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Power storage cell

Abstract

A power storage cell comprises an electrode assembly, a collector plate that has the first electrode sheet connected thereto, and a laminate film, wherein the collector plate has a peripheral edge portion including an inner side located closer to the electrode assembly and an outer side located on a side opposite to the electrode assembly with respect to the inner side, the collector plate is provided with a welding portion and an adhesive portion, and when a direction from the inner side toward the outer side is defined as a first direction and a direction intersecting the first direction is defined as a second direction, the welding portion and the adhesive portion are aligned in the second direction.

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Background/Summary

(1) This is a continuation of U.S. application Ser. No. 17/707,219, filed on Mar. 29, 2022 (allowed), which is based on Japanese Patent Application No. 2021-060106 filed on Mar. 31, 2021 with the Japan Patent Office, the entire contents of which are hereby incorporated by reference.

BACKGROUND
Field
(1) The present disclosure relates to a power storage cell.
Description of the Background Art
(2) A conventionally known power storage cell comprises an electrode assembly, a collector plate

connected to the electrode assembly, and a laminate film sealing the electrode assembly.
(3) For example, Japanese Patent Laying-Open No. 2020-173989 discloses a power storage cell comprising an electrode assembly, an exterior covering the electrode assembly, and a collector plate connected to the electrode assembly.
(4) The electrode assembly is composed of a plurality of positive electrode plates, a plurality of separators, and a plurality of negative electrode plates stacked in layers. A positive electrode current collecting lead is formed for each positive electrode plate, and a negative electrode current collecting lead is formed for each negative electrode plate.
(5) The exterior is formed of two laminate films. The exterior has a shorter side portion, at which the collector plate externally projects from an interior of the exterior. Specifically, the collector plate externally projects between the two laminate films.
(6) Inside the exterior, the collector plate has an upper surface with a welding portion and an adhesive portion formed thereon. The welding portion is located inside the exterior and welds a plurality of current collecting leads. The adhesive portion is formed outwardly of the welding portion. The adhesive portion adheres the laminate film to an upper surface of the collector plate.
SUMMARY
(7) For the above-described power storage cell, on the upper surface of the collector plate, the welding portion and the adhesive portion are aligned in a direction in which the collector plate projects from the inside of the exterior to the outside of the exterior. Therefore, inside the exterior, a space is created between the welding portion and the adhesive portion. This results in a reduced occupancy of the interior of the exterior by the electrode assembly.
(8) The present disclosure has been made in view of the above-described problem, and an object thereof is to provide a power storage cell allowing an improved occupancy of an interior of an exterior by an electrode assembly.
(9) According to the present disclosure, a power storage cell comprises an electrode assembly that is composed of a first electrode sheet, a separator and a second electrode sheet stacked in layers, a collector plate that is disposed adjacent to the electrode assembly and has the first electrode sheet connected thereto, and a laminate film that seals the electrode assembly and the collector plate inside, wherein the collector plate has a peripheral edge portion including an inner side located closer to the electrode assembly and an outer side located on a side opposite to the electrode assembly with respect to the inner side, the collector plate is provided with a welding portion having the first electrode sheet welded thereto, and at least one adhesive portion that adheres the laminate film, and when a direction from the inner side toward the outer side is defined as a first direction and a direction intersecting the first direction is defined as a second direction, the welding portion and the adhesive portion are aligned in the second direction.
(10) The above power storage cell can reduce wasteful space inside the laminate film and increase occupancy inside the laminate film by the electrode assembly.
(11) The laminate film includes a first film that covers the electrode assembly on one side and a second film that covers the electrode assembly on another side, and the power storage cell further comprises a fusing portion that fuses a peripheral portion of the first film and a peripheral portion of the second film together. The fusing portion is located outwardly of the collector plate and the electrode assembly, and formed annularly along the peripheral portion of the first film and the peripheral portion of the second film.
(12) The adhesive portion is a plurality of such adhesive portions spaced in the second direction, and the welding portion is disposed between the adhesive portions.
(13) The adhesive portion has a hole that exposes a portion of the collector plate, an exposure hole is formed through a portion of the laminate film that faces the hole, and a portion of the collector plate is formed so as to be externally exposed through the hole and the exposure hole.
(14) The foregoing and other objects, features, aspects and advantages of the present disclosure will

become more apparent from the following detailed description of the present disclosure when taken in conjunction with the accompanying drawings.

