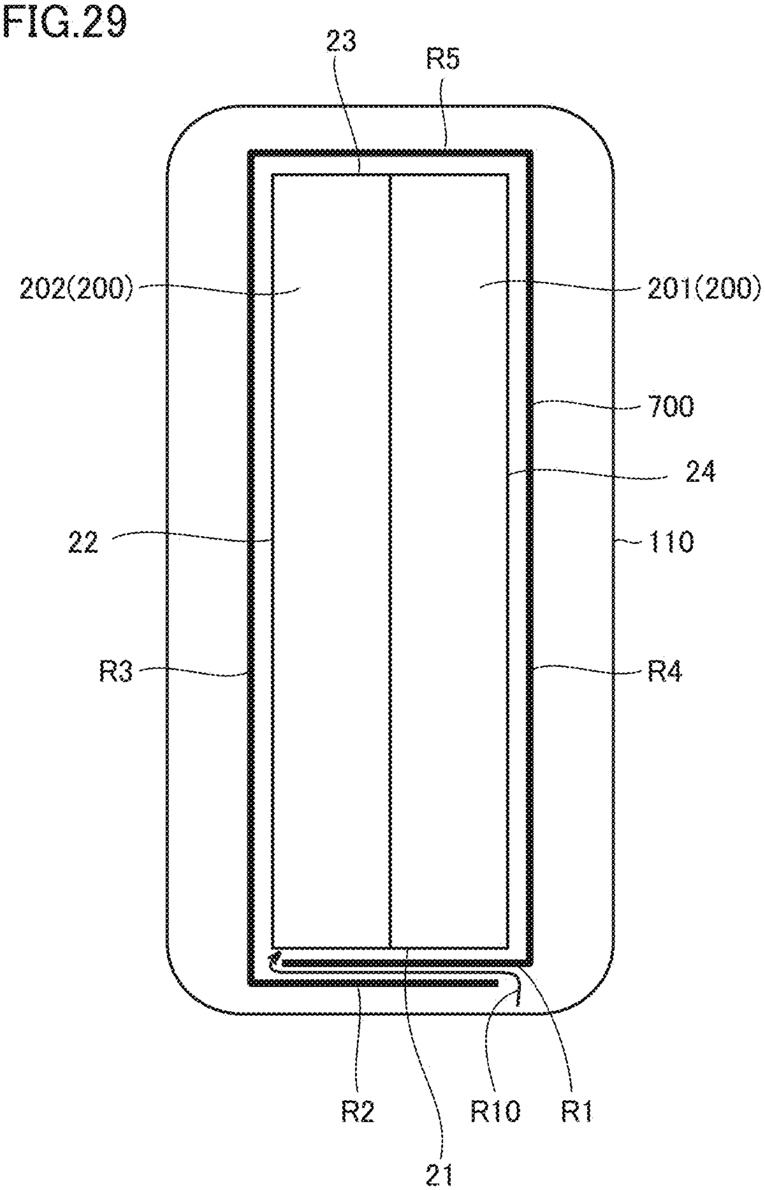


FIG.30

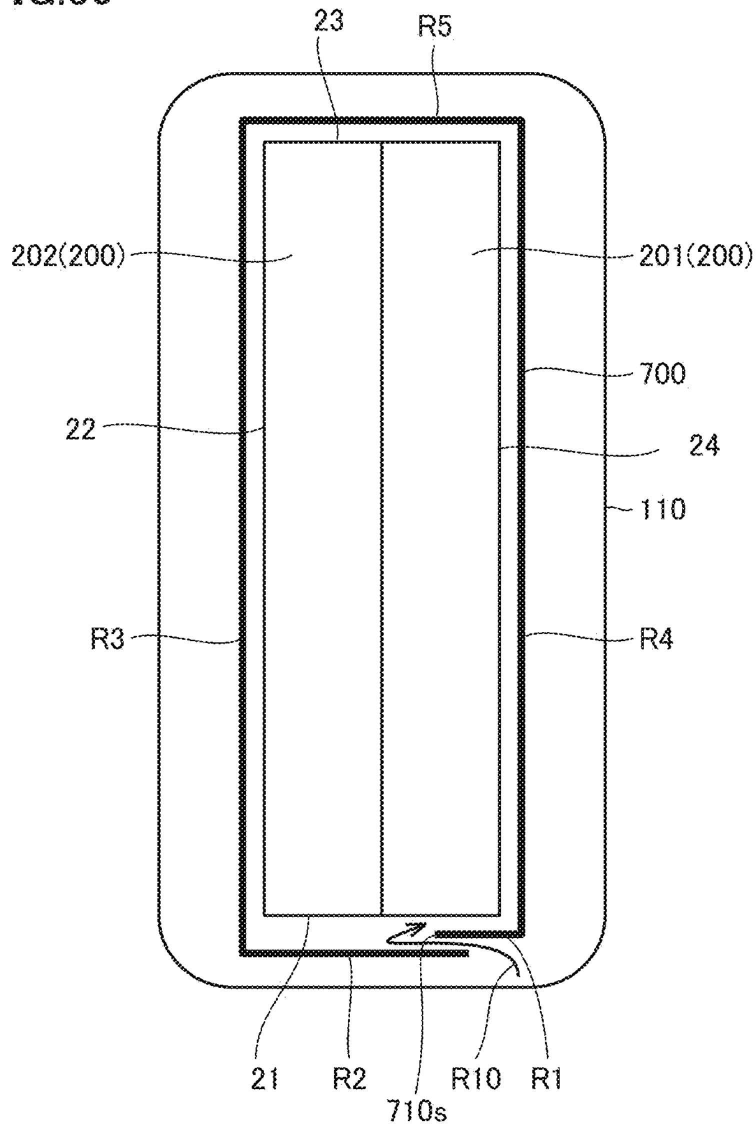


FIG.31

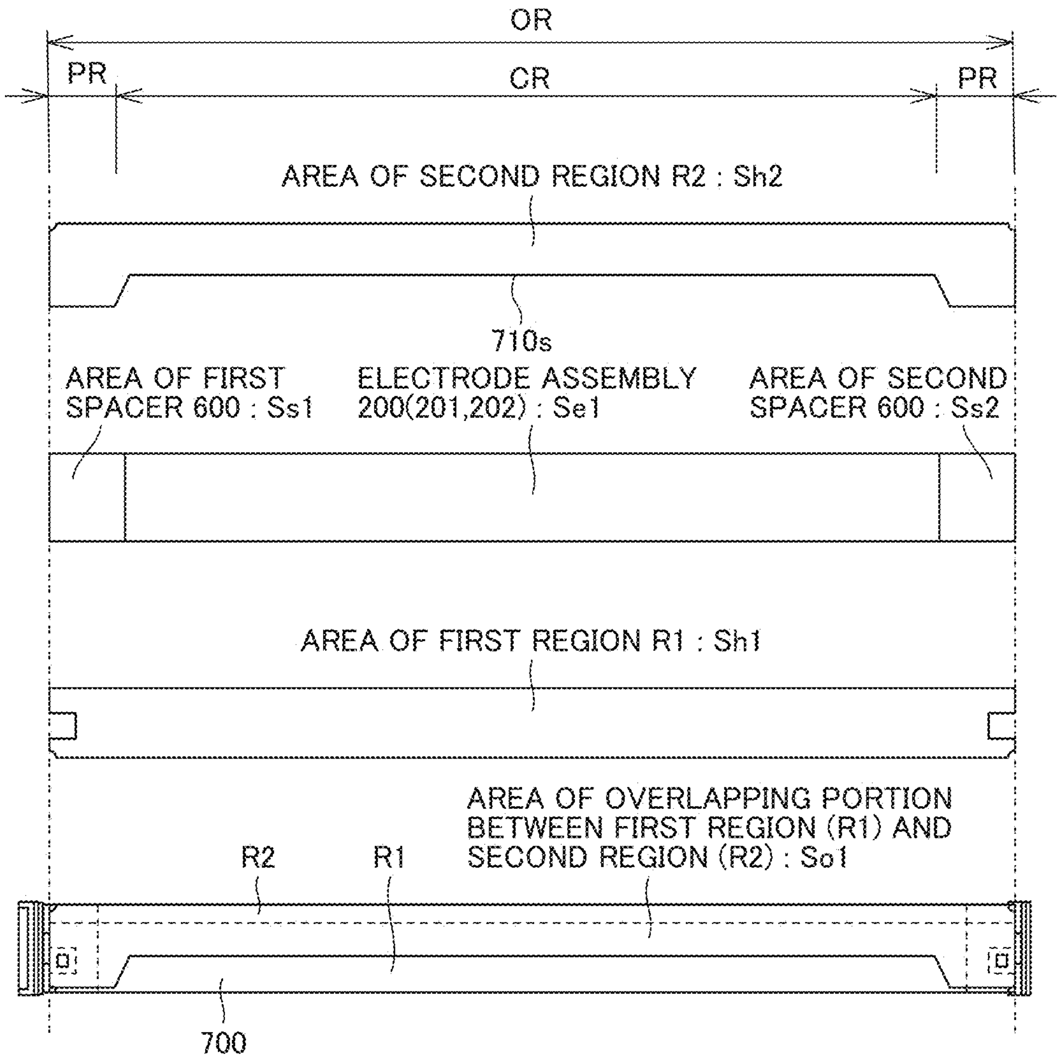

OR
PR
CR
PR
AREA OF SECOND REGION R2 : Sh2
710s
AREA OF FIRST
SPACER 600 : Ss1
ELECTRODE ASSEMBLY
200(201,202) : Se1
AREA OF SECOND
SPACER 600 : Ss2
AREA OF FIRST REGION R1 : Sh1
AREA OF OVERLAPPING PORTION
BETWEEN FIRST REGION (R1) AND
SECOND REGION (R2) : So1
R2
R1
700

