United States Patent Application Publication	20250260100
Kind Code	A1
Publication Date	August 14, 2025
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METHOD OF MANUFACTURING ELECTRICITY STORAGE DEVICE CASE COMPONENT, ELECTRICITY STORAGE DEVICE CASE COMPONENT, AND ELECTRICITY STORAGE DEVICE

Abstract

A method of manufacturing a case component includes the steps of preparing a plate member, placing the plate member in a mold, and integrally molding a sealing member with the plate member. In the step of integrally molding the sealing member with the plate member, a resin is poured into the mold to integrally mold the plate member and the sealing member that seals the plate member. The mold includes a protruding portion to be pressed against a circumferential periphery around the through hole of the plate member. The step of placing the plate member in the mold includes pressing the protruding portion of the mold against the circumferential periphery around the through hole of the plate member. The plate member includes a recessed portion formed between the through hole and a position against which the protruding portion of the mold is to be pressed.

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Appl. No.: **19/051799**

Filed: **February 12, 2025**

Foreign Application Priority Data

JP	2024-020529	Feb. 14, 2024

Publication Classification

Int. Cl.: **H01M50/171** (20210101); **H01G11/80** (20130101); **H01M50/15** (20210101)

U.S. Cl.:

CPC **H01M50/171** (20210101); **H01G11/80** (20130101); **H01M50/15** (20210101);

Background/Summary

[0001] The present application claims priority from Japanese Patent Application No. 2024-020529 filed on Feb. 14, 2024, which is incorporated by reference herein in its entirety.

BACKGROUND

[0002] The present disclosure relates to a method of manufacturing an electricity storage device case component, an electricity storage device case component, and an electricity storage device.

[0003] JP 2005-004968 A discloses a method of manufacturing a sealing plate by integrating an electrode terminal with a sealing plate main body made of a polymer material by insert molding. In the manufacturing method disclosed in the publication, the molding die is brought into pressure contact with an end face of the electrode terminal when mold clamping of a molding die used for insert molding, to thereby dam off the flow of the molding material for the sealing plate main body. The molding die is provided in advance with an annular-shaped protruding portion that bites into the end face of the electrode terminal at the time of mold clamping. The diameter dimension of the annular-shaped protruding portion is set to be smaller than the diameter dimension of the outer circumferential edge portion of the electrode terminal. It is stated that such a manufacturing method can effectively reduce the permeating of the electrolyte solution into the joint surface of the sealing plate main body and the electrode terminal.

SUMMARY

[0004] For case components used for electricity storage devices, it is necessary that plate members and sealing members be firmly joined to each other.

[0005] According to the present disclosure, a method of manufacturing an electricity storage device case component includes: a step of preparing plate member in which a through hole is formed; a step of placing the plate member in a mold; and a step of integrally molding a sealing member sealing the plate member with the plate member by pouring a resin into the mold. The mold includes a protruding portion to be pressed against a circumferential periphery around the through hole of the plate member. The step of placing the plate member in the mold includes pressing the protruding portion of the mold against the circumferential periphery around the through hole of the plate member. The plate member includes a recessed portion formed between the through hole and a position against which the protruding portion of the mold is to be pressed. The case component manufactured by such a manufacturing method shows good joining capability between the plate member and the sealing member.

Description

BRIEF DESCRIPTION OF THE DRAWINGS

[0006] FIG. **1** is a perspective view illustrating an electricity storage device **100**.

[0007] FIG. **2** is a flowchart illustrating a method of manufacturing an electricity storage device case component **14**.

[0008] FIG. **3** is a perspective view illustrating a plate member **14***a*.

[0009] FIG. **4** is a cross-sectional view taken along line IV-IV in FIG. **3**.

[0010] FIG. **5** is a schematic view of the plate member **14***a* disposed in a mold **60**.

[0011] FIG. **6** is another schematic view of the plate member **14***a* disposed in the mold **60**.
[0012] FIG. **7** is a schematic view of a case component **14** integrally molded inside the mold **60**.
[0013] FIG. **8** is a schematic view illustrating the way in which the plate member **14***a* deforms.
[0014] FIG. **9** is a cross-sectional view of the electricity storage device **100**.

DETAILED DESCRIPTION

[0015] Hereinbelow, embodiments of the technology according to the present disclosure will be described with reference to the drawings. It should be noted, however, that the disclosed embodiments are, of course, not intended to limit the disclosure. The drawings are depicted schematically and do not necessarily accurately depict actual objects. The features and components that exhibit the same effects are designated by the same reference symbols as appropriate, and the description thereof will not be repeated as appropriate. In the following description, reference characters L, R, F, Rr, U and D in the drawings represent left, right, front, rear, up, and down, respectively, and reference characters X, Y, and Z in the drawings represent the shorter-side axis, the longer-side axis, and the heightwise axis, respectively. These directional terms are, however, merely provided for purposes in illustration and are not intended to limit the present disclosure in any way.