Description

BRIEF DESCRIPTION OF THE DRAWINGS

(1) FIG. **1** is a perspective view schematically showing a power storage device **1** and the like according to an embodiment.

(2) FIG. **2** is a cross-sectional view taken along a line II-II indicated in FIG. **1**.

(3) FIG. **3** is a perspective view schematically showing a power storage module **20**, bus bars **21**, **22**, and the like.

(4) FIG. **4** is a perspective view of a power storage cell **30**.

(5) FIG. **5** is an exploded perspective view of power storage cell **30**.

(6) FIG. **6** is a perspective view schematically showing a positive electrode sheet **50**.

(7) FIG. **7** is a plan view schematically showing a negative electrode sheet **52**.

(8) FIG. **8** is a plan view of a major surface **46** of a positive electrode collector plate **37** and a configuration surrounding the major surface.

(9) FIG. **9** is a plan view of a major surface **47** of positive electrode collector plate **37**.

(10) FIG. **10** is a plan view of a major surface **48** of a negative electrode collector plate **38**.

(11) FIG. **11** is a plan view of a major surface **49** of negative electrode collector plate **38**.

(12) FIG. **12** is a cross-sectional view of power storage cell **30**.

(13) FIG. **13** is a plan view of an exposure hole **96**A and a hole **71**A.

(14) FIG. **14** is a perspective view of a power storage cell **30**A according to a comparative example.

(15) FIG. **15** is a cross-sectional view of power storage cell **30**A.

(16) FIG. **16** is a perspective view of a positive electrode sheet **50**A.

(17) FIG. **17** is a perspective view of a negative electrode sheet **52**A.

(18) FIG. **18** is a plan view of a major surface **46**A of a positive electrode collector plate **37**A.

(19) FIG. **19** is a plan view of a major surface **48**A of a negative electrode collector plate **38**A.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

(20) A power storage cell and a power storage device according to an embodiment will now be described with reference to FIGS. **1** to **19**. Of the configurations shown in FIGS. **1** to **19**, any configuration that is identical or substantially identical is identically denoted and will not be described redundantly.

(21) FIG. **1** is a perspective view schematically showing a power storage device **1** and the like according to an embodiment. A battery pack **100** comprises power storage device **1** and cooling devices **5** and **6**. Power storage device **1** includes an accommodation case **2**, a positive electrode's external terminal **3**, and a negative electrode's external terminal **4**.

(22) Accommodation case **2** is formed generally in a rectangular parallelepiped. Accommodation case **2** includes a top plate **10**, a bottom plate **11**, lateral walls **12** and **13**, and end walls **14** and **15**. Lateral walls **12** and **13** are aligned in a widthwise direction W and formed to extend in a longitudinal direction L. End walls **14** and **15** are aligned in longitudinal direction L and formed to extend in widthwise direction W.

(23) The positive electrode's external terminal **3** and the negative electrode's external terminal **4** are provided on an upper surface of top plate **10**. The positive electrode's external terminal **3** and the negative electrode's external terminal **4** are spaced in widthwise direction W.

(24) Cooling device **5** is disposed on lateral wall **12**, and cooling device **6** is disposed on lateral wall **13**. Coolant C flows through cooling devices **5** and **6**. In FIG. **1**, cooling devices **5** and **6** are partially shown in cross section and thus omitted.

(25) FIG. **2** is a cross-sectional view taken along a line II-II indicated in FIG. **1**. Power storage

device **1** includes a power storage module **20**, bus bars **21** and **22** connected to power storage module **20**, expansion absorbing materials **23** and **24**, insulating members **25** and **26**, and an insulating film **27**.