FIG.32

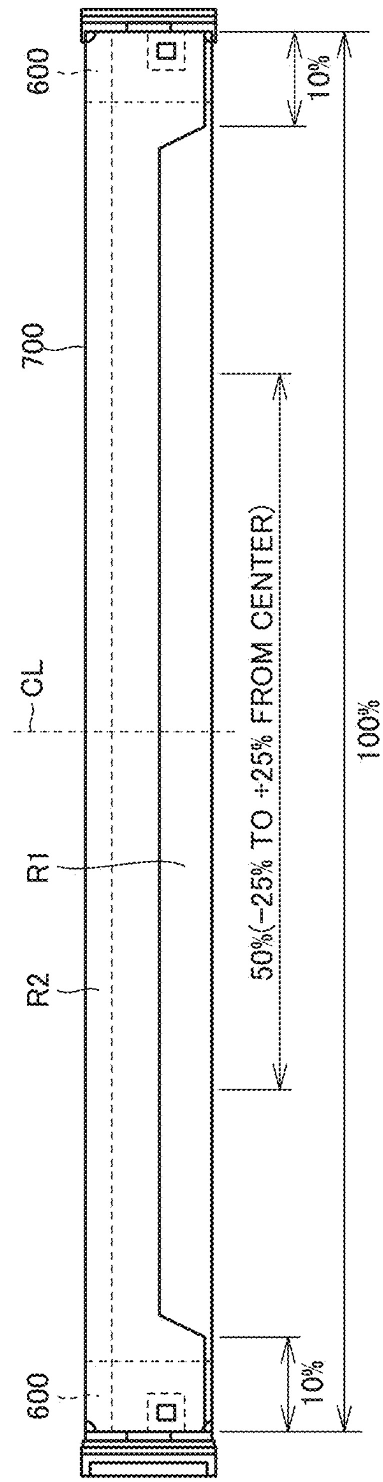


FIG.33

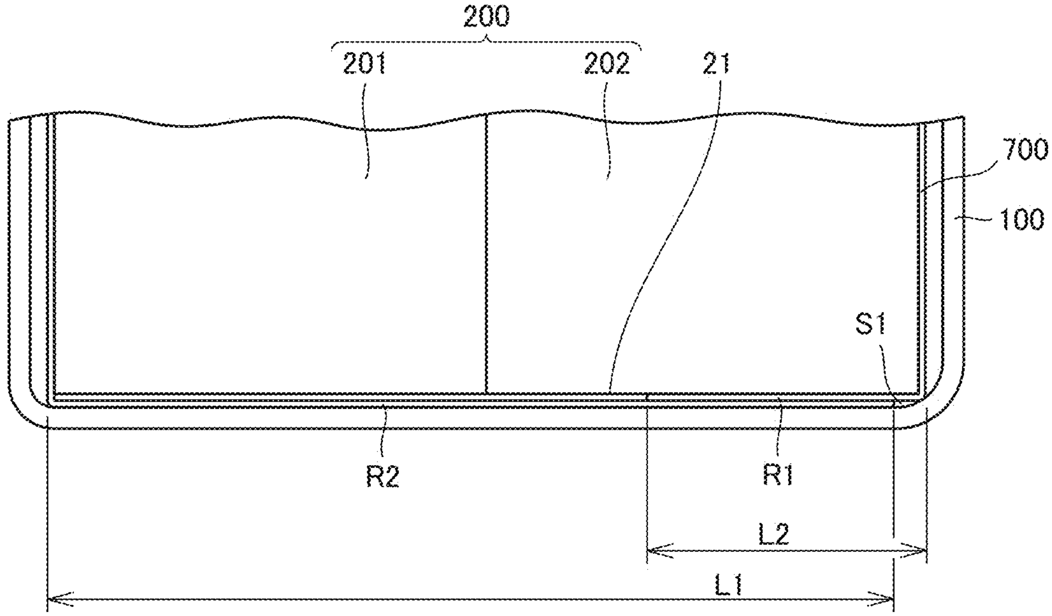

200
201
202
21
700
100
S1
R2
R1
L2
L1

FIG.34

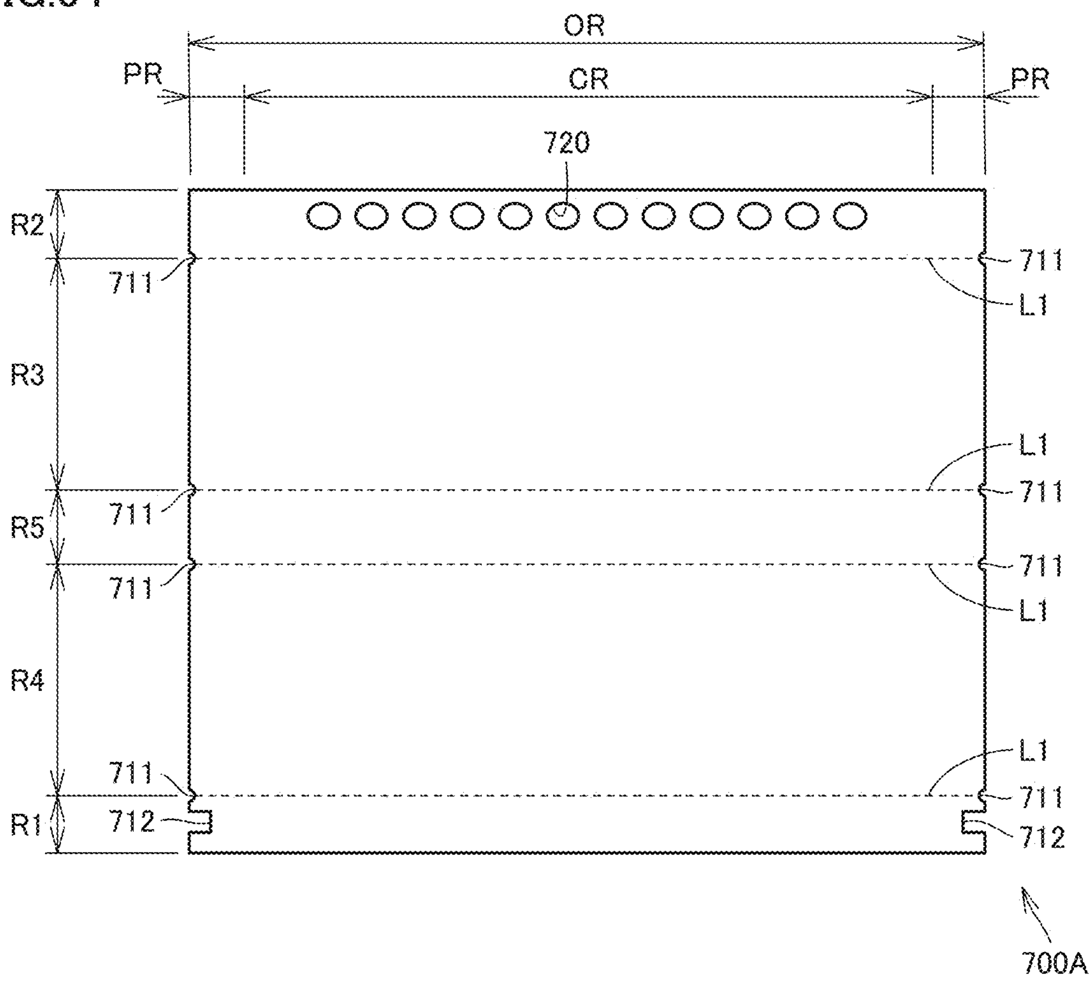

OR
PR
CR
PR
720
R2
711
711
L1
R3
L1
711
R5
711
711
711
L1
R4
711
L1
711
R1
712
712
700A

FIG.35

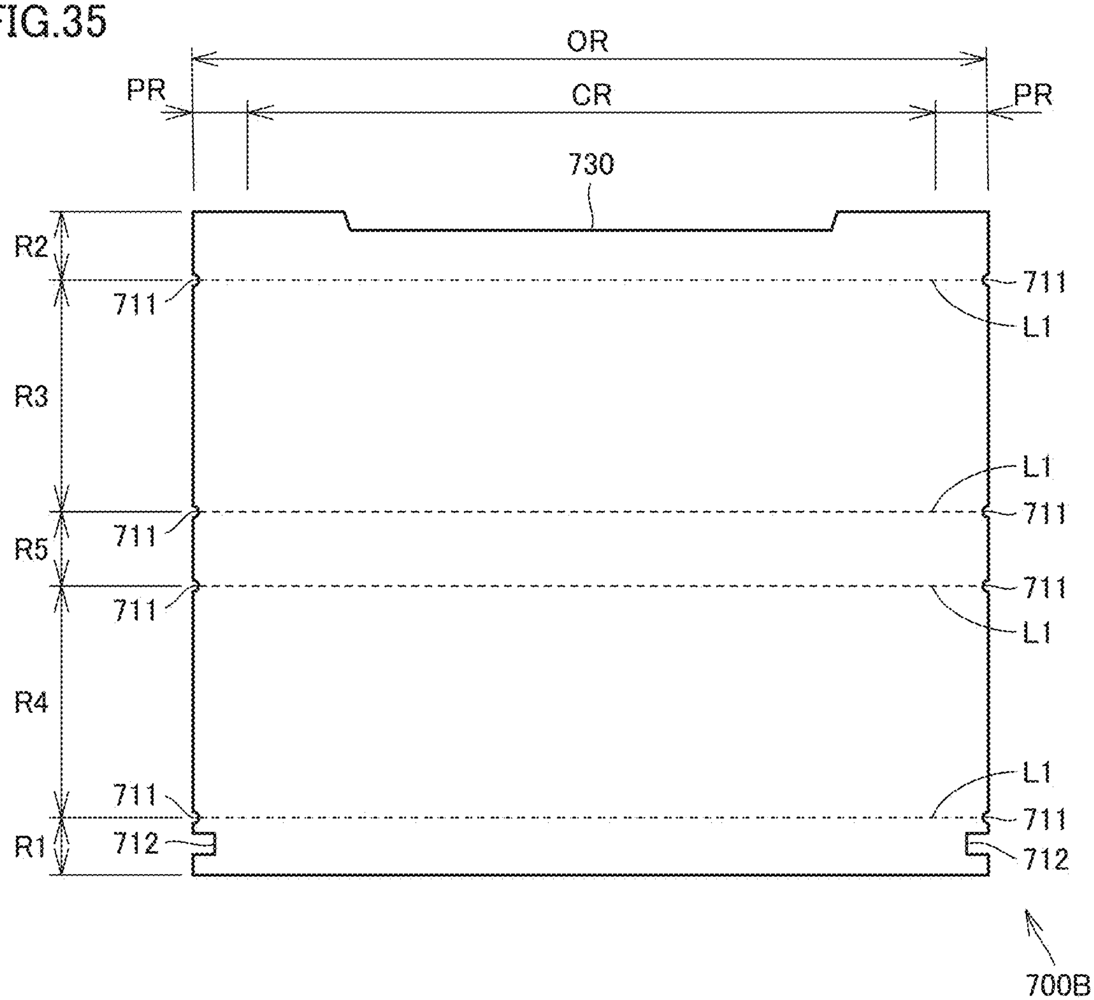
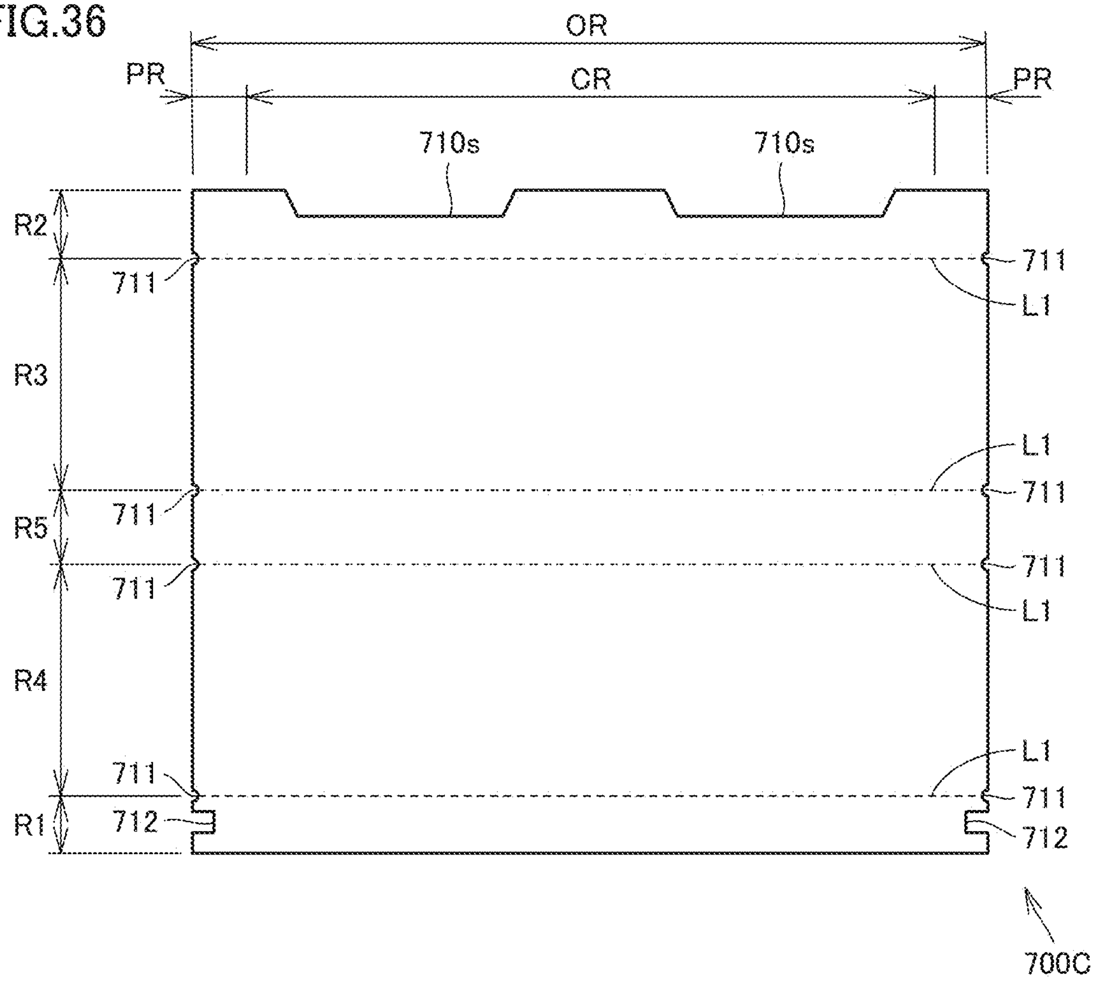

OR
PR
CR
PR
730
R2
711
711
L1
R3
L1
711
R5
711
711
711
L1
R4
711
L1
711
R1
712
712
700B

FIG.36



OR
PR
CR
PR
710s
710s
R2
711
711
L1
R3
L1
711
R5
711
711
711
L1
R4
L1
711
711
R1
712
712
700C

SECONDARY BATTERY

CROSS REFERENCE TO RELATED APPLICATIONS

[0001] This nonprovisional application is based on Japanese Patent Application No. 2024-021240 filed on Feb. 15, 2024 with the Japan Patent Office, the entire contents of which are hereby incorporated by reference.

BACKGROUND OF THE INVENTION

Field of the Invention

[0002] The present technology relates to a secondary battery.