[0016] FIG. **1** is a perspective view illustrating an electricity storage device **100**. FIG. **2** is a flowchart illustrating a method of manufacturing an electricity storage device case component **14**. FIG. **3** is a perspective view illustrating a plate member **14***a*. FIG. **4** is a cross-sectional view taken along line IV-IV in FIG. **3**. FIGS. **5** and **6** are each a schematic view of the plate member **14***a* disposed in a mold **60**. FIG. **5** shows the plate member **14***a* that is placed on a lower mold **61**. FIG. **6** shows the plate member **14***a* that is sandwiched between the lower mold **61** and an upper mold **66**. FIG. **7** is a schematic view of a case component **14** integrally molded inside the mold **60**. In FIGS. **5** to **7**, the mold **60** is not hatched. FIG. **8** is a schematic view illustrating the way in which the plate member **14***a* deforms. FIG. **9** is a cross-sectional view of the electricity storage device **100**. In FIG. **8**, portions of the mold **60** that bite into the plate member **14***a* and portions of the plate member **14***a* that undergo deformation are indicated by dash-dot-dot lines. FIG. **9** schematically shows a case component **14** attached to a case **10**.

[0017] As illustrated in FIG. **1**, the electricity storage device **100** includes an electrode body **40** (see FIG. **9**) and a case **10** that houses the electrode body **40**. Although not shown in the drawings, the case **10** also houses an electrolyte solution therein. The electrode body **40** and the electrolyte solution are power-generating elements of the electricity storage device **100**. For these power-generating elements, it is possible to use any type of power-generating elements used for conventionally known electricity storage devices without any particular limitation. Therefore, detailed descriptions thereof will not be provided herein.

[0018] In the present description, the term “electricity storage device” is meant to encompass any type of device in which charge-discharge reactions are caused by migration of charge carriers between a pair of electrodes (positive electrode and negative electrode). Accordingly, the electricity storage devices according to the technology disclosed herein are intended to encompass secondary batteries, such as lithium-ion secondary batteries, nickel-metal hydride batteries, and nickel-cadmium batteries, as well as capacitors, such as lithium-ion capacitors and electric double-layer capacitors.

[0019] In the present description, the term “case component” refers to a component that makes up the case of an electricity storage device. For example, the electricity storage device **100** shown in FIG. **1** employs a case **10** that is made up of a case main body **12** and a lid **14**. The case main body **12** includes an opening at its top. The lid **14** is a component that is attached to the opening of the case main body **12** to seal the opening. In such a case **10**, the case main body **12** and the lid **14** each are case components. In the embodiment shown in FIG. **1**, electrode terminals **20** and sealing members **30** are attached to the lid **14** as a case component. Although an embodiment in which the electrode terminals **20** and the sealing members **30** are attached to the lid **14** is shown herein, it is

also possible that the electrode terminals **20** and the sealing members **30** may be attached to the case main body **12**. The case components may be made of aluminum or aluminum alloy.
Hereinafter, a method of manufacturing a case component **14** as the lid **14** will be described with reference to the embodiment shown in FIG. **1**.

Method of Manufacturing Electricity Storage Device Case Component **14**

[0020] A method of manufacturing an electricity storage device case component (hereinafter also referred to simply as "case component") **14** includes, as illustrated in FIG. **2**, step S**10** of preparing a plate member **14***a*, step S**20** of placing the plate member **14***a* in a mold **60**, and step S**30** of integrally molding a sealing member **30** with the plate member **14***a*.

Step S**10** of Preparing Plate Member **14***a*

[0021] Step S**10** of preparing a plate member **14***a* involves preparing a plate member **14***a* in which through holes **14***b* are formed, as illustrated in FIG. **3**. The plate member **14***a*, also referred to as a sealing plate, is a member that closes the case main body **12** (see FIG. **1**) that houses the electrode body. The plate member **14***a* may be made of the same material as that for the case main body **12**, which may be, for example, aluminum or aluminum alloy. The plate member **14***a* is an oblong plate-shaped member.

[0022] Through holes **14***b* are provided at opposite ends of the plate member **14***a*. Each through hole **14***b* is a substantially rectangular-shaped opening as viewed in plan. The planar shape of the through hole **14***b* is not particularly limited as long as an electrode terminal **20** (see FIG. **1**) can be inserted therethrough. The planar shape of the through hole **14***b* may be a circular shape, an elliptical shape, or the like.

[0023] An outer surface **14***c* of the plate member **14***a* includes a groove **14***e* surrounding the through hole **14***b*. Likewise, an inner surface **14***d* of the plate member **14***a* also includes another groove **14***e* (see FIG. **4**) surrounding the through hole **14***b*. The grooves **14***e* are formed at a position against which the mold **60** (see FIG. **5**) is to be pressed in a later step.

[0024] Step S**10** of preparing the plate member **14***a* may include forming a recessed portion **14***f* in the plate member **14***a*. The method of forming the recessed portion **14***f* and the groove **14** is not particularly limited. In step S**10** of preparing the plate member **14***a*, the recessed portion **14***f* may be formed in the plate member **14***a* by conventionally known methods, such as cutting and forging.

[0025] In the plate member **14***a*, the recessed portion **14***f* is formed between the through hole **14***b* and the position (i.e., the groove **14***e*) against which the mold **60** (see FIG. **5**) is to be pressed. In other words, the recessed portion **14***f* is provided between the through hole **14***b* and the position against which the mold **60** is to be pressed. The recessed portion **14***f* is provided proximate to the groove (the position against which the mold **60** is to be pressed). The recessed portion **14***f* is provided at locations closer to the groove **14***e* than the through hole **14***b*. The recessed portion **14***f* is provided on both surfaces, i.e., the outer surface **14***c* and the inner surface **14***d*, of the plate member **14***a*.