(26) FIG. **3** is a perspective view schematically showing power storage module **20**, bus bars **21**, **22**, and the like. Power storage module **20** includes a plurality of power storage cells **30**, **31** and **32** stacked in a stacking direction H, and a plurality of connecting members **33** and **34**.

(27) Power storage cells **31** and **32** have substantially the same configuration as power storage cell **30**, and accordingly, power storage cell **30** will be described.

(28) FIG. **4** is a perspective view of power storage cell **30**, and FIG. **5** is an exploded perspective view of power storage cell **30**. Power storage cell **30** includes an electrode assembly **35**, a laminate film **36**, a positive electrode collector plate **37**, and a negative electrode collector plate **38**.

(29) Laminate film **36** has a structure composed of a resin film, an aluminum foil, and a resin film stacked in layers. Laminate film **36** seals electrode assembly **35**, positive electrode collector plate **37**, negative electrode collector plate **38**, and an electrolyte (not shown) therein.

(30) Electrode assembly **35** is formed generally in a rectangular parallelepiped. Electrode assembly **35** includes an upper surface **40**, a lower surface **41**, lateral surfaces **42** and **43**, and end surfaces **44** and **45**. Lateral surfaces **42** and **43** are aligned in widthwise direction W and formed to extend in longitudinal direction L. End surfaces **44** and **45** are aligned in longitudinal direction L and formed to extend in widthwise direction W. A length of lateral surfaces **42**, **43** in longitudinal direction L is longer than a length of end surfaces **44**, **45** in widthwise direction W.

(31) Positive electrode collector plate **37** is provided on the side of lateral surface **42** of electrode assembly **35**, and negative electrode collector plate **38** is provided on the side of lateral surface **43** of electrode assembly **35**.

(32) Electrode assembly **35** includes a plurality of positive electrode sheets **50**, a plurality of separators **51**, and a plurality of negative electrode sheets **52** stacked in stacking direction H. The sheets are stacked such that separator **51** is disposed between positive electrode sheet **50** and negative electrode sheet **52**.

(33) FIG. **6** is a perspective view schematically showing positive electrode sheet **50**. Positive electrode sheet **50** includes an aluminum foil **54** and a positive electrode composite material layer **55** formed on the front and back surfaces of aluminum foil **54**.

(34) Aluminum foil **54** is formed in a rectangle. A portion of aluminum foil **54** on the side of one longer side is free of positive electrode composite material layer **55** and hence has an exposed portion **56**.

(35) Aluminum foil **54** includes a connecting piece **57** formed at exposed portion **56**. A plurality of connecting pieces **57** are formed such that they are spaced in a direction in which aluminum foil **54** extends.

(36) FIG. **7** is a perspective view schematically showing negative electrode sheet **52**. Negative electrode sheet **52** includes a copper foil **60** and a negative electrode composite material layer **61** formed on the front and back surfaces of copper foil **60**. Copper foil **60** is formed in a rectangle, and has one side free of negative electrode composite material layer **61** and hence has an exposed portion **62**. Negative electrode sheet **52** includes a connecting piece **63** formed at exposed portion **62**. Connecting pieces **63** are formed such that they are spaced in a direction in which copper foil **60** extends.

(37) Referring back to FIG. **5**, positive electrode collector plate **37** is provided on the side of lateral surface **42** of electrode assembly **35**, and negative electrode collector plate **38** is provided on the side of lateral surface **43** of electrode assembly **35**.