Description of the Background Art

[0003] Japanese Patent No. 4537353 discloses a prismatic battery in which a positive electrode terminal is provided on a side surface on one side and a negative electrode terminal is provided at an end portion on the other side in a battery case.

SUMMARY OF THE INVENTION

[0004] When a prismatic battery is configured such that a positive electrode terminal is provided on a side surface on one side and a negative electrode terminal is provided at an end portion on the other side in the battery case, a battery assembly can be likely to have a low height. However, there is room for further improvement in order to obtain a battery that can be manufactured efficiently and stably. For example, injection of an electrolyte solution needs to take a long time or needs to be performed a plurality of times in order to attain infiltration of the electrolyte solution into an electrode assembly having a high capacity and a high density.

[0005] An object of the present technology is to provide a secondary battery so as to improving an infiltration property of an electrolyte solution into an electrode assembly.

[0006] The present technology provides the following secondary battery.

[0007] [1] A secondary battery comprising: an electrode assembly including a first electrode and a second electrode having a polarity different from a polarity of the first electrode; a battery case that accommodates the electrode assembly; a first electrode tab group electrically connected to the first electrode and disposed at one end portion of the electrode assembly; a second electrode tab group electrically connected to the second electrode and disposed at the other end portion of the electrode assembly; and an insulating sheet that covers the electrode assembly, wherein the electrode assembly includes a first surface, the insulating sheet includes a first region constituted of a vicinity of one end portion of the insulating sheet and a second region constituted of the other end portion of the insulating sheet, the first region and the second region cover the first surface, an overlapping region in which the second region overlaps with the first region is provided, in a width direction of the electrode assembly, the overlapping region includes a central region and an end-portion region located beside each of both sides of the central region, and the central region has a non-overlapping region that reduces an overlapping area of the overlapping region.

[0008] [2] The secondary battery according to [1], wherein in the central region, a ratio of providing the non-overlapping region with respect to the overlapping area when the non-overlapping region is not provided is 20% or more.

[0009] [3] The secondary battery according to [1] or [2], wherein at least one of the first region and the second region is provided with a recess as the non-overlapping region at an end side of the central region in a peripheral direction of the insulating sheet, the recess being recessed inward with respect to an end side of the end-portion region.

[0010] [4] The secondary battery according to [3], wherein the recess is provided in the second region.

[0011] [5] The secondary battery according to [3] or [4], wherein an angle formed by each of lateral sides of both ends of the recess and the end side of the end-portion region is 100° or more.

[0012] [6] The secondary battery according to any one of [1] to [5], further comprising: a first spacer disposed on an end surface of the electrode assembly on which the first electrode tab group is provided; and a second spacer disposed on an end surface of the electrode assembly on which the second electrode tab group is provided, wherein the insulating sheet and the first spacer are connected to each other on a side on which the first electrode tab group is provided, and the insulating sheet and the second spacer are connected to each other on a side on which the second electrode tab group is provided.

[0013] [7] The secondary battery according to [6], wherein in an area when viewed from the first surface side of the electrode assembly, X1 is larger than Y1, where X1 is defined as a ratio of [an area of a region in which the first spacer, the first region, and the second region overlap]/[an area of the first spacer], and Y1 is defined as a ratio of [an area of a region in which the electrode assembly, the first region, and the second region overlap]/[an area of the electrode assembly].

[0014] [8] The secondary battery according to [6] or [7], wherein in order to connect the insulating sheet to the first spacer, the first region is provided with an opening or notch, and the second region is connected to the first spacer at a region facing the opening or notch.

[0015] [9] The secondary battery according to any one of [1] to [8], wherein in an area when viewed from the first surface side of the electrode assembly, X2 is larger than Y2, where X2 is defined as a ratio of [an area of an overlapping portion between the first region and the second region in the end-portion region]/[an area of the end-portion region], and Y2 is defined as a ratio of [an area of the overlapping portion between the first region and the second region in the central region]/[an area of the central region].

[0016] [10] The secondary battery according to any one of [1] to [9], wherein the electrode assembly has a third surface adjacent to the first surface, the insulating sheet has a fourth region that covers the third surface, a bent portion is provided between the first region and the fourth region, and a tip of the second region is located away from the bent portion.

[0017] [11] The secondary battery according to any one of [1] to [10], wherein a gas-discharge valve is provided in the battery case, and a surface of the battery case in which the gas-discharge valve is provided faces the first surface.

[0018] [12] The secondary battery according to any one of [1] to [11], wherein the battery case includes a case main body provided with a first opening at one end portion of the case main body and a second opening at the other end portion of the case main body, a first sealing plate that seals the first opening and that is welded to the case main body, and a second sealing plate that seals the second opening and that is welded to the case main body, the first electrode tab group is disposed at an end portion of the electrode assembly on the first opening side, and the second electrode tab group is disposed at an end portion of the electrode assembly on the second opening side.

[0019] The foregoing and other objects, features, aspects and advantages of the present invention will become more apparent from the following detailed description of the present invention when taken in conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

[0020] FIG. **1** is a front view showing a configuration of a secondary battery according to a first embodiment.

[0021] FIG. **2** is a diagram showing a state in which the secondary battery shown in FIG. **1** is viewed in a direction of arrow II.

[0022] FIG. **3** is a diagram showing a state in which the secondary battery shown in FIG. **1** is viewed in a direction of arrow III.

[0023] FIG. **4** is a diagram showing a state in which the secondary battery shown in FIG. **1** is viewed in a direction of arrow IV.

[0024] FIG. **5** is a diagram showing a state in which the secondary battery shown in FIG. **1** is viewed in a direction of arrow V.

[0025] FIG. **6** is a front cross sectional view of the secondary battery shown in FIG. **1**.

[0026] FIG. **7** is a cross sectional view of a negative electrode plate.

[0027] FIG. **8** is a front view showing the negative electrode plate.

[0028] FIG. **9** is a cross sectional view of a positive electrode plate.

[0029] FIG. **10** is a front view showing the positive electrode plate.

[0030] FIG. **11** is a cross sectional view of the secondary battery shown in FIG. **1** along XI-XI.

[0031] FIG. **12** is a cross sectional view of the secondary battery shown in FIG. **1** along XII-XII.

[0032] FIG. **13** is a flowchart showing a method of manufacturing a secondary battery according to one embodiment.

[0033] FIG. **14** is a perspective view showing a state before two electrode assemblies included in the secondary battery according to one embodiment are overlapped with each other.

[0034] FIG. **15** is a cross sectional view of each of the electrode assemblies and the current collectors shown in FIG. **14** along XV-XV.

[0035] FIG. **16** is a perspective view showing a state of attaching a holder and a spacer to the electrode assembly.

[0036] FIG. **17** is a perspective view showing a state of attaching a sealing plate to the current collectors on the negative electrode side.

[0037] FIG. **18** is a cross sectional view of each of the electrode assemblies and the current collectors shown in FIG. **17** along XVIII-XVIII.

[0038] FIG. **19** is a first perspective view showing an implementation of the spacer.

[0039] FIG. **20** is a second perspective view showing the implementation of the spacer.

[0040] FIG. **21** is a side view showing a positional relation between the spacer and an insulating sheet.

[0041] FIG. **22** is a perspective view showing a state of inserting the electrode assemblies into the case main body.

[0042] FIG. **23** is a perspective view showing a state of attaching a sealing plate to the current collectors on the positive electrode side.

[0043] FIG. **24** is a cross sectional view of each of the electrode assemblies and the current collectors shown in FIG. **23** along XXIV-XXIV.

[0044] FIG. **25** is a perspective view showing a configuration of the secondary battery.

[0045] FIG. **26** is a cross sectional view of the secondary battery shown in FIG. **25** along XXVI-XXVI.

[0046] FIG. **27** is a cross sectional view of the secondary battery shown in FIG. **25** along XXVII-XXVII.

[0047] FIG. **28** is a development view of the insulating sheet.

[0048] FIG. **29** is a reference cross sectional view corresponding to the cross section of the secondary battery shown in FIG. **25** along XXVI-XXVI.

[0049] FIG. **30** is a reference cross sectional view corresponding to the cross section of the secondary battery shown in FIG. **25** along XXVI-XXVI.

[0050] FIG. **31** is a diagram showing an area of each region when viewed from the first surface side of the electrode assembly.

[0051] FIG. **32** is a diagram showing a central region and an end-portion region when viewed from the first surface side of the electrode assembly.

[0052] FIG. **33** is a partial enlarged view of the first surface side of the electrode assembly shown in FIG. **30**.

[0053] FIG. **34** is a development view of an insulating sheet according to a second embodiment.

[0054] FIG. **35** is a development view of an insulating sheet according to a third embodiment.

[0055] FIG. **36** is a development view of an insulating sheet according to an fourth embodiment.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0056] Hereinafter, embodiments of the present technology will be described. It should be noted that the same or corresponding portions are denoted by the same reference characters, and may not be described repeatedly.

[0057] In the embodiments described below, when reference is made to number, amount, and the like, the scope of the present technology is not necessarily limited to the number, amount, and the like unless otherwise stated particularly. Further, in the embodiments described below, each component is not necessarily essential to the present technology unless otherwise stated particularly. Further, the present technology is not limited to one that necessarily exhibits all the functions and effects stated in the present embodiment.

[0058] In the present specification, the terms “comprise”, “include”, and “have” are open-end terms. That is, when a certain configuration is included, a configuration other than the foregoing configuration may or may not be included.

[0059] In the present specification, when geometric terms and terms representing positional/directional relations are used, for example, when terms such as “parallel”, “orthogonal”, “obliquely at 45°”, “coaxial”, and “along” are used, these terms permit manufacturing errors or slight fluctuations. In the present specification, when terms representing relative positional relations such as “upper side” and “lower side” are used, each of these terms is used to indicate a relative positional relation in one state, and the relative positional relation may be reversed or turned at any angle in accordance with an installation direction of each mechanism (for example, the entire mechanism is reversed upside down).

[0060] In the present specification, the term “secondary battery” is not limited to a lithium ion battery, and may include other secondary batteries such as a nickel-metal hydride battery and a sodium-ion battery. In the present specification, the term “electrode” may collectively represent a positive electrode and a negative electrode.

[0061] In the figures, when an electrode assembly included in the secondary battery is a stacked type electrode assembly, an X direction is defined as a long-side direction of a stacked surface, whereas when the electrode assembly is a wound type electrode assembly, the X direction is defined as a direction along a winding axis thereof. Further, a Y direction is defined as a short-side direction of the electrode assembly when viewed in the X direction, and a Z direction is defined as a long-side direction of the electrode assembly when viewed in the X direction. In order to facilitate understanding of the invention, the size of each configuration in the figures may be illustrated to be changed from its actual size.

[0062] In the specification of the present application, the first direction (X direction) may be referred to as a “width direction” of each of the secondary battery, the electrode assembly, and the case main body, the second direction (Z direction) may be referred to as a “height direction” of the secondary battery or the case main body, and the third direction (Y direction) may be referred to as a “thickness direction” of the secondary battery or the case main body.

First Embodiment: Overall Configuration of Battery

[0063] FIG. **1** is a front view of a secondary battery **1** according to a first embodiment. FIGS. **2** to **5** are diagrams showing states of secondary battery **1** shown in FIG. **1** when viewed in directions of arrows II, III, IV, and V respectively. FIG. **6** is a front cross sectional view of secondary battery **1** shown in FIG. **1**.

[0064] Secondary battery **1** can be mounted on a battery electric vehicle (BEV), a plug-in hybrid electric vehicle (PHEV), a hybrid electric vehicle (HEV), or the like. It should be noted that the purpose of use of secondary battery **1** is not limited to the use on a vehicle.

[0065] As shown in FIGS. **1** to **6**, secondary battery **1** includes a case **100**, an electrode assembly **200**, electrode terminals **300**, and current collectors **400**. Case **100** includes a case main body **110**, a sealing plate **120** (first sealing plate), and a sealing plate **130** (second sealing plate).

[0066] When forming a battery assembly including secondary battery **1**, a plurality of secondary batteries **1** are stacked in the thickness direction of each of the plurality of secondary batteries **1**. Secondary batteries **1** stacked may be restrained in the stacking direction (Y direction) by a restraint member to form a battery module, or the battery assembly may be directly supported by a side surface of a case of a battery pack without using the restraint member.

[0067] Case main body **110** is constituted of a member having a tubular shape, preferably, a prismatic tubular shape. Thus, secondary battery **1** having a prismatic shape is obtained. Case main body **110** is composed of a metal. Specifically, case main body **110** is composed of aluminum, an aluminum alloy, iron, an iron alloy, or the like.