[0026] The recessed portion **14***f* is in a substantially rectangularly recessed shape (see FIG. **4**) when viewed in a direction in which the groove **14***e* extends. In this embodiment, the recessed portion **14***f* surrounds the circumferential periphery around the through hole **14***b* entirely circumferentially. The recessed portion **14***f* is continuous in a substantially rectangular shape in the circumferential periphery around the through hole **14***b*, as viewed in plan. It should be noted that the recessed portion **14***f* is not necessarily continuous entirely circumferentially in the circumferential periphery around the through hole **14***b*. The recessed portion **14***f* may be discontinuous in the circumferential periphery around the through hole **14***b*. In the circumferential periphery around the through hole **14***b*, it is possible to provide a portion in which the recessed portion **14***f* is not formed partially.

[0027] Step S**10** of preparing the plate member **14***a* may also include forming a second recessed portion in the plate member **14***a*. The second recessed portion may be formed in the same method as the method of forming the recessed portions **14***f*. In the plate member **14***a*, the second recessed portion may be provided at a position against which the mold **60** is to be pressed. Herein, the

second recessed portion is provided on both surfaces, i.e., the outer surface **14***c* and the inner surface **14***d*, of the plate member **14***a*. In this embodiment, each of the grooves **14***e* corresponds to the second recessed portion. Hereinafter, the groove **14***e* may also be referred to as the second recessed portion **14***e*. In this embodiment, the second recessed portion **14***e* surrounds the circumferential periphery entirely around the through hole **14***b* (and the recessed portion **14***f*). The second recessed portion **14***e* is continuous in a substantially rectangular shape around the recessed portion **14***f*, as viewed in plan.

[0028] The second recessed portion **14***e* includes linear portions **14***e***1**, which are parallel to linear portions **14***b***1** of the substantially rectangular-shaped through hole **14***b*, and corner portions **14***e***2**, which connect adjacent linear portions **14***e***1**. The linear portions **14***e***1** of the second recessed portion **14***e* are provided spaced apart from the linear portions **14***b***1** of the through hole **14***b* substantially at a certain distance, and are substantially parallel to the linear portions **14***b***1** of the through hole **14***b*. The corner portions **14***e***2** of the second recessed portion **14***e* are in a substantially circular arc shape, and connect the end portions of adjacent linear portions **14***e***1**.

[0029] The shape of the second recessed portion **14***e* is not limited to any particular shape. In this embodiment, the second recessed portion **14***e* is recessed in a substantially wedge shape when viewed in a direction in which the groove **14***e* extends. The second recessed portion **14***e* is narrower toward the depth direction. The shape of the second recessed portion **14***e* may be determined according to the shape of the mold **60** that presses. Note that the second recessed portion **14***e* may be provided partially in the circumferential periphery around the recessed portion **14***f*. When the second recessed portion **14***e* is provided partially, it may be provided at least on the outside of the corner portions **14***b***2** of the rectangular-shaped through hole **14***b*. For example, of the above-described second recessed portion **14***e*, at least a circular arc-shaped corner portion **14***e***2** may be provided. Note that the second recessed portion **14***e* (i.e., groove **14***e*) may not necessarily be provided.

[0030] In addition, the plate member **14***a* may also be provided with a roughened surface portion **14***a***1**, to which surface roughening is performed for improving the joining capability with the sealing member **30**. The roughened surface portion **14***a***1** is a portion in which the surface roughness is relatively increased by performing a surface roughening process (surface treatment) for the material. The roughened surface portion **14***a***1** may be formed by processing such as laser application, sand blasting, or chemical etching, for example. In the plate member **14***a*, the roughened surface portion **14***a***1** may be provided around the through hole **14***b*. The roughened surface portion **14***a***1** may be provided inward further than the position against which the mold **60** is to be pressed (i.e., the groove **14***e*). In this embodiment, the roughened surface portion **14***a***1** is provided in a region inward of the recessed portion **14***f*. The roughened surface portion **14***a***1** may be formed on the inner circumferential surface of the through hole **14***b*. Providing the roughened surface portion **14***a***1** on the plate member **14***a* improves the joining capability between the plate member **14***a* and the sealing member **30**. The surface roughness (arithmetical mean roughness Ra) of the roughened surface portion **14***a***1** is higher than the portion that is not processed by a surface roughening process. The arithmetical mean roughness Ra may be measured, for example, according to JIS B 0601:2001, using a stylus-type surface roughness measuring instrument.

[0031] In this embodiment, the surface roughening is performed by laser application. Using laser application for the surface roughening process eliminates the need for covering, removal, or the like during the processing. This facilitates mass production of the plate member **14***a*.

[0032] The surface morphology of the roughened surface portion **14***a***1** is not particularly limited. The surface that is roughened by laser application may form a large number of protrusions that are raised from the pre-processed base material surface because fumes are attached thereto during processing. The surface that is roughened by chemical etching may form a large number of recesses that are recessed from the pre-processed base material surface. Note that the surface of the roughened surface portion **14***a***1** is not limited to the form in which protrusions and recesses are

formed. The surface of the roughened surface portion **14***a***1** may also be a porous surface in which a large number of micropores are formed. The surface of the roughened surface portion **14***a***1** may also be a surface on which a large number of hook-shaped protrusions such that the surface is warped upward in a thin-layered form.