(38) Herein, in longitudinal direction L, positive electrode collector plate **37** is formed to extend from one end side of lateral surface **42** to the other end side of lateral surface **42**. Similarly, negative electrode collector plate **38** is formed to extend from one end side of lateral surface **43** to the other end side of lateral surface **43**. Thus, positive and negative electrode collector plates **37**

and **38** are formed to be elongate in longitudinal direction L.
(39) Positive electrode collector plate **37** is formed in a flat plate and includes a major surface **46** and a major surface **47**. Major surface **46** is an upper surface, and major surface **47** is a lower surface. Connecting piece **57** formed at each positive electrode sheet **50** is welded to major surface **46**.
(40) FIG. **8** is a plan view of major surface **46** of positive electrode collector plate **37** and a configuration surrounding the major surface.
(41) A plurality of adhesive materials **70**A, **70**B, **70**C and **70**D are formed on major surface **46** of positive electrode collector plate **37** such that they are each spaced in longitudinal direction L.
(42) Adhesive materials **70**A, **70**B, **70**C and **70**D are substantially identical, and adhesive material **70**A will be described.
(43) Adhesive material **70**A is formed of thermoplastic resin or the like. A hole **71**A is formed through adhesive material **70**A, and a portion of major surface **46** is exposed through hole **71**A. Through holes **72**A and **73**A are formed through a portion of positive electrode collector plate **37** that is exposed through hole **71**A. Through holes **72**A and **73**A are spaced in longitudinal direction L. Through holes **72**A and **73**A are formed to extend from major surface **46** to reach major surface **47**.
(44) Adhesive materials **70**B, **70**C, and **70**D also have holes **71**B, **71**C, and **71**D, respectively. Through holes **72**B, **73**B, **72**C, **73**C, **72**D, **73**D are formed through portions of positive electrode collector plate **37** exposed through holes **71**B, **71**C, **71**D.
(45) The plurality of connecting pieces **57** are welded to portions of major surface **46** located between adhesive materials **70**A, **70**B, **70**C and **70**D. For example, a plurality of connecting pieces **57** are collectively welded by a welding portion **58**A between adhesive material **70**A and adhesive material **70**B. Between adhesive materials **70**B and **70**C and between adhesive materials **70**C and **70**D as well, welding portions **58**B and **58**C, respectively, each weld a plurality of connecting pieces **57** to major surface **46**.
(46) Positive electrode collector plate **37** includes an outer side **67** and an inner side **68**, and a short side **28** and a short side **29**. Outer side **67** and inner side **68** are formed to extend in longitudinal direction L. Outer side **67** is located on one end side in widthwise direction W, and inner side **68** is located on the other end side in widthwise direction W. Inner side **68** is located closer to electrode assembly **35**, and outer side **67** is located on a side opposite to electrode assembly **35** with respect to inner side **68**. Short side **28** is located on one end side in longitudinal direction L, and short side **29** is located on the other end side in longitudinal direction L. Short sides **28** and **29** are formed to extend in widthwise direction W. A direction from inner side **68** toward outer side **67** is defined as a direction D**1**, and a direction intersecting direction D**1** is defined as a direction D**2**. In the present embodiment, direction D**2** is longitudinal direction L.
(47) Adhesive materials **70**A, **70**B, **70**C, **70**D and welding portions **58**A, **58**B, **58**C are aligned in direction D**2**. In other words, adhesive materials **70**A, **70**B, **70**C, **70**D and welding portions **58**A, **58**B, **58**C are aligned in longitudinal direction L along an outer side **67** of positive electrode collector plate **37**.
(48) And welding portion **58**A is disposed between adhesive materials **70**A and **70**B, and welding portions **58**B and **58**C are also similarly disposed.
(49) FIG. **9** is a plan view of major surface **47** of positive electrode collector plate **37**. Major surface **47** is also provided with a plurality of adhesive materials **75**A, **75**B, **75**C and **75**D such that they are spaced in longitudinal direction L.
(50) Adhesive materials **75**A, **75**B, **75**C and **75**D have holes **76**A, **76**B, **76**C and **76**D, respectively. Each hole **76**A, **76**B, **76**C, **76**D exposes a portion of major surface **47**. Through holes **72**A and **73**A are formed through a portion of major surface **47** exposed through hole **76**A. Similarly, through holes **72**B, **73**B, **72**C, **73**C, **72**D, **73**D are formed through portions of major surface **47** exposed through holes **76**B, **76**C, **76**D.