[0068] As shown in FIGS. **1** and **2**, sealing plate **120** (first wall) and sealing plate **130** (second wall) are provided at respective end portions of the case main body. Case main body **110** can be formed to have a prismatic tubular shape in, for example, the following manner: end sides of a plate-shaped member having been bent are brought into abutment with each other (joining portion **115** illustrated in FIG. **2**) and are joined together (for example, laser welding). Each of the corners of the “prismatic tubular shape” may have a shape with a curvature. Moreover, the secondary battery in the present technology is not necessarily limited to the prismatic secondary battery.

[0069] In the present embodiment, case main body **110** is formed to be longer in the width direction (X direction) of secondary battery **1** than in each of the thickness direction (Y direction) and the height direction (Z direction) of secondary battery **1**. The size (width) of case main body **110** in the X direction is preferably about 30 cm or more. In this way, secondary battery **1** can be formed to have a relatively large size (high capacity). The size (height) of case main body **110** in the Z direction is preferably about 20 cm or less, more preferably about 15 cm or less, and further preferably about 10 cm or less. Thus, (low-height) secondary battery **1** having a relatively low height can be formed, thus resulting in improved ease of mounting on a vehicle, for example.

[0070] Case main body **110** includes a pair of first side surface portions **111** and a pair of second side surface portions **112**. The pair of first side surface portions **111** constitute parts of the side surfaces of case **100**. The pair of second side surface portions **112** constitute the bottom surface portion and upper surface portion of case **100**. The pair of first side surface portions **111** and the pair of second side surface portions **112** are provided to intersect each other. The pair of first side surface portions **111** and the pair of second side surface portions **112** are connected at their respective end portions. Each of the pair of first side surface portions **111** desirably has an area larger than that of each of the pair of second side surface portions **112**.

[0071] As shown in FIG. **5**, a gas-discharge valve **150** is provided in one second side surface portion **112**A of the pair of second side surface portions **112**. Gas-discharge valve **150** extends in the width direction (X direction) of secondary battery **1**. Gas-discharge valve **150** extends from the center of case main body **110** in the X direction to such an extent that gas-discharge valve **150** does not reach both ends of case main body **110** in the X direction. The shape of gas-discharge valve **150** can be changed appropriately.

[0072] The thickness of the plate-shaped member in gas-discharge valve **150** is thinner than the thickness of the plate-shaped member of case main body **110** other than gas-discharge valve **150**. Thus, when the pressure in case **100** becomes equal to or more than a predetermined value, gas-discharge valve **150** is fractured prior to the other portions of case main body **110**, thereby discharging the gas in case **100** to the outside.

[0073] As shown in FIG. **2**, joining portion **115** is formed at the other second side surface portion **112**B of the pair of second side surface portions **112**. Joining portion **115** extends in the width direction (X direction) of secondary battery **1**. At joining portion **115**, the end sides of the plate-shaped member of case main body **110** are joined to each other.

[0074] As shown in FIG. **3**, an opening **113** (first opening) is provided at an end portion of case main body **110** on a first side in the first direction (X direction). Opening **113** is sealed by sealing plate **120**. Joining portion **115** is formed at opening **113** so as to seal opening **113**. Each of opening **113** and sealing plate **120** has a substantially rectangular shape in which the Y direction corresponds to its short-side direction and the Z direction corresponds to its long-side direction. The substantially rectangular shape includes a rectangular shape or a generally rectangular shape such as a rectangular shape having corners each with a curvature.

[0075] Sealing plate **120** (first sealing plate) is provided with a negative electrode terminal **301**. The position of negative electrode terminal **301** can be appropriately changed.

[0076] As shown in FIG. **4**, an opening **114** (second opening) is provided at an end portion of case main body **110** on a second side opposite to the first side in the first direction (X direction). That is, opening **114** is located at an end portion opposite to opening **113**, and openings **113** and **114** face each other. Opening **114** is sealed by sealing plate **130**. Joining portion **115** is formed at opening **114** so as to seal opening **114**. Each of opening **114** and sealing plate **130** has a substantially rectangular shape in which the Y direction corresponds to its short-side direction and the Z direction corresponds to its long-side direction.

[0077] Sealing plate **130** (second sealing plate) is provided with a positive electrode terminal **302** and an injection hole **134**. The positions of positive electrode terminal **302** and injection hole **134** can be appropriately changed.

[0078] Each of sealing plate **120** and sealing plate **130** is composed of a metal. Specifically, each of sealing plate **120** and sealing plate **130** is composed of aluminum, an aluminum alloy, iron, an iron alloy, or the like.

[0079] Negative electrode terminal **301** (first electrode terminal) is electrically connected to a negative electrode of electrode assembly **200**. Negative electrode terminal **301** is attached to sealing plate **120**, i.e., case **100**.

[0080] Positive electrode terminal **302** (second electrode terminal) is electrically connected to a positive electrode of electrode assembly **200**. Positive electrode terminal **302** is attached to sealing plate **130**, i.e., case **100**.

[0081] Negative electrode terminal **301** is composed of a conductive material (more specifically, a metal), and can be composed of copper, a copper alloy, or the like, for example. A portion or layer composed of aluminum or an aluminum alloy may be provided at a portion of an outer surface of negative electrode terminal **301**.

[0082] Positive electrode terminal **302** is composed of a conductive material (more specifically, a metal), and can be composed of aluminum, an aluminum alloy, or the like, for example.

[0083] Injection hole **134** is sealed by a sealing member (not shown). As the sealing member, for example, a blind rivet or another metal member can be used.

[0084] Electrode assembly **200** is an electrode assembly having a flat shape and having a below-described positive electrode plate and a below-described negative electrode plate stacked on each other. Specifically, electrode assembly **200** is a stacked type electrode assembly in which a plurality of positive electrode plates and a plurality of negative electrode plates are alternately stacked with below-described separators **800** being interposed therebetween. However, in the present specification, the "electrode assembly" is not limited to the stacked type electrode assembly, and may be a wound type electrode assembly in which a strip-shaped positive electrode plate and a strip-shaped negative electrode plate are wound together with a strip-shaped separator being interposed therebetween. The separator can be constituted of, for example, a microporous membrane composed of polyolefin. When the electrode assembly is the stacked type electrode assembly including the plurality of positive electrode plates and the plurality of negative electrode plates, positive electrode tabs provided on the positive electrode plates may be stacked to form a positive electrode tab group, and negative electrode tabs provided on the negative electrode plates may be stacked to form a negative electrode tab group.

[0085] As shown in FIG. **6**, case **100** accommodates electrode assembly **200**. FIG. **6** illustrates a first electrode assembly **201** described below. First electrode assembly **201** is accommodated in case **100** such that the long-side direction thereof is parallel to the X direction.

[0086] Specifically, one or a plurality of the stacked type electrode assemblies and an electrolyte solution (electrolyte) (not shown) are accommodated inside a below-described insulating sheet **700** disposed in case **100**. As the electrolyte solution (non-aqueous electrolyte solution), it is possible to use, for example, a solution obtained by dissolving $LiPF_6$ at a concentration of 1.2 mol/L in a non-aqueous solvent obtained by mixing ethylene carbonate (EC), ethyl methyl carbonate (EMC), and dimethyl carbonate (DMC) at a volume ratio (25° C.) of 30:30:40. Instead of the electrolyte solution, a solid electrolyte may be used.

[0087] First electrode assembly **201** includes a main body portion having a substantially rectangular shape, a negative electrode tab group **220** (first electrode tab group), and a positive electrode tab group **250** (second electrode tab group).

[0088] The main body portion is constituted of a below-described negative electrode plate **210** and a below-described positive electrode plate **240**. Negative electrode tab group **220** is located at an end portion of first electrode assembly **201** on the first side with respect to the main body portion thereof in the first direction (X direction). The first side in the present embodiment is the sealing plate **120** side. Positive electrode tab group **250** is located at an end portion of first electrode assembly **201** on the second side with respect to the main body portion thereof in the first direction (X direction). The second side in the present embodiment is the sealing plate **130** side.

[0089] Each of negative electrode tab group **220** and positive electrode tab group **250** is formed to protrude from a central portion of electrode assembly **200** toward sealing plate **120** or sealing plate **130**.

[0090] Current collectors **400** include a negative electrode current collector **400**A and a positive electrode current collector **400**B. Each of negative electrode current collector **400**A and positive electrode current collector **400**B is constituted of a plate-shaped member. Electrode assembly **200** is electrically connected to negative electrode terminal **301** and positive electrode terminal **302** through current collectors **400**.

[0091] Negative electrode current collector **400**A is disposed on sealing plate **120** with an insulating member composed of a resin being interposed therebetween. Negative electrode current collector **400**A is electrically connected to negative electrode tab group **220** and negative electrode terminal **301**. Negative electrode current collector **400**A is composed of a conductive material (more specifically, a metal), and can be composed of copper, a copper alloy, or the like, for example. Details of negative electrode current collector **400**A will be described later.

[0092] Positive electrode current collector **400**B is disposed on sealing plate **130** with an insulating member composed of a resin being interposed therebetween. Positive electrode current collector **400**B is electrically connected to positive electrode tab group **250** and positive electrode terminal **302**. Positive electrode current collector **400**B is composed of a conductive material (more specifically, a metal), and can be composed of aluminum, an aluminum alloy, or the like, for example. Positive electrode tab group **250** may be electrically connected to sealing plate **130** directly or via positive electrode current collector **400**B. In this case, sealing plate **130** may serve as positive electrode terminal **302**. Details of positive electrode current collector **400**B will be described later.

Configuration of Electrode Assembly 200

[0093] FIG. **7** is a cross sectional view of negative electrode plate **210** (cross sectional view along VII-VII in FIG. **8**), and FIG. **8** is a front view showing negative electrode plate **210**.

[0094] As shown in FIG. **8**, a negative electrode tab **230** (first electrode tab) constituted of a negative electrode core body **211** is provided at one end portion, in the width direction, of negative electrode plate **210**. When negative electrode plates **210** are stacked, a plurality of negative electrode tabs **230** are stacked to form negative electrode tab group **220**. The length of each of the plurality of negative electrode tabs **230** in the plurality of negative electrode plates **210** in the protruding direction is appropriately adjusted in consideration of the state in which negative electrode tab group **220** is connected to negative electrode current collector **400**A. The shape of negative electrode tab **230** is not limited to the one illustrated in FIG. **7**.

[0095] FIG. **9** is a cross sectional view of positive electrode plate **240** (cross sectional view along IX-IX in FIG. **10**), and FIG. **10** is a front view showing positive electrode plate **240**.

[0096] As shown in FIG. **10**, a positive electrode tab **260** (second electrode tab) constituted of a positive electrode core body **241** is provided at one end portion, in the width direction, of positive electrode plate **240** formed. When positive electrode plates **240** are stacked, a plurality of positive electrode tabs **260** are stacked to form positive electrode tab group **250**. The length of each of positive electrode tabs **260** in the plurality of positive electrode plates **240** in the protruding direction is appropriately adjusted in consideration of the state in which positive electrode tab group **250** is connected to positive electrode current collector **400**B. The shape of positive electrode tab **260** is not limited to the one illustrated in FIG. **10**.

[0097] A positive electrode protective layer **243** is provided at the root of positive electrode tab **260**. Positive electrode protective layer **243** may not necessarily be provided at the root of positive electrode tab **260**.

[0098] In a typical example, the thickness of (one) negative electrode tab **230** is smaller than the thickness of (one) positive electrode tab **260**. In this case, the thickness of negative electrode tab group **220** is smaller than the thickness of positive electrode tab group **250**.

Connection Structure Between Electrode Assembly 200 and Current Collector 400

[0099] FIG. **11** is a cross sectional view of the secondary battery shown in FIG. **1** along XI-XI. As shown in FIG. **11**, electrode assembly **200** includes first electrode assembly **201** and a second electrode assembly **202**. Each of first electrode assembly **201** and second electrode assembly **202** includes a positive electrode (second electrode) and a negative electrode (first electrode). Electrode assembly **200** may be constituted of three or more electrode assemblies.

[0100] Electrode assembly **200** is formed by overlapping first electrode assembly **201** and second electrode assembly **202** with each other. First electrode assembly **201** and second electrode assembly **202** are arranged side by side in the thickness direction (Y direction) of each of first electrode assembly **201** and second electrode assembly **202**.

[0101] First electrode assembly **201** includes negative electrode tab group **220**. Negative electrode tab group **220** is electrically connected to one current collector **410** (negative electrode current collector) at its first end portion **205** in the X direction. Second electrode assembly **202** includes a negative electrode tab group **270**. Negative electrode tab group **270** is electrically connected to the other current collector **410** (negative electrode current collector) at its third end portion **207** in the X direction.