[0033] The timing for the surface roughening process is not particularly limited. In this embodiment, the surface roughening process is performed between the recessed portion **14***f* and the through hole **14***b* after the recessed portion **14***f* has been formed. It is also possible that, after the recessed portion **14***f* has been formed in the above-described manner, the surface roughening process may be performed for the surface of the plate member **14***a* from the edge of the recessed portion **14***f* along the edge of the through hole **14***b*. This may improve the positional accuracy of the surface roughening process. In addition, when the recessed portion **14***f* is formed in advance, the processing for forming the recessed portion **14***f* does not adversely affect the roughened surface portion **14***a***1**, so the quality of the roughened surface portion **14***a***1** may be improved.

Step S**20** of Placing Plate Member **14***a* in Mold **60**

[0034] In step S**10** of placing the plate member **14***a* in the mold **60**, the electrode terminal **20** and the plate member **14***a* are placed in the mold **60** with the electrode terminal **20** being inserted through the through hole **14***b*, as illustrated in FIG. **5**. At this time, the electrode terminal **20** and the plate member **14***a* are placed in the mold **60** so that the electrode terminal **20** and the plate member **14***a* do not come into contact with each other.

[0035] In this embodiment, the electrode terminal **20** includes a shaft portion **22** and a plate portion **24**. The shaft portion **22** is a portion that is to be inserted in the through hole **14***b*. The shaft portion **22** is an oblong plate-shaped member extending along a height direction Z. The shape of the shaft portion **22** is not limited to a plate shape but may be, for example, a columnar shape (such as a cylindrical columnar shape and a prismatic columnar shape). In the electricity storage device **100** after manufacture, the shaft portion **22** is housed inside the case **10** and is connected to the electrode body **40** (see FIG. **9**). The shaft portion **22** may be connected to the electrode body **40** via a current collector terminal or the like.

[0036] The plate portion **24** is a portion that is to be disposed along the plate member **14***a* when the shaft portion **22** is inserted in the through hole **14***b*. The plate portion **24** is continuous from the upper end of the shaft portion **22**. The plate portion **24** is a portion that is exposed outside the case **10** so as to be connected to an external conductive member, such as a bus bar (see FIG. **1**). The plate portion **24** extend along the widthwise axis X (see FIG. **1**). The planar shape of the plate portion **24** is a substantially rectangular shape. The plate portion **24** and the shaft portion **22** may be formed by bending an oblong plate-shaped conductive member. The electrode terminal may not necessarily be an integral component in which the shaft portion and the plate portion are continuous. For example, the electrode terminal may be constructed by fabricating the shaft portion and the plate portions separately from each other and combining them together.

[0037] The electrode terminal **20** may include a portion that has been subjected to a surface roughening process. A surface of the electrode terminal **20** that is housed in the mold **60** and also is exposed to the internal space of the mold **60** may be subjected to the surface roughening process. Allowing the electrode terminal **20** to contain a portion subjected to the surface roughening process may improved the joining capability between the electrode terminal **20** and the sealing member **30**. The method of surface roughening the electrode terminal **20** may be the same as the method of surface roughening the plate member **14***a*, so the detailed description thereof will not be given further.

[0038] The configuration of the mold **60** may be set as appropriate according to the shapes of the plate member **14***a* and the electrode terminal **20**. In this embodiment, the mold **60** includes a lower mold **61** and an upper mold **66**. The material for the mold **60** is not limited to any particular material, but may be composed of a high strength metal material, such as stainless steel-based material, die steel-based material, maraging steel-based material, for example.