(51) Herein, adhesive material **70**A shown in FIG. **8** and adhesive material **75**A shown in FIG. **9** are formed so as to be opposite to each other with positive electrode collector plate **37** interposed therebetween. That is, adhesive material **75**A is disposed under adhesive material **70**A. Similarly, adhesive materials **70**B, **70**C, **70**D and adhesive materials **75**B, **75**C, **75**D, respectively, are disposed to be opposite to each other.
(52) FIG. **10** is a plan view of major surface **48** of negative electrode collector plate **38**, and FIG. **11** is a plan view of major surface **49** of negative electrode collector plate **38**. As well as positive electrode collector plate **37**, negative electrode collector plate **38** is also provided with a plurality of adhesive materials.
(53) Negative electrode collector plate **38** includes an outer side **59**, an inner side **69**, a short side **19**, and a short side **89**. Outer side **59** is located on one end side in widthwise direction W, and inner side **69** is located on the other end side in widthwise direction W. Short side **19** is located at one end in longitudinal direction L, and short side **89** is located at the other end in longitudinal direction L.
(54) A direction from inner side **69** toward outer side **59** is defined as a direction D**3**, and a direction intersecting direction D**3** is defined as a direction D**4**. Direction D**4** is longitudinal direction L.
(55) On major surface **48**, a plurality of adhesive materials **77**A, **77**B, **77**C and **77**D and a plurality of welding portions **58**D, **58**E, **58**F are formed such that they are aligned in direction D**4**.
(56) Adhesive materials **77**A, **77**B, **77**C, **77**D are spaced in direction D**4** (or longitudinal direction L), and welding portions **58**D, **58**E, **58**F are provided between adhesive materials **77**A, **77**B, **77**C, **77**D.
(57) In FIG. **11**, a plurality of adhesive materials **78**A, **78**B, **78**C and **78**D are formed on major surface **49** such that they are spaced in longitudinal direction L. Adhesive material **77**A and adhesive material **78**A are disposed opposite to each other with negative electrode collector plate **38** interposed therebetween. Similarly, adhesive material **77**B and adhesive material **78**B are opposite to each other, adhesive material **77**C and adhesive material **78**C are opposite to each other, and adhesive material **77**D and adhesive material **78**D are opposite to each other.
(58) Holes **80**A, **80**B, **80**C and **80**D are formed through adhesive materials **77**A, **77**B, **77**C and **77**D, respectively, and holes **81**A, **81**B, **81**C and **81**D are formed through adhesive materials **78**A, **78**B, **78**C and **78**D, respectively.
(59) A plurality of through holes **83**A, **84**A, **83**B, **84**B, **83**C, **84**C, **83**D and **84**D are formed through negative electrode collector plate **38**. Through holes **83**A and **84**B are formed through a portion of negative electrode collector plate **38** exposed through holes **80**A and **81**A. Similarly, through holes **83**B, **84**B, **83**C, **84**C, **83**D, **84**D are formed through portions exposed through holes **80**B, **81**B, **80**C, **81**C, **80**D, **81**D.
(60) Referring back to FIG. **5**, laminate film **36** includes an upper film **39**A and a lower film **39**B. Upper film **39**A is provided so as to cover electrode assembly **35**, positive electrode collector plate **37**, and negative electrode collector plate **38** from above. Lower film **39**B is provided so as to cover electrode assembly **35**, positive electrode collector plate **37**, and negative electrode collector plate **38** from below. Upper film **39**A includes a covering portion **85**A and a peripheral portion **86**A.
(61) Peripheral portion **86**A is formed at a peripheral edge portion of covering portion **85**A annularly. Covering portion **85**A is formed so as to protrude upward, and is formed so as to cover electrode assembly **35** from above.
(62) Peripheral portion **86**A includes a flange **87**A, a flange **88**A, and connecting pieces **90**A and **91**A. Flanges **87**A and **88**A are formed to extend in longitudinal direction L. Connecting piece **90**A is formed to interconnect one end of flange **87**A and one end of flange **88**A. Connecting piece **91**A is formed to interconnect the other end of flange **87**A to the other end of flange **88**A.
(63) Flange **87**A is disposed on major surface **46** of positive electrode collector plate **37**, and flange **88**A is disposed on major surface **48** of negative electrode collector plate **38**.