[0102] Negative electrode tab group **220** has a curved portion **221** and a tip portion **222**. Curved portion **221** is a portion at which negative electrode tab group **220** is curved on the side, on which the first electrode is connected, with respect to tip portion **222**. Tip portion **222** is a portion located at an end portion of negative electrode tab group **220** on the side opposite to the side on which the first electrode is connected.

[0103] Negative electrode tab group **270** has a curved portion **271** and a tip portion **272**. Curved portion **271** is a portion at which negative electrode tab group **270** is curved on the side, on which the first electrode is connected, with respect to tip portion **272**. Tip portion **272** is a portion located at an end portion of negative electrode tab group **270** on the side opposite to the side on which the first electrode is connected.

[0104] Negative electrode tab group **220** and negative electrode tab group **270** are curved in opposite directions such that tip portions **222**, **272** are close to each other. Tip portions **222**, **272** are separated from each other in the present embodiment; however, it is not limited to this configuration, and tip portions **222**, **272** may be in contact with each other.

[0105] Negative electrode current collector **400**A electrically connects negative electrode terminal **301** to negative electrode tab group **220** and negative electrode tab group **270**. Negative electrode current collector **400**A in the present embodiment is connected to negative electrode terminal **301** between electrode assembly **200** and sealing plate **120**.

[0106] Negative electrode current collector **400**A includes two current collectors **410** and a current collector **430**. Each of current collectors **410** is a plate-shaped member. Current collector **410** has a long-side direction in the Z direction and a short-side direction in the Y direction. Current collector **430** is a plate-shaped member. Current collector **430** has a long-side direction in the Z direction and a short-side direction in the Y direction. Current collector **410** and current collector **430** are arranged side by side in parallel in the X direction. In this way, current collector **410** and current collector **430** are constituted of separate components.

[0107] Negative electrode tab group **220** is joined to one current collector **410** at a joining location **411** (see FIG. **14**) described later. Negative electrode tab group **270** is joined to the other current collector **410** at a joining location **411** (see FIG. **14**) described later. Each of joining locations **411** may be formed by ultrasonic welding, resistance welding, laser welding, swaging, or the like, for example. In the present embodiment, negative electrode tab group **220** and one current collector **410** are joined by ultrasonic joining, and negative electrode tab group **270** and the other current collector **410** are joined by ultrasonic joining, for example.

[0108] Current collector **430** is joined to each of one current collector **410** and the other current collector **410** at a joining location (not shown) located at its end portion in the Z direction. Current collector **430** is connected to negative electrode terminal **301**. The connection between current collector **430** and negative electrode terminal **301** may be formed by swaging and/or welding, for example.

[0109] Negative electrode terminal **301** is located on the outer side with respect to sealing plate **120**. Negative electrode terminal **301** is connected to a plate-shaped member **303**. It should be noted that negative electrode terminal **301** preferably includes a region **301***a* composed of copper or a copper alloy and a region **301***b* composed of aluminum or an aluminum alloy, and region **301***a* composed of copper or a copper alloy is preferably connected to current collector **430**.

[0110] Plate-shaped member **303** is located on the outer side with respect to sealing plate **120**. Plate-shaped member **303** is disposed along sealing plate **120**. Plate-shaped member **303** has electric conductivity. Plate-shaped member **303** is disposed to secure an area of connection with a bus bar or the like that electrically connects secondary battery **1** and another secondary battery adjacent thereto. The connection between negative electrode terminal **301** and plate-shaped member **303** can be formed by, for example, laser welding or the like.

[0111] An insulating member **510** is disposed between plate-shaped member **303** and sealing plate **120**. An insulating member **520** is disposed between negative electrode terminal **301** and sealing plate **120**. An insulating member **530** is disposed between current collector **430** and sealing plate **120**.

[0112] It should be noted that negative electrode terminal **301** may be electrically connected to sealing plate **120**. Further, sealing plate **120** may function as negative electrode terminal **301**.

[0113] A below-described spacer **600** (first spacer) is disposed between sealing plate **120** and the main body portion (negative electrode tab group **220** is not included) of electrode assembly **200**. Spacer **600** is composed of a resin member having an insulating property. Negative electrode tab group **220** passes internal to spacer **600**, thereby protecting negative electrode tab group **220** by spacer **600**. It should be noted that it is also possible to employ a configuration in which spacer **600** (first spacer) is not provided.

[0114] Although a detailed structure of spacer **600** will be described later, spacer **600** is provided with a protrusion **616** protruding in the Y direction. With this protrusion **616** of spacer **600**, spacer **600** functions as a guide to facilitate curving of curved portions **221**, **271** when forming curved portions **221**, **271**.

[0115] Insulating sheet **700** (electrode assembly holder) composed of a resin is disposed between electrode assembly **200** and case main body **110**. Insulating sheet **700** may be composed of, for example, a resin. More specifically, the material of insulating sheet **700** is, for example, polypropylene (PP), polyethylene terephthalate (PET), polyphenylene sulfide (PPS), polyimide (PI), or polyolefin (PO).

[0116] FIG. **12** is a cross sectional view of the secondary battery shown in FIG. **1** along XII-XII. The connection structure between electrode assembly **200** and current collector **400** on the positive electrode side of secondary battery **1** according to the present embodiment is different from that of the configuration on the negative electrode side in the following point: a portion corresponding to one current collector **410** and the other current collector **410** on the negative electrode side is constituted of a single component.

[0117] First electrode assembly **201** includes positive electrode tab group **250**. Positive electrode tab group **250** is electrically connected to current collector **420** (positive electrode current collector) at its second end portion **206** in the X direction. Second electrode assembly **202** includes a positive electrode tab group **280**. Positive electrode tab group **280** is electrically connected to current collector **420** (positive electrode current collector) at its fourth end portion **208** in the X direction.

[0118] Positive electrode tab group **250** has a curved portion **251** and a tip portion **252**. Curved portion **251** is a portion at which positive electrode tab group **250** is curved on the side, on which the second electrode is connected, with respect to tip portion **252**. Tip portion **252** is a portion located at an end portion of positive electrode tab group **250** on the side opposite to the side on which the second electrode is connected.

[0119] Positive electrode tab group **280** has a curved portion **281** and a tip portion **282**. Curved portion **281** is a portion at which positive electrode tab group **280** is curved on the side, on which the second electrode is connected, with respect to tip portion **282**. Tip portion **282** is a portion located at an end portion of positive electrode tab group **280** on the side opposite to the side on which the second electrode is connected.

[0120] Positive electrode tab group **250** and positive electrode tab group **280** are curved in opposite directions such that tip portions **252**, **282** are close to each other. Tip portions **252**, **272** are separated from each other in the present embodiment; however, it is not limited to this configuration, and tip portions **252**, **282** may be in contact with each other.

[0121] Positive electrode current collector **400**B electrically connects positive electrode terminal **302** to positive electrode tab group **250** and positive electrode tab group **280**. Positive electrode current collector **400**B in the present embodiment is connected to positive electrode terminal **302** between electrode assembly **200** and sealing plate **130**.

[0122] Positive electrode current collector **400**B includes current collector **420** (first current collecting member) and a current collector **450** (second current collecting member). Although a plate **460** is interposed as an insulating member between current collector **420** (first current collecting member) and current collector **450** (second current collecting member), current collector **420** and current collector **450** are electrically joined to each other at a position different from the cross section shown in the figure.

[0123] Current collector **420** is a plate-shaped member. Current collector **420** has a long-side direction in the Z direction and a short-side direction in the Y direction. Current collector **420** is constituted of a single component in one piece.

[0124] Positive electrode tab group **250** and positive electrode tab group **280** are joined, at below-described joining locations **421** (see FIG. **14**), to current collector **420** constituted of the single component. Each of joining locations **421** may be formed by ultrasonic welding, resistance welding, laser welding, swaging, or the like, for example. In the present embodiment, positive electrode tab group **250** and positive electrode tab group **280** are joined to current collector **420** by ultrasonic joining, for example.

[0125] Current collector **440** is joined to current collector **420** at a joining location (not shown) located at its end portion in the Z direction. Current collector **440** is connected to positive electrode terminal **302**. The connection between current collector **440** and positive electrode terminal **302** may be formed by swaging and/or welding, for example.

[0126] Positive electrode terminal **302** is provided to be exposed to the outside of sealing plate **130** and reach current collector **440** of positive electrode current collector **400**B provided on the inner surface side of sealing plate **130**. Positive electrode terminal **302** is connected to a plate-shaped member **304**.

[0127] Plate-shaped member **304** is located on the outer side with respect to sealing plate **130**. Plate-shaped member **304** is disposed along sealing plate **130**. Plate-shaped member **304** has electric conductivity. Plate-shaped member **304** is disposed to secure an area of connection with a bus bar or the like that electrically connects secondary battery **1** and another secondary battery adjacent thereto. The connection between positive electrode terminal **302** and plate-shaped member **304** may be formed by, for example, laser welding or the like.

[0128] An insulating member **510** is disposed between plate-shaped member **304** and sealing plate **130**. An insulating member **520** is disposed between positive electrode terminal **302** and sealing plate **130**. An insulating member **470** is disposed between current collector **440** and sealing plate **130**.

[0129] It should be noted that positive electrode terminal **302** may be electrically connected to sealing plate **130**. Further, sealing plate **130** may function as positive electrode terminal **302**.

[0130] A spacer **600** (second spacer) is disposed between sealing plate **130** and the main body portion (positive electrode tab groups **250**, **280** are not included) of electrode assembly **200**. Spacer **600** is composed of a resin member having an insulating property. Since each of positive electrode tab groups **250**, **280** passes internal to spacer **600**, each of positive electrode tab groups **250**, **280** is protected by spacer **600**. It should be noted that it is also possible to employ a configuration in which spacer **600** (second spacer) is not provided.

[0131] Although a detailed structure of spacer **600** will be described later, spacer **600** is provided with a protrusion **616** protruding in the Y direction. With this protrusion **616** of spacer **600**, spacer **600** functions as a guide to facilitate curving of curved portions **251**, **281** when forming curved portions **251**, **281**.

[0132] Insulating sheet **700** (electrode assembly holder) composed of a resin as described above is disposed between electrode assembly **200** and case main body **110**.

Manufacturing Process for Secondary Battery 1

[0133] Hereinafter, a method of manufacturing the secondary battery according to the present embodiment will be described. FIG. **13** is a flowchart showing a method of manufacturing the secondary battery according to the first embodiment. FIG. **14** is a perspective view showing a state before two electrode assemblies included in the secondary battery according to the first embodiment are overlapped with each other. FIG. **15** is a cross sectional view of each of the electrode assemblies and the current collectors shown in FIG. **14** along XV-XV.

[0134] As shown in FIG. **13**, in the method of manufacturing the secondary battery according to the present embodiment, first, first electrode assembly **201** and second electrode assembly **202** are produced (step S1). Parts of the tips of negative electrode tab group **220**, positive electrode tab group **250**, negative electrode tab group **270**, and positive electrode tab group **280** are preferably cut such that they have the same tip length when bundled.

[0135] As shown in FIGS. **13** to **15**, after producing first electrode assembly **201** and second electrode assembly **202**, negative electrode tab group **220** is joined to one current collector **410** (step S2). Negative electrode tab group **220** is joined to one current collector **410** at joining location **411**. Next, negative electrode tab group **270** is joined to the other current collector **410** (step S3). Negative electrode tab group **270** is joined to the other current collector **410** at joining location **411**.

[0136] Next, first electrode assembly **201**, current collector **420**, and second electrode assembly **202** are disposed side by side in this order in the first direction (DR1 direction). Positive electrode tab group **250** is disposed on one side with respect to current collector **420** in the first direction (DR1 direction). Positive electrode tab group **250** and positive electrode tab group **280** are joined to current collector **420** with positive electrode tab group **280** being disposed on the other side with respect to current collector **420** in the first direction (DR1 direction) (step S4). Positive electrode tab group **250** and positive electrode tab group **280** are joined to current collector **420** at joining locations **421**.

[0137] In the height direction of each of first electrode assembly **201** and second electrode assembly **202**, each of one current collector **410**, the other current collector **410** and current collector **420** is disposed on one side with respect to the center of each of first electrode assembly **201** and second electrode assembly **202**. Thus, each of the current collectors can be formed to be short, thereby reducing the size of the current collector.