[0039] The lower mold **61** is a mold on which the plate member **14***a* and the electrode terminal **20** are placed. The lower mold **61** includes an upper surface **62**, on which the plate member **14***a* is placed, and a recessed portion **63**, which is recessed downward from the upper surface **62**.
[0040] As illustrated in FIG. **5**, the upper surface **62** of the lower mold **61** is a flat surface extending along the outer surface **14***c* of the plate member **14***a*. The outer surface **14***c* of the plate member **14***a* is placed on the upper surface **62**. The lower mold **61** includes a protruding portion **62***a*, which is to be pressed against the circumferential periphery around the through hole **14***b* of the plate member **14***a*. The protruding portion **62***a* protrudes upward from the upper surface **62** of the lower mold **61**. The protruding portion **62***a* is provided circumferentially continuously so as to surround the through hole **14***b* when the plate member **14***a* is placed on the lower mold **61**. The recessed portion **63** has a shape along the shape of the plate portion **24**. The recessed portion **63** is recessed in a substantially rectangular shape. The depth of the recessed portion **63** is slightly less than the thickness of the plate portion **24** of the electrode terminal **20**. The depth of the recessed portion **63** is not limited to any particular depth. The recessed portion **63** functions as a cavity surface in a later step of integrally molding.
[0041] The upper mold **66** is a mold that is to be pressed onto the plate member **14***a*. The upper mold **66** includes a lower surface **67**, which is placed on the plate member **14***a*, and a recessed portion **68**, which is recessed upward from the lower surface **67**. The lower surface **67** of the upper mold **66** is a flat surface extending along the inner surface **14***d* of the plate member **14***a*. The lower surface **67** is placed on the inner surface **14***d* of the plate member **14***a* (see FIG. **6**). The upper mold **66** includes a protruding portion **67***a* that is to be pressed against the circumferential periphery around the through hole **14***b* of the plate member **14***a*. The protruding portion **67***a* protrudes downward from the lower surface **67** of the upper mold **66**. The protruding portion **67***a* is provided circumferentially continuously so as to surround the through hole **14***b* when the upper mold **66** is placed on the plate member **14***a*. Like the recessed portion **63**, the recessed portion **68** has a shape along the shape of the plate portion **24**. The recessed portion **68** is recessed in a substantially rectangular shape. The depth of the recessed portion **68** is substantially the same as the depth of the recessed portion **63**. The depth of the recessed portion **68** is not limited to any particular depth. The recessed portion **68** of the upper mold **66** is provided with a through hole **68***a* through which the shaft portion **22** of the electrode terminal **20** passes. The recessed portion **68** is also provided with a filling port **69**. The injection port **69** is a hole for injecting a resin **31** (see FIG. **7**) into the mold **60**. The recessed portion **68** functions as a cavity surface in a later step of integrally molding.
[0042] The shapes, dimensions, arrangements, and the like of the protruding portions **62***a* and **67***a* are not particularly limited and may be determined according to the configuration of the plate member **14***a*. The protruding portions **62***a* and **67***a* protrude in a substantially wedge shape in cross section when viewed along a direction in which the protruding portions **62***a* and **67***a* are continuously provided. The protruding portions **62***a* and **67***a* become narrower toward the height direction of the protruding portions **62***a* and **67***a*. The protruding portions **62***a* and **67***a* have substantially the same shape and dimensions. In this embodiment, the protruding portions **62***a* and **67***a* are provided at corresponding positions with respect to the vertical direction. In this embodiment, the protruding portions **62***a* and **67***a* are provided respectively at positions that overlap the second recessed portions **14***e* formed on the outer surface **14***c* and the inner surface **14***d* of the plate member **14***a*. The height of the protruding portions **62***a* and **67***a* is greater than the depth of the second recessed portions **14***e*.
[0043] On the upper surface **62** of the lower mold **61**, the plate member **14***a* is placed such that the outer surface **14***c* faces downward. In this embodiment, the plate member **14***a* is placed on the lower mold **61** so that the second recessed portion **14***e* can fit on the protruding portion **62***a* on the upper surface **62** of the lower mold **61**. The plate member **14***a* is supported by the protruding portion **62***a*. The outer surface **14***c* of the plate member **14***a* is slightly lifted from the upper surface **62** of the lower mold **61**. On the bottom surface of the recessed portion **63** of the lower mold **61**,

the plate portion **24** of the electrode terminal **20** is placed so that the upper surface **24***a* faces downward. The electrode terminal **20** passes through the through hole **14***b* in the plate member **14***a*. The upper surface **24***a* of the plate portion **24** of the electrode terminal **20** protrudes downward further than the outer surface **14***c* of the plate member **14***a*.

[0044] In step S**20** of placing a plate member **14***a* in the mold **60**, the plate member **14***a* is mold clamped by the lower mold **61** and the upper mold **66**. The lower mold **61** may be mounted on a base, not shown. The upper mold **66** may be mounted on a press machine, not shown.

[0045] As illustrated in FIG. **6**, the plate member **14***a* is clamped and pressed between the lower mold **61** and the upper mold **66** with the electrode terminal **20** being inserted through the through hole **14***b*. The protruding portion **67***a* of the upper mold **66** is pressed against the second recessed portion **14***e* in the inner surface **14***d* of the plate member **14***a*. The plate member **14***a* is pressed by the protruding portion **62***a* of the lower mold **61** and the protruding portion **67***a* of the upper mold **66**, which are provided at corresponding positions with respect to the vertical direction. The protruding portions **62***a* and **67***a* of the lower mold **61** and the upper mold **66** are pressed against the circumferential periphery (the second recessed portions **14***e* in this embodiment) around the through hole **14***b*. At this time, the protruding portions **62***a* and **67***a* bite into the circumferential periphery around the through hole **14***b*, deforming the circumferential periphery around the portion against which the protruding portions **62***a* and **67***a* are pressed. Under the condition in which the protruding portions **62***a* and **67***a* bite into the circumferential periphery around the through hole **14***b* and the plate member **14***a* is mold clamped, the resin **31** (see FIG. **7**) is poured into the mold **60**.

Step S**30** of Integrally Molding Plate Member **14***a* and Sealing Member **30**

[0046] In step S**30** of integrally molding a plate member **14***a* and a sealing member **30**, a resin is poured into the mold **60** to integrally mold the plate member **14***a* and the sealing member **30**. Herein, the plate member **14***a*, the electrode terminal **20**, and the sealing member **30** are molded integrally with each other. The sealing member **30** is a member for sealing the plate member **14***a*.

[0047] As illustrated in FIG. **7**, the resin **31** is poured into the mold **60** in which the electrode terminal **20** and the plate member **14***a* have been placed. The electrode terminal **20** and the plate member **14***a* are joined via the sealing member **30** by what is called injection molding. Herein, the resin **31** is poured through the injection port **69** of the upper mold **66**. The resin **31** flows into the space enclosed by the recessed portion **63** of the lower mold **61**, the recessed portion **68** of the upper mold **66**, the plate member **14***a*, and the electrode terminal **20**.