[0138] Each of one current collector **410**, the other current collector **410**, and current collector **420** is not limited to this configuration. In the height direction of each of first electrode assembly **201** and second electrode assembly **202**, each of current collectors **410** and current collector **420** may be disposed at the center of a corresponding one of first electrode assembly **201** and second electrode assembly **202**. In this case, in the height direction of each of first electrode assembly **201** and second electrode assembly **202**, each of negative electrode tab group **220**, positive electrode tab group **250**, negative electrode tab group **270**, and positive electrode tab group **280** is disposed at the center of a corresponding one of first electrode assembly **201** and second electrode assembly **202** so as to correspond to a corresponding one of current collectors **410** and current collector **420**.

[0139] The order of the steps of joining current collectors **410** and current collector **420** to first electrode assembly **201** and second electrode assembly **202** is not limited to the one described above, and the order may be changed. Each of the respective steps of joining current collectors **410** to first electrode assembly **201** and second electrode assembly **202** is preferably performed before the below-described step of overlapping first electrode assembly **201** and second electrode assembly **202** with each other, and is preferably performed before the step of joining current collector **420** to first electrode assembly **201** and second electrode assembly **202**.

[0140] Next, after joining positive electrode tab group **250** and positive electrode tab group **280** to current collector **420**, positive electrode tab group **250** and positive electrode tab group **280** are bent in the thickness direction (direction orthogonal to the DR1 direction in FIGS. **14** and **15**) of each of first electrode assembly **201** and second electrode assembly **202**, thereby overlapping first electrode assembly **201** and second electrode assembly **202** with each other (step S**5**). That is, first electrode assembly **201** and second electrode assembly **202** are collected together.

[0141] Regarding the expression "overlapping the first electrode assembly and the second electrode assembly with each other", the first electrode assembly and the second electrode assembly may be overlapped with each other directly, or another member may be disposed between the first electrode assembly and the second electrode assembly. Further, the first electrode assembly and the second electrode assembly may or may not be fixed by a tape or the like. Further, the first electrode assembly, the current collector, and the second electrode assembly may not be disposed on a straight line in the first direction (DR1 direction), and the first electrode assembly or the second electrode assembly may be inclined with respect to the current collector in the first direction (DR1 direction).

[0142] Positive electrode tab group **250** and positive electrode tab group **280** are folded such that tip portions thereof face each other. Similarly, negative electrode tab group **220** and negative electrode tab group **270** are also folded such that tip portions thereof face each other.

[0143] Each of FIGS. **13** and **16** is a perspective view showing a state of attaching the holder and the spacer to the electrode assembly. As shown in FIG. **16**, next, spacer **600** and insulating sheet **700** are assembled to electrode assembly **200** (step S**6**).

[0144] Insulating sheet **700** does not necessarily need to cover a whole of the surfaces of electrode assembly **200**. Insulating sheet **700** preferably covers an area of about 50% or more, more preferably about 70% or more, of the outer surfaces of the electrode assembly. Insulating sheet **700** preferably covers a whole of at least four surfaces of the six surfaces of electrode assembly **200** having a substantially rectangular parallelepiped shape (flat shape) other than the two surfaces thereof on which negative electrode tab group **220** and positive electrode tab group **250** are formed respectively. A specific implementation of insulating sheet **700** will be described later.

[0145] FIG. **17** is a perspective view showing a state of attaching sealing plate **120** to the current collectors on the negative electrode side. FIG. **18** is a cross sectional view of each of the electrode assemblies and the current collectors shown in FIG. **17** along XVIII-XVIII. FIGS. **19** and **20** are first and second perspective views each showing an implementation of spacer **600**, and FIG. **21** is a front view showing a positional relation between spacer **600** and insulating sheet **700**. It should be noted that in FIG. **18**, case main body **110** is not shown.

[0146] As shown in FIGS. **19** and **20**, spacer **600** is composed of a resin member having an insulating property. Spacer **600** includes: a first component **612** and a second component **614** each having three surrounding side walls; and a coupling wall **611** that couples one side wall of first component **612** and one side wall of second component **614** to each other. Protrusion **616** is provided on an inner side of coupling wall **611** so as to extend between first component **612** and second component **614** (in the Z direction).

[0147] First component **612** includes a first plate portion **617** provided to couple the three walls. First plate portion **617** is provided with a plurality of first through holes **617*s*** each having an elliptical shape. The shape of each first through hole **617*s*** and the number of first through holes **617*s*** are appropriately selected, and are not limited to the shape and number shown. A first protrusion **612*p*** protruding outward is provided in a region of first component **612** opposite to first plate portion **617** (side opposite to the electrode assembly).

[0148] Second component **614** includes a second plate portion **618** provided to couple the three walls. Second plate portion **618** is provided with a plurality of second through holes **618*s*** each having an elliptical shape. The shape of each second through hole **618*s*** and the number of second through holes **618*s*** are appropriately selected, and are not limited to the shape and number shown. A second protrusion **614*p*** protruding outward is provided in a region of second component **614** opposite to second plate portion **618** (side opposite to the electrode assembly).

[0149] Each of first plate portion **617** and second plate portion **618** described above is located on an end surface side of the electrode assembly. Each of these plate portions may be in abutment with the end surface of the electrode assembly, or when each of these plate portions is not in abutment with the end surface, the shortest distance to the electrode assembly is preferably 2 mm or less, and is more preferably 1 mm or less. Further, since first through hole **617*s*** and second through hole **618*s*** are provided, when secondary battery **1** shown in FIG. **1** is placed with the Z direction corresponding to the upward direction (such a direction that opening **113** (first opening) and opening **114** (second opening) at the both ends of case main body **110** are arranged on the left and right), even if the electrolyte solution pushed out from the electrode assembly flows to outside of the through holes during charging (generally, the electrode plate is expanded), the electrolyte solution can be readily returned to inside of the electrode assembly during discharging (generally, the electrode plate is contracted).

[0150] The outer size of spacer **600** (each of the first spacer and the second spacer) is preferably smaller than the outer size of electrode assembly **200**. Since insulating sheet **700** is wound around electrode assembly **200** and is also wound around spacer **600**, insertability of electrode assembly **200** of case main body **110** can be improved by making the outer size of spacer **600** smaller than that of electrode assembly **200**.

[0151] As shown in FIG. **21**, when electrode assembly **200** is covered with insulating sheet **700**, spacer **600** is also preferably covered with insulating sheet **700**. In this case, each of the negative electrode tab group and the positive electrode tab group passes internal to spacer **600**, thereby protecting each of the negative electrode tab group and the positive electrode tab group by spacer **600**. Further, since spacer **600** is also covered with insulating sheet **700**, each of the negative electrode tab group and the positive electrode tab group is further protected. It should be noted that each of first protrusion **612*p*** and second protrusion **614*p*** provided in spacer **600** is desirably exposed from insulating sheet **700**.

[0152] As shown in FIGS. **13**, **17**, and **18**, one current collector **410** and the other current collector **410** are electrically connected to negative electrode terminal **301** via current collector **430** after joining negative electrode tab group **220** to current collector **410**, joining negative electrode tab group **270** to current collector **430**, and overlapping first electrode assembly **201** and second electrode assembly **202** with each other (step S7). It should be noted that step S7 can be performed before step S**6**.

[0153] Specifically, negative electrode tab group **220** and negative electrode tab group **270** are folded such that tip portions **222**, **272** face each other.

[0154] Each of negative electrode terminal **301** and current collector **430** is attached to sealing plate **120** with an insulating member being interposed therebetween. Current collector **430** is brought into abutment with one current collector **410** and the other current collector **410** in the X direction. It should be noted that the connecting of plate-shaped member **303** to negative electrode terminal **301** may be performed at any timing. Current collector **430** is joined to one current collector **410** and the other current collector **410** by laser welding from between sealing plate **120** and insulating sheet **700**.

[0155] FIG. **22** is a perspective view showing a state of inserting the electrode assemblies into the case main body. As shown in FIGS. **13** and **22**, next, after overlapping first electrode assembly **201** and second electrode assembly **202** with each other, first electrode assembly **201** and second electrode assembly **202** are inserted into case main body **110** via opening **113** with the current collector **420** side being inserted first (step S**8**). On this occasion, at each of the end portions of first electrode assembly **201** and second electrode assembly **202** on the negative electrode tab **230** side, first electrode assembly **201** and second electrode assembly **202** may be inserted into case main body **110** with negative electrode active material layer **212** protruding to the negative electrode tab **230** side with respect to the end portion of positive electrode active material layer **242**.

[0156] Negative electrode tab group **220** and negative electrode tab group **270** are curved by bringing sealing plate **120** close to the main body portion of electrode assembly **200** (first electrode assembly **201** and second electrode assembly **202**). It should be noted that sealing plate **120** and case main body **110** are preferably brought close to each other by bringing sealing plate **120** close to the main body portion of electrode assembly **200** disposed in case main body **110**. As shown in FIG. **11**, negative electrode tab group **220** and negative electrode tab group **270** are curved along the shape of spacer **600** such that the folded portions of curved portions **221**, **271** are close to case main body **110** in the Y direction.

[0157] After bringing sealing plate **120** into abutment with case main body **110**, sealing plate **120** is temporarily joined to case main body **110**. By the temporary joining, sealing plate **120** is partially joined to opening **113** of case main body **110**. Thus, sealing plate **120** is positioned with respect to case main body **110**.

[0158] When inserting electrode assembly **200** into case main body **110**, electrode assembly **200** may be pulled from the current collector **420** side, or may be pushed from each of the current collector **410** side and the current collector **430** side. When electrode assembly **200** is pressed from each of the current collector **410** side and the current collector **430** side, negative electrode tab group **220** and negative electrode tab group **270** can be curved at the same time.

[0159] FIG. **23** is a perspective view showing a state of attaching sealing plate **130** to the current collectors on the positive electrode side. FIG. **24** is a cross sectional view of each of the electrode assemblies and the current collectors shown in FIG. **23** along XXIII-XXIII. In FIG. **24**, case main body **110** is not shown.

[0160] As shown in FIGS. **13**, **22** and **23**, current collector **420** is electrically connected to positive electrode terminal **302** after inserting first electrode assembly **201** and second electrode assembly **202** into case main body **110** (step S9).

[0161] Specifically, each of positive electrode terminal **302** and current collector **450** is attached to sealing plate **130** with an insulating member being interposed therebetween. After inserting first electrode assembly **201** and second electrode assembly **202** into case main body **110**, current collector **450** is brought into abutment, in the X direction, with current collector **420** protruding from opening **114**. The connecting of plate-shaped member **304** to positive electrode terminal **302** may be performed at any timing.

[0162] As shown in FIG. **24**, positive electrode tab group **250** and positive electrode tab group **280** connected to current collector **420** are folded such that tip portions **252**, **282** face each other. From the state shown in FIG. **24**, sealing plate **130** is brought into abutment with case main body **110**. On this occasion, positive electrode tab group **250** and positive electrode tab group **280** are curved by bringing sealing plate **130** and the main body portion of electrode assembly **200** close to each other. As shown in FIG. **12**, positive electrode tab group **250** and positive electrode tab group **280** are curved along the shape of spacer **600** such that the folded portions of curved portions **251**, **281** are close to case main body **110** in the Y direction.

[0163] After sealing plate **130** is brought into abutment with case main body **110**, sealing plate **130** is temporarily welded to case main body **110**. By the temporary joining, sealing plate **130** is partially joined to opening **114** of case main body **110**. Thus, sealing plate **130** is positioned with respect to case main body **110**.

[0164] FIG. **25** is a perspective view showing the configuration of secondary battery **1**. As shown in FIGS. **13** and **25**, next, sealing plate **120** and sealing plate **130** are joined to case main body **110** (step S**10**). Sealing plate **120** seals opening **113** of case main body **110**, and sealing plate **130** seals opening **114** of case main body **110**. Thus, first electrode assembly **201** and second electrode assembly **202** are accommodated in case **100**.

[0165] After the above-described steps, an inspection such as a leakage inspection is performed (step S**11**). After the leakage inspection, secondary battery **1** is dried to remove moisture in case **100**. Then, the electrolyte solution is injected into case **100** through injection hole **134**. When injecting the electrolyte solution, case **100** is inclined with sealing plate **130** facing upward and sealing plate **120** facing downward, thereby injecting the electrolyte solution into case **100** via injection hole **134** of sealing plate **130**. Thereafter, charging is performed to result in release of gas. For performing the charging to result in release of gas, injection hole **134** may be temporarily sealed. Thereafter, injection hole **134** is sealed, thereby completing secondary battery **1**.