[0048] For the resin **31**, it is possible to use thermoplastic resins, such as polyethylene, polyamide, polypropylene, and vinyl chloride. After the resin **31** has been poured, the mold **60** is cooled, and thereby the resin **31** is also cooled. The cooled resin **31** is cured, whereby the sealing member **30** is formed. This allows the sealing member **30** to fill the space between the plate member **14***a* and the electrode terminal **20**. Thereby, the plate member **14***a*, the electrode terminal **20**, and the sealing member **30** are integrally molded, to produce the case component **14**.

[0049] The roughened surface portion **14***a***1** of the plate member **14***a* has a high surface roughness, allowing the resin **31** to be easily impregnated on the surface of the roughened surface portion **14***a***1**. The resin **31** cures with it being impregnated on the surface of the roughened surface portion **14***a***1**. This facilitates improving the joining strength between the electrode terminal **20** and the cured sealing member **30** due to what is called an anchoring effect.

[0050] It should be noted that the plate member **14***a* and the electrode terminal **20** are disposed in the mold **60** so as not to be in contact with each other. This allows the sealing member **30** to be interposed between the plate member **14***a* and the electrode terminal **20** in the case component **14**. This serves to reduce interference between the plate member **14***a* and the electrode terminal **20**. The upper surface **24***a* of the plate portion **24** of the electrode terminal **20** is exposed outside case **10** without being covered by the sealing member **30**.

[0051] When the plate member is placed in the mold and the protruding portion of the mold is

pressed against the circumferential periphery around the through hole, the plate member may be deformed because of the pressing by the protruding portion. For example, the portion of the plate member against which the protruding portion is pressed may be depressed by the protruding portion of the mold. According to the present inventor's knowledge, when the portion against which the protruding portion is pressed is depressed, the circumferential periphery thereof may in some cases be raised accordingly. For example, a raised portion may be formed by plastic deformation in the region between the through hole and the portion against which the protruding portion is pressed. This may impair flatness in the region between the through hole and the portion against which the protruding portion is pressed. This may weaken the joining between the plate member and the sealing member.

[0052] In the above-described embodiment, the method of manufacturing a case component **14** includes step S**10** of preparing a plate member **14***a*, step S**20** of placing the plate member **14***a* in a mold **60**, and step S**30** of integrally molding a sealing member **30** with the plate member **14***a*. In step S**30** of integrally molding the sealing member **30** with the plate member **14***a*, a resin **31** is poured into the mold **60** to integrally mold the plate member **14***a* with the sealing member **30**, which seals the plate member **14***a*. The mold **60** includes protruding portions **62***a* and **67***a* that are to be pressed against the circumferential periphery around the through hole **14***b* of the plate member **14***a*. Step S**20** of placing the plate member **14***a* in the mold **60** includes pressing the protruding portions **62***a* and **67***a* of the mold **60** against the circumferential periphery around the through hole **14***b* of the plate member **14***a*. The plate member **14***a* includes a recessed portion **14***f* formed between the through hole **14***b* and positions against which the protruding portions **62***a* and **67***a* of the mold **60** are pressed.

[0053] As illustrated in FIG. **8**, the protruding portions **62***a* and **67***a* are pressed against the plate member **14***a*, and in the plate member **14***a*, the circumferential peripheries around the pressed portions are deformed. At this time, because the recessed portion **14***f* is formed between the through hole **14***b* and the positions against which the protruding portions **62***a* and **67***a* of the mold **60** are pressed, deformation tends to occur between the through hole **14***b* and the positions where the protruding portions **62***a* and **67***a* are pressed. For example, because of the protruding portions **62***a* and **67***a* pressing the plate member **14***a*, the portion of the plate member **14***a* that is between the recessed portion **14***f* and the positions against which the protruding portions **62***a* and **67***a* are pressed is more likely to be deformed toward the recessed portion **14***f*. Therefore, the region closer to the through hole **14***b* than the recessed portion **14***f* is less likely to be affected by the deformation caused by the pressing by the protruding portions **62***a* and **67***a*. Thus, the region between the through hole **14***b* and the recessed portion **14***f* is easily kept in a flat condition. As a result, the plate member **14***a* and the sealing member **30** after being integrally formed show good joining capability. This serves to improve hermeticity effected by the sealing member **30** in the electricity storage device **100**.

[0054] Although the dimensions and the like of the recessed portion **14***f* are not particularly limited, it is possible that the dimensions of the recessed portion **14***f* may be determined according to the amount of deformation caused by the protruding portions **62***a* and **67***a* pressing the plate member **14***a*. For example, the volumetric capacity of the recessed portion **14***f* of the plate member **14***a* may be set to greater than or equal to the volume of the protruding portions **62***a* and **67***a* that bite into the plate member **14***a* when the protruding portions **62***a* and **67***a* of the mold **60** are pressed against the circumferential periphery around the through hole **14***b* of the plate member **14***a*. This allows the region closer to the through hole **14***b* than the recessed portion **14***f* to be even less likely to be affected by the deformation caused by the pressing by the protruding portions **62***a* and **67***a*.