[0166] The order of the step of inserting electrode assembly **200** and the step of connecting the current collectors is not limited to the above-described example. For example, after only a portion of electrode assembly **200** is inserted into case main body **110** with the end portion of negative electrode active material layer **212** (second electrode active material layer) on the opening **113** side being disposed outside case main body **110** (first step), negative electrode terminal **301** (first electrode terminal) provided on sealing plate **120** (first sealing plate) and negative electrode tab groups **220**, **270** (first electrode tab) may be electrically connected to each other, and then electrode assembly **200** may be inserted into case main body **110** until the end portion of negative electrode active material layer **212** on the opening **113** side is disposed inside case main body **110** (second step). That is, negative electrode terminal **301** and electrode assembly **200** can be electrically connected to each other during the step of inserting electrode assembly **200** into case main body **110**.

[0167] In the present embodiment, since first electrode assembly **201** is provided with negative electrode tab group **220** and positive electrode tab group **250** and second electrode assembly **202** is provided with negative electrode tab group **270** and positive electrode tab group **280**, first electrode assembly **201** and second electrode assembly **202** can be configured to have separate electrode tabs.

[0168] With this configuration, the electrode tabs can be shortened as compared with a case where one collective electrode tab is formed by first electrode assembly **201** and second electrode assembly **202** and the electrode tab is bent.

[0169] As a result, the occupied volume of the electrode tabs can be reduced, thereby improving the energy density of secondary battery **1**. Further, in the configuration in which the separate electrode tabs are respectively provided for first electrode assembly **201** and second electrode assembly **202**, the electrode tabs are readily bent and the electrode tabs and the current collectors can be therefore readily joined as compared with the case where one collective electrode tab is formed by first electrode assembly **201** and second electrode assembly **202**, with the result that the secondary battery can be stably manufactured. In particular, since secondary battery **1** can be stably manufactured, reliability of the connection portion between each of the electrode tabs and each of the current collectors can be increased.

Specific Implementation of Insulating Sheet

[0170] A specific implementation of insulating sheet **700** will be described with reference to FIGS. **26** to **30**. In part of the figures, the shape, cross sectional shape, and the like of secondary battery **1** are schematically shown without consideration of its actual dimensional relation in order to facilitate understanding of the structure. FIG. **26** is a cross sectional view of the secondary battery shown in FIG. **25** along XXVI-XXVI, FIG. **27** is a cross sectional view of the secondary battery shown in FIG. **25** along XXVII-XXVII, FIG. **28** is a development view of insulating sheet **700**, FIG. **29** is a reference cross sectional view corresponding to the cross section of the secondary battery shown in FIG. **25** along XXVI-XXVI, and FIG. **30** is a reference cross sectional view corresponding to the cross section of the secondary battery shown in FIG. **25** along XXVI-XXVI.

[0171] As shown in FIGS. **26** and **27**, insulating sheet **700** is provided to cover the outer surface of electrode assembly **200** (first electrode assembly **201** and second electrode assembly **202**) inside case main body **110**. Insulating sheet **700** is preferably constituted of one sheet, and such one insulating sheet **700** may be wound around electrode assembly **200**. A first region R**1** and a second region R**2** of insulating sheet **700** are overlapped with each other to provide an overlapping region OR as described below.

[0172] As shown in FIG. **28**, insulating sheet **700** is one sheet having a rectangular shape in an unfolded state. Insulating sheet **700** can be divided into first region R**1**, second region R**2**, a third region R**3**, a fourth region R**4**, and a fifth region R**5** along a direction orthogonal to the width direction (X direction) of electrode assembly **200**. In insulating sheet **700**, first region R**1** is constituted of a vicinity of one end portion of the sheet, and second region R**2** is constituted of a vicinity of the other end portion of the sheet.

[0173] In the width direction (X direction) of electrode assembly **200**, overlapping region OR includes a central region CR and an end-portion region PR located beside each of both sides of central region CR, central region CR is provided with a non-overlapping region that reduces an area of overlapping region OR, and central region CR of insulating sheet **700** is about 80% from the center and the remainder, i.e., each of end-portion regions PR located beside both sides thereof, is about 10% in the lateral direction (width direction of electrode assembly **200**) in the present embodiment.

[0174] The non-overlapping region that reduces the area of overlapping region OR means a region that reduces the area of overlapping region OR by changing the shape of second region R**2** in central region CR when the non-overlapping region is provided as compared with a state in which the shape of second region R**2** is unchanged in the lateral direction in each of central region CR and end-portion region PR.

[0175] Second region R**2** of insulating sheet **700** of the present embodiment is provided with a recess **710***s* as the non-overlapping region at an end side of central region CR in a peripheral direction of insulating sheet **700**, recess **710***s* being recessed inward with respect to an end side of the end-portion region. Various implementations of recess **710**s can be employed; however, in central region CR, a ratio of providing the non-overlapping region with respect to the overlapping area when recess **710**s serving as the non-overlapping region is not provided may be 20% or more.

[0176] The width of recess **710**s is preferably about 30% or more, and more preferably 50% or more of the entire width of the main body portion of electrode assembly **200**. The length of the main body portion of electrode assembly **200** means the length of electrode assembly **200** except for the lengths of the negative electrode tab group and the positive electrode tab group provided on the both sides of electrode assembly **200**. It should be noted that the width of recess **710**s is defined as the width thereof at its portion having the largest width. For example, when recess **710**s has such a shape that the width of recess **710**s is increased toward the tip (upper end in FIG. **28**) of second region R**2** as shown in FIG. **28**, the width of recess **710**s is defined as the width of recess **710**s at a position corresponding to the tip (upper end in FIG. **28**) of second region R**2**.

[0177] Insulating sheet **700** preferably has a bending line (bend) L**1** at a boundary between the respective regions in advance in order to facilitate an operation of winding it around electrode assembly **200**. When a first notch region **711** recessed inward is provided at each of both end portions of bending line (bend) L**1** in the width direction, the operation of winding it around electrode assembly **200** is further facilitated. The shape of first notch region **711** is a semicircular shape in the figure, but may be a trapezoidal shape, a rectangular shape, a triangular shape, or the like.

[0178] In order to facilitate connection to spacer **600** as described below, a second notch **712** recessed inward may be provided at each of both end portions of first region R**1** of insulating sheet **700** in the width direction. The shape of second notch **712** is a rectangular shape in the figure, but may be a semicircular shape, a trapezoidal shape, a rectangular shape, a triangular shape, or the like. Further, instead of the notch with its one side being open as shown in the figure, a shape of a through hole may be employed.

[0179] An angle (α) formed by each of lateral sides **710**s**1** of both ends of recess **710**s and an end side **710**t of end-portion region PR may be 100° or more. Thus, insulating sheet **700** can be suppressed from being snagged when electrode assembly **200** around which insulating sheet **700** is wound is inserted into case main body **110**.

[0180] Insulating sheet **700** may be composed of, for example, a resin as described above. More specifically, as the material of insulating sheet **700**, for example, polypropylene (PP), polyethylene terephthalate (PET), polyphenylene sulfide (PPS), polyimide (PI), or polyolefin (PO) can be used. The thickness of insulating sheet **700** is preferably larger than the thickness (5 μm to 20 μm) of separator **800**.

[0181] Referring again to FIGS. **26** and **27**, electrode assembly **200** has a pair of a first surface **21** and a third surface **23** corresponding to the height direction (Z direction) of secondary battery **1**, and a pair of a second surface **22** and a fourth surface **24** corresponding to the thickness direction (Y direction) of the secondary battery. It should be noted that the area of each of first surface **21** and third surface **23** is preferably smaller than the area of each of second surface **22** and fourth surface **24**.

[0182] Electrode assembly **200** can be a stacked type electrode assembly including a plurality of positive electrode plates and a plurality of negative electrode plates. In this case, first surface **21** is a surface on a side on which the end surface of each positive electrode plate and the end surface of each negative electrode plate are disposed. It should be noted that the end surface of the positive electrode plate or the end surface of the negative electrode plate may be covered with a separator. Further, the positions of the end surface of the positive electrode plate and the end surface of the negative electrode plate may be deviated from each other. It should be noted that the separator may be a plurality of separators each having a rectangular shape, may be a separator that has a shape of strip and that is folded in a meandering manner, or may be implemented in a different manner.

[0183] When insulating sheet **700** is wound around electrode assembly **200**, first region R**1** and second region **2** face first surface **21**, third region R**3** faces second surface **22**, fourth region R**4** faces third surface **23**, and fifth region R**5** faces fourth surface **24**. First region R**1** and second region R**2** cover first surface **21** and have overlapping region OR in which second region R**2** overlaps with first region R**1**. It should be noted that in each of first region R**1** to fifth region R**5**, a portion of boundary with an adjacent region is a bent portion.

[0184] The tip of second region R**2** may be separated from a bent portion (outer surface of fourth region R**4**) between first region R**1** and fourth region R**4** (distance H**1** in the figure). Distance H**1** is 5% or more, preferably 10% or more of the thickness of electrode assembly **200**.

[0185] When insulating sheet **700** implemented as described above is wound around electrode assembly **200**, the insulating sheet is wound such that first region R**1** is located on the side in contact with spacer **600** and second region R**2** is located over first region R**1** as shown in FIG. **26**.

[0186] In the region in which each of spacers **600** (the first spacer and the second spacer) provided on the both sides is located, insulating sheet **700** is connected to each of spacers **600** (the first spacer and the second spacer) by using second notches **712** provided in first region R**1**. For the connection of insulating sheet **700** to spacer **600**, connection means such as thermal welding, ultrasonic welding, adhesion by a tape, adhesion by an adhesive agent, fitting, or hooking is employed.

[0187] As shown in FIG. **26**, it is preferable that a region of second region R**2** facing second notch **712** is connected to spacer **600** via second notch **712** so as to provide a connection portion **740**. It should be noted that a through hole or the like may be employed instead of second notch **712** as described above.

[0188] For the connection of insulating sheet **700** to spacer **600**, by using second notch **712** provided in first region R**1**, second region R**2** is directly fixed to spacer **600** with first region R**1** being pressed by second region R**2**. As a result, insulating sheet **700** can be stably and readily fixed to spacer **600**.

[0189] When a configuration in which no spacer **600** is provided is employed, first region R**1** and second region R**2** are connected to each other using the above-described connection method in the regions of the both end portions in which second notches **712** are provided.

[0190] When insulating sheet **700** implemented as described above is wound around electrode assembly **200**, a ratio of an overlapping portion between first region R**1** and second region R**2** in a region corresponding to the central region of first surface **21** of electrode assembly **200** is preferably larger than a ratio of the overlapping portion between first region R**1** and second region R**2** in a region corresponding to the end-portion region of first surface **21** of electrode assembly **200** as shown in FIGS. **26** to **29**. Thus, since the overlapping region between first region R**1** and second region R**2** is provided to some extent, a positional relation between insulating sheet **700** and electrode assembly **200** can be stabilized and an impregnation property of the electrolyte solution into the central region of electrode assembly **200** can be increased. It should be noted that the present disclosure is particularly effective in a battery having a high capacity (for example, a battery having a capacity of 50 Ah or more).

[0191] When spacer **600** is provided, the positional relation between insulating sheet **700** and electrode assembly **200** can be stabilized more effectively. When insulating sheet **700** implemented as described above is wound around electrode assembly **200**, in the overlapping portion between first region R**1** and second region R**2**, a large ratio of the overlapping area between first region R**1** and second region R**2** is secured in end-portion region PR, and a ratio of the overlapping area between first region R**1** and second region R**2** in recess **710***s* is smaller than that in end-portion region PR as shown in FIG. **26**.

[0192] As a result, an area for winding of insulating sheet **700** around spacer **600** can be secured in end-portion region PR, thereby stabilizing a state of winding of insulating sheet **700** around spacer **600**. On the other hand, since recess **710***s* is provided, the overlapping area is reduced and a clearance is formed between first region R**1** and second region R**2**.

[0193] With such an overlapping state that reduces the overlapping area, in the manufacturing process for the secondary battery, a path for entry of the electrolyte solution (arrow R**10** in FIG. **26**) into electrode assembly **200** becomes short to facilitate the entry of the electrolyte solution thereinto. As a result, the entry of the electrolyte solution can be suppressed from being hindered. For example, as shown in FIG. **29**, when the overlapping length between first region R**1** and second region R**2** is long, the path for the entry of the electrolyte solution (arrow R**10** in FIG. **30**) into electrode assembly **200** becomes long, with the result that the entry of the electrolyte solution is likely to be hindered.

[0194] Thus, according to the structure of secondary battery **1** in the embodiment, it is possible to suppress the hinderance of impregnation, entry and exit of the electrolyte solution into and from electrode assembly **200** while suppressing direct contact between electrode assembly **200** and case main body **110**. As a result, it is possible to provide secondary battery **1** improved in the infiltration property of the electrolyte solution into electrode assembly **200** having a high capacity and a high density.

[0195] As shown in FIG. **5**, gas-discharge valve **150** is provided in case main body **110**, and the surface thereof in which gas-discharge valve **150** is provided may be disposed to face first surface **21** of electrode assembly **200**. Gas-discharge valve **150** is fractured when internal pressure of case main body **110** becomes equal to or more than a predetermined value, and discharges the gas in case main body **110** to the outside of case main body **110**. Therefore, as the overlapping area between first region R**1** and second region R**2** of insulating sheet **700** is smaller, the gas generated from electrode assembly **200** can be more efficiently discharged to the outside of case main body **110**.

[0196] For example, referring to FIG. **28**, width W**1** of recess **710***s* is preferably 50% or more, more preferably 70% or more, and further preferably 80% or more of entire width W of insulating sheet **700**. Thus, the gas generated from electrode assembly **200** can be efficiently discharged to the outside.

[0197] Insulating sheet **700** described above employs such a configuration that recess **710***s* is provided in second region R**2** located on the outer side; however, the same function and effect can be obtained also when insulating sheet **700** employs such a configuration that recess **710***s* is provided in first region R**1** located on the inner side as shown in FIG. **30**.

Specific Implementations of Recess **710***s*

[0198] Next, specific implementations of recess **710***s* that constitutes the non-overlapping region provided in second region R**2** will be described with reference to FIG. **31**. FIG. **31** shows the areas of the regions when viewed from the first surface **21** side of electrode assembly **200** (when viewed in the direction perpendicular to first surface **21**) as follows: [1] the area (Sh**2**) of second region R**2** of insulating sheet **700**; [2] the area (Ss**1**) of spacer **600** (first spacer), the area (Se**1**) of first surface **21** of electrode assembly **200**, and the area (Ss**2**) of spacer **600** (second spacer); [3] the area (Sh**1**) of first region R**1** of insulating sheet **700**; and [4] the area (So**1**) of the region in which first region R**1** and second region R**2** of insulating sheet **700** overlap with each other. It should be noted that the areas of the positive electrode tab group and the negative electrode tab group are excluded from the area of electrode assembly **200**. In FIG. **32**, case main body **110** is not shown.

[0199] When the areas of the respective regions are thus defined, X1 may be provided to be larger than Y1, where X1 is defined as a ratio of [the area of the region in which spacer **600** (first spacer), first region R**1**, and second region R**2** overlap]/[the area (Ss**1**) of spacer **600** (first spacer)], and Y1 is defined as a ratio of [the area of the region in which the region of electrode assembly **200** that does not overlap with spacer **600** (first spacer), first region R**1**, and second region R**2** overlap]/[the area (Se**1**) of the region of electrode assembly **200** that does not overlap with spacer **600** (first spacer)]. The same applies to a case where spacer **600** (first spacer) is replaced with spacer **600** (second spacer).

[0200] Thus, the ratio of the overlapping region between first region R**1** and second region R**2** in the region overlapping with spacer **600** is preferably larger than the ratio of the overlapping region between first region R**1** and second region R**2** in the region overlapping with electrode assembly **200**.

[0201] Specifically, X1 is preferably 0.5 or more, more preferably 0.6 or more, and further preferably 0.7 or more. Y1 is preferably less than 0.5, more preferably 0.4 or less, and further preferably 0.3 or less. It should be noted that Y1 is preferably 0.03 or more, and more preferably 0.05 or more, for example.

[0202] It should be noted that only one of the first spacer side and the second spacer side may satisfy the above-described relation. However, both the first spacer side and the second spacer side preferably satisfy the above-described relation. It should be noted that both the first spacer and the second spacer are not essential configurations, and only one of them may be provided.

[0203] Here, the above-described numerical values are obtained in the case where spacers **600** (the first spacer and the second spacer) are provided, but the following describes a case where optimization of the area (Sol) of the region in which first region R**1** and second region R**2** overlap with each other is examined regardless of the presence or absence of spacers **600** with reference to FIG. **32**. FIG. **32** is a diagram showing central region CR and the end-portion regions when viewed from the first surface **21** side of electrode assembly **200**. It should be noted that case main body **110** is not shown in FIG. **32**.

[0204] Referring to FIG. **32**, regardless of the presence or absence of spacers **600**, when viewed from the first surface **21** side of electrode assembly **200**, central region CR means a region of −25% to +25% (the leftward direction in the figure represents the negative direction and the rightward direction in the figure represents the positive direction) from the central line (CL) of insulating sheet **700** (electrode assembly **200**), and each of the end-portion regions means a region of 10% from a corresponding end portion of insulating sheet **700**.

[0205] In the above case, X2 is preferably provided to be larger than Y2, where X2 is defined as a ratio of [the area of the overlapping portion between first region R**1** and second region R**2** in the end-portion region (region of 10% from the end portion)]/[the area of the end-portion region (region of 10% from the end portion)], and Y2 is defined as a ratio of [the area of the overlapping portion between first region R**1** and second region R**2** in central region CR (region of −25% to +25% from the center)]/[the area of central region CR (region of −25% to +25% from the center)].

[0206] Specifically, X2 is preferably 0.5 or more, more preferably 0.6 or more, and further preferably 0.7 or more. Y2 is preferably less than 0.5, more preferably 0.4 or less, and further preferably 0.3 or less. It should be noted that Y2 is preferably 0.03 or more, and more preferably 0.05 or more, for example.

[0207] Referring to FIG. **33**, the following describes a case where recess **710*s*** is provided in first region R**1** of first region R**1** located on the inner side and second region R**2** located on the outer side with respect to insulating sheet **700** facing first surface **21** of electrode assembly **200**. FIG. **33** corresponds to a partial enlarged view of the first surface **21** side of electrode assembly **200** shown in FIG. **30**.

[0208] When recess **710*s*** is provided on the inner side, the electrolyte solution may remain in a clearance S**1** formed between insulating sheet **700** and case main body **110**. Therefore, length L**1**, in the thickness direction of electrode assembly **200**, of second region R**2** located on the case main body **110** side is preferably 90 or more when the thickness of electrode assembly **200** is assumed to be 100. On the other hand, length L**2** of first region R**1** located on the electrode assembly **200** side is preferably 20 or less when the thickness of electrode assembly **200** is assumed to be 100 in order to secure an internal space in which the electrolyte solution flows and to inject a large amount of the electrolyte solution at one time.

Second Embodiment: Insulation Sheet 700A

[0209] Another implementation of the insulating sheet will be described with reference to FIG. **34**. It is not limited to the implementation of recess **710*s*** as long as there is provided a region having the same function as the function required for the non-overlapping region that reduces the overlapping area of the overlapping region provided in central region CR of insulating sheet **700**. FIG. **34** is a development view showing an implementation of an insulating sheet **700**A according to a second embodiment.

[0210] In insulating sheet **700**A, a plurality of through holes **720** are provided in central region CR instead of recess **710*s*** that constitutes the non-overlapping region. The shape of each of through holes **720** is not particularly limited, and various shapes such as a circular shape, an elliptical shape, and a rectangular shape can be employed. It should be noted that through hole **720** may be formed in at least one of first region R**1** or second region R**2**.

[0211] Thus, also when the plurality of through holes **720** are used as the non-overlapping region, it is possible to exhibit the same function and effect as those of insulating sheet **700** in the first embodiment.

Third Embodiment: Insulation Sheet 700B

[0212] Another implementation of the insulating sheet will be described with reference to FIG. **35**. FIG. **35** is a development view showing an implementation of an insulating sheet **700**B according to a third embodiment.

[0213] In insulating sheet **700** shown in FIG. **28**, recess **710*s*** is provided in the whole of central region CR, whereas in insulating sheet **700**B of the present embodiment, recess **710*s*** is provided in a part of central region CR, rather than the whole of central region CR.

[0214] Also with such an implementation of recess **710*s***, it is possible to exhibit the same function and effect as those of insulating sheet **700** in the first embodiment.

Fourth Embodiment: Insulation Sheet 700C

[0215] Another implementation of the insulating sheet will be described with reference to FIG. **36**. FIG. **36** is a development view showing an implementation of an insulating sheet **700**C according to a fourth embodiment.

[0216] In the present embodiment, recesses **710*s*** provided in central region CR are provided at two separate locations. Recesses **710*s*** are not limited to being provided at the two locations and may be provided at three or more separate locations.

[0217] Thus, also when the plurality of recesses **710*s*** are separately provided, it is possible to exhibit the same function and effect as those of insulating sheet **700** in the first embodiment.

[0218] Although the embodiments of the present invention have been described and illustrated in detail, it is clearly understood that the same is by way of illustration and example only and is not to be taken by way of limitation. The scope of the present invention is defined by the terms of the claims, and is intended to include any modifications within the scope and meaning equivalent to the terms of the claims.

What is claimed is:

1. A secondary battery comprising:

an electrode assembly including a first electrode and a second electrode having a polarity different from a polarity of the first electrode;

a battery case that accommodates the electrode assembly;

a first electrode tab group electrically connected to the first electrode and disposed at one end portion of the electrode assembly;

a second electrode tab group electrically connected to the second electrode and disposed at the other end portion of the electrode assembly; and

an insulating sheet that covers the electrode assembly, wherein

the electrode assembly includes a first surface,

the insulating sheet includes a first region constituted of a vicinity of one end portion of the insulating sheet and a second region constituted of the other end portion of the insulating sheet,

the first region and the second region cover the first surface,

an overlapping region in which the second region overlaps with the first region is provided,

in a width direction of the electrode assembly, the overlapping region includes a central region and an end-portion region located beside each of both sides of the central region, and

the central region has a non-overlapping region that reduces an overlapping area of the overlapping region.

2. The secondary battery according to claim **1**, wherein in the central region, a ratio of providing the non-overlapping region with respect to the overlapping area when the non-overlapping region is not provided is 20% or more.

3. The secondary battery according to claim **1**, wherein at least one of the first region and the second region is provided with a recess as the non-overlapping region at an end side of the central region in a peripheral direction of the insulating sheet, the recess being recessed inward with respect to an end side of the end-portion region.

4. The secondary battery according to claim **3**, wherein the recess is provided in the second region.

5. The secondary battery according to claim **3**, wherein an angle formed by each of lateral sides of both ends of the recess and the end side of the end-portion region is 100° or more.

6. The secondary battery according to claim **1**, further comprising:

a first spacer disposed on an end surface of the electrode assembly on which the first electrode tab group is provided; and

a second spacer disposed on an end surface of the electrode assembly on which the second electrode tab group is provided, wherein

the insulating sheet and the first spacer are connected to each other on a side on which the first electrode tab group is provided, and

the insulating sheet and the second spacer are connected to each other on a side on which the second electrode tab group is provided.

7. The secondary battery according to claim **6**, wherein

in an area when viewed from the first surface side of the electrode assembly, X1 is larger than Y1, where

X1 is defined as a ratio of [an area of a region in which the first spacer, the first region, and the second region overlap]/[an area of the first spacer], and

Y1 is defined as a ratio of [an area of a region in which the electrode assembly, the first region, and the second region overlap]/[an area of the electrode assembly].

8. The secondary battery according to claim **6**, wherein

in order to connect the insulating sheet to the first spacer, the first region is provided with an opening or notch, and

the second region is connected to the first spacer at a region facing the opening or notch.

9. The secondary battery according to claim **1**, wherein

in an area when viewed from the first surface side of the electrode assembly, X2 is larger than Y2, where

X2 is defined as a ratio of [an area of an overlapping portion between the first region and the second region in the end-portion region]/[an area of the end-portion region], and

Y2 is defined as a ratio of [an area of the overlapping portion between the first region and the second region in the central region]/[an area of the central region].

10. The secondary battery according to claim **1**, wherein

the electrode assembly has a third surface adjacent to the first surface,

the insulating sheet has a fourth region that covers the third surface,

a bent portion is provided between the first region and the fourth region, and

a tip of the second region is located away from the bent portion.

11. The secondary battery according to claim **1**, wherein

a gas-discharge valve is provided in the battery case, and

a surface of the battery case in which the gas-discharge valve is provided faces the first surface.

12. The secondary battery according to claim **1**, wherein

the battery case includes

a case main body provided with a first opening at one end portion of the case main body and a second opening at the other end portion of the case main body,

a first sealing plate that seals the first opening and that is welded to the case main body, and

a second sealing plate that seals the second opening and that is welded to the case main body,

the first electrode tab group is disposed at an end portion of the electrode assembly on the first opening side, and

the second electrode tab group is disposed at an end portion of the electrode assembly on the second opening side.

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