[0055] In the above-described embodiment, the region of the plate member **14***a* that is at least between the recessed portion **14***f* and the through hole **14***b* is subjected to a surface roughening process for improving the joining capability with the sealing member **30**. Such a plate member **14***a* is also unlikely to cause deformation in the region between the recessed portion **14***f* and the through

hole **14***b* to thereby easily maintain the surface roughened portion. As a result, the joining capability between the plate member **14***a* and the sealing member **30** may be favorable due to the anchoring effect.

[0056] In the above-described embodiment, the plate member **14***a* is provided with the second recessed portion **14***e* at the positions against which the protruding portions **62***a* and **67***a* of the mold **60** are to be pressed. This makes the positioning of the plate member **14***a* relative to the mold **60** easier. Moreover, because the positions against which the protruding portions **62***a* and **67***a* are pressed are recessed in advance, the amount of deformation of the plate member **14***a* may be reduced when the protruding portions **62***a* and **67***a* are pressed against the plate member **14***a*.

[0057] In the above-described embodiment, the through hole **14***b* of the plate member **14***a* is in a rectangular shape. The second recessed portion **14***e* is provided at least on the outside of a corner portion **14***b***2** of the rectangular-shaped through hole **14***b*. In comparison with the linear portion **14***b***1**, the corner portion **14***b***2** has a smaller area from the corner portion **14***b***2** of the through hole **14***b* to the corner portion **14***e***2** of the second recessed portion **14***e* relative to the size of the portion against which the protruding portions **62***a* and **67***a* are pressed. For this reason, the region between the corner portion **14***b***2** of the through hole **14***b* and the corner portion **14***e***2** of the second recessed portion **14***e* may result in a greater amount of deformation per unit area. Providing the second recessed portion **14***e* on the outside of the corner portion **14***b***2** serves to easily reduce the deformation in the portion that is likely to result in a greater amount of deformation. For the same reason, when the recessed portion **14***f* is provided partially in the circumferential periphery around the through hole **14***b*, it may be provided on the outside of the corner portion **14***b***2**.

[0058] In the above-described embodiment, the second recessed portion **14***e* of the plate member **14***a* surrounds the circumferential periphery around the through hole **14***b* entirely circumferentially. This serves to reduce deformation even when the deformation occurs in any region between the through hole **14***b* and the second recessed portion **14***e*.

[0059] In addition, the recessed portion **14***f* of the plate member **14***a* surrounds the circumferential periphery around the through hole **14***b* entirely circumferentially. This serves to reduce deformation even when the deformation occurs in any region between the through hole **14***b* and the second recessed portion **14***e*.

[0060] In the above-described embodiment, the protruding portions **62***a* and **67***a* of the mold **60** are in a wedge shape. This serves to prevent the resin **31** from flowing out of the mold **60**. Moreover, the dimensions of the protruding portions **62***a* and **67***a* that bite into the plate member **14***a* are relatively reduced, which may reduce deformation of the plate member **14***a*.

[0061] In the above-described embodiment, the recessed portion **14***f* is provided proximate to the positions against which the protruding portions **62***a* and **67***a* of the mold **60** are to be pressed. This allows the deformation of the plate member **14***a* that is caused by pressing by the protruding portions **62***a* and **67***a* to be easily restricted within a narrow area.

[0062] The case component **14** manufactured by the above-described method includes, as illustrated in FIG. **9**, a plate member **14***a* including a through hole **14***b* formed therein, an electrode terminal **20** inserted through the through hole **14***b* of the plate member **14***a*, and a sealing member **30** interposed between the electrode terminal **20** and a plate portion **24**. The plate member **14***a* includes a continuous groove **14***e* surrounding the through hole **14***b*, and a recessed portion **14***f* formed between the groove **14***e* and the through hole **14***b*. The sealing member **30** fits in the recessed portion **14***f*. The case component **14** may be used as the lid **14** of the electricity storage device **100**. In addition, the electricity storage device **100** may be produced by housing the electrode body into the case main body **12** and sealing the opening of the case main body **12** with the lid **14** by any known method.

[0063] Note that the case component **14** is not limited to the embodiments described above. When a case main body is provided with an electrode terminal and a sealing member, it is also possible to manufacture a case component as the case main body according to the method described above.

The case component disclosed herein may constitute a case main body or a lid.
[0064] The case component **14** disclosed herein includes the plate member **14***a*, the electrode terminal **20**, and the sealing member **30** that are molded integrally with each other. However, such embodiments are merely illustrative. The above-described method of manufacturing a case component **14** may also be applied to the cases that a member that is to be integrally molded with a case **10**, such as a safety valve or the like, for example, is manufactured as a separate component from the case **10**.
[0065] Various embodiments of the technology according to the present disclosure have been described hereinabove. Unless specifically stated otherwise, the embodiments described herein do not limit the scope of the present disclosure. It should be noted that various other modifications and alterations may be possible in the embodiments of the technology disclosed herein. In addition, the features, structures, or steps described herein may be omitted as appropriate, or may be combined in any suitable combinations, unless specifically stated otherwise. In addition, the present description includes the disclosure as set forth in the following items. [0066] Item 1:
[0067] A method of manufacturing an electricity storage device case component, the method including the steps of: [0068] preparing a plate member in which a through hole is formed; [0069] placing the plate member in a mold; and [0070] integrally molding a sealing member sealing the plate member with the plate member by pouring a resin into the mold, wherein: [0071] the mold includes a protruding portion to be pressed against a circumferential periphery around the through hole of the plate member; [0072] the step of placing the plate member in the mold includes pressing the protruding portion of the mold against the circumferential periphery around the through hole of the plate member; and [0073] the plate member includes a recessed portion formed between the through hole and a position against which the protruding portion of the mold is to be pressed. [0074] Item 2:
[0075] The method according to item 1, wherein the plate member is subjected to a surface roughening process in at least a region of the plate member that is between the recessed portion and the through hole. [0076] Item 3:
[0077] The method according to item 2, wherein the step of preparing the plate member includes forming the recessed portion in the plate member, and performing the surface roughening process in the region of the plate member between the recessed portion and the through hole subsequent to the forming the recessed portion. [0078] Item 4:
[0079] The method according to any one of items 1 to 3, wherein the plate member includes a second recessed portion provided at a position against which the protruding portion of the mold is to be pressed. [0080] Item 5:
[0081] The method according to item 4, wherein the through hole of the plate member is in a rectangular shape, and the second recessed portion is provided outside at least a corner portion of the rectangular-shaped through hole. [0082] Item 6:
[0083] The method according to item 4 or 5, wherein the second recessed portion of the plate member surrounds the through hole around its entire circumference. [0084] Item 7:
[0085] The method according to any one of items 1 to 6, wherein the recessed portion of the plate member has a volumetric capacity greater than or equal to a volume of the protruding portion that bites into the plate member when the protruding portion of the mold is pressed against the circumferential periphery around the through hole of the plate member. [0086] Item 8:
[0087] The method according to any one of items 1 to 7, wherein the recessed portion of the plate member surrounds the through hole around its entire circumference. [0088] Item 9:
[0089] The method according to any one of claims **1** to **8**, wherein the protruding portion of the mold is in a wedge shape. [0090] Item 10:
[0091] The method according to any one of items 1 to 9, wherein the recessed portion is provided proximate to the position against which the protruding portion of the mold is to be pressed. [0092] Item 11:

[0093] An electricity storage device case component, including: [0094] a plate member in which a through hole is formed; [0095] an electrode terminal inserted through the through hole of the plate member; and [0096] a sealing member interposed between the plate member and the electrode terminal, wherein: [0097] the plate member includes a continuous groove surrounding the through hole, and a recessed portion formed between the groove and the through hole; and [0098] the sealing member enters the recessed portion. [0099] Item 12:
[0100] An electricity storage device, including: [0101] an electrode body; [0102] a case main body including an opening, and housing the electrode body; and [0103] a lid attached to the opening, wherein [0104] the case main body or the lid is an electricity storage device case component according to item 11.

Claims

1. A method of manufacturing an electricity storage device case component, the method comprising the steps of: preparing a plate member in which a through hole is formed; placing the plate member in a mold; and integrally molding a sealing member sealing the plate member with the plate member by pouring a resin into the mold, wherein: the mold includes a protruding portion to be pressed against a circumferential periphery around the through hole of the plate member; the step of placing the plate member in the mold includes pressing the protruding portion of the mold against the circumferential periphery around the through hole of the plate member; and the plate member includes a recessed portion formed between the through hole and a position against which the protruding portion of the mold is to be pressed.
2. The method according to claim 1, wherein the plate member is subjected to a surface roughening process in at least a region of the plate member that is between the recessed portion and the through hole.
3. The method according to claim 2, wherein the step of preparing the plate member includes forming the recessed portion in the plate member, and performing the surface roughening process in the region of the plate member between the recessed portion and the through hole subsequent to the forming the recessed portion.
4. The method according to claim 1, wherein the plate member includes a second recessed portion provided at a position against which the protruding portion of the mold is to be pressed.
5. The method according to claim 4, wherein the through hole of the plate member is in a rectangular shape, and the second recessed portion is provided outside at least a corner portion of the rectangular-shaped through hole.
6. The method according to claim 4, wherein the second recessed portion of the plate member surrounds the through hole around its entire circumference.
7. The method according to claim 1, wherein the recessed portion of the plate member has a volumetric capacity greater than or equal to a volume of which the protruding portion that bites into the plate member when the protruding portion of the mold is pressed against the circumferential periphery around the through hole of the plate member.
8. The method according to claim 1, wherein the recessed portion of the plate member surrounds the through hole around its entire circumference.
9. The method according to claim 1, wherein the protruding portion of the mold is in a wedge shape.
10. The method according to claim 1, wherein the recessed portion is provided proximate to the position against which the protruding portion of the mold is to be pressed.
11. An electricity storage device case component comprising: a plate member in which a through hole is formed; an electrode terminal inserted through the through hole of the plate member; and a sealing member interposed between the plate member and the electrode terminal, wherein: the plate member includes a continuous groove surrounding the through hole, and a recessed portion formed

between the groove and the through hole; and the sealing member enters the recessed portion.

12. An electricity storage device comprising: an electrode body; a case main body including an opening, and housing the electrode body; and a lid attached to the opening, wherein the case main body or the lid comprises an electricity storage device case component according to claim **11**.