(64) Flange **87**A has a plurality of exposure holes **92**A, **93**A, **94**A and **95**A such that they are spaced in longitudinal direction L. Flange **87**A is disposed such that exposure holes **92**A, **93**A, **94**A and **95**A are positioned at adhesive materials **70**A, **70**B, **70**C and **70**D, respectively. Adhesive materials **70**A, **70**B, **70**C and **70**D adhere flange **87**A to positive electrode collector plate **37**. Exposure holes **92**A, **93**A, **94**A and **95**A and holes **71**A, **71**B, **71**C and **71**D externally expose a portion of major surface **46** of positive electrode collector plate **37**.
(65) Flange **88**A also has a plurality of exposure holes **96**A, **97**A, **98**A and **99**A such that they are spaced in longitudinal direction L. Flange **88**A is disposed such that exposure holes **96**A, **97**A, **98**A and **99**A are positioned at adhesive materials **77**A, **77**B, **77**C and **77**D, respectively. Exposure holes **96**A, **97**A, **98**A and **99**A and holes **80**A, **80**B, **80**C and **80**D externally expose a portion of major surface **48**. Adhesive materials **77**A, **77**B, **77**C and **77**D adhere flange **88**A to negative electrode collector plate **38**.
(66) Lower film **39**B is configured to be similar to upper film **39**A. Lower film **39**B includes a flange **87**B, a flange **88**B, and connecting pieces **90**B and **91**B. Flange **87**B is disposed on major surface **47** of positive electrode collector plate **37**, and flange **88**B is disposed on major surface **49** of negative electrode collector plate **38**.
(67) Flange **87**B has a plurality of exposure holes **92**B, **93**B, **94**B and **95**B such that they are spaced in longitudinal direction L. Flange **87**B is disposed such that exposure holes **92**B, **93**B, **94**B and **95**B are positioned at adhesive materials **75**A, **75**B, **75**C and **75**D, respectively. Exposure holes **92**B, **93**B, **94**B and **95**B and holes **76**A, **76**B, **76**C and **76**D externally expose a portion of major surface **47**. Adhesive materials **75**A, **75**B, **75**C and **75**D adhere flange **87**B to positive electrode collector plate **37**.
(68) Flange **88**B has a plurality of exposure holes **96**B, **97**B, **98**B and **99**B such that they are spaced in longitudinal direction L. Flange **88**B is disposed such that exposure holes **96**B, **97**B, **98**B and **99**B are positioned at adhesive materials **78**A, **78**B, **78**C and **78**D, respectively. Exposure holes **96**B, **97**B, **98**B and **99**B and holes **81**A, **81**B, **81**C and **81**D externally expose a portion of major surface **49**. Adhesive materials **78**A, **78**B, **78**C and **78**D adhere flange **88**B to negative electrode collector plate **38**.
(69) FIG. **12** is a cross-sectional view of power storage cell **30**. In FIG. **12**, peripheral portions **86**A and **86**B have their respective peripheral edge portions located outside electrode assembly **35**, positive electrode collector plate **37**, and negative electrode collector plate **38**.
(70) The peripheral edge portion of the lower surface of peripheral portion **86**A and the peripheral edge portion of the upper surface of peripheral portion **86**B are adhered to each other at a fusing portion **16**. Fusing portion **16** is formed to extend annularly. Thus, electrode assembly **35**, positive electrode collector plate **37**, negative electrode collector plate **38**, and the electrolyte (not shown) are sealed inside laminate film **36**.
(71) Thus, positive and negative electrode collector plates **37** and **38** are not formed so as to project between upper and lower films **39**A and **39**B. Therefore, a gap is not formed between laminate film **36** and positive and negative electrode collector plates **37** and **38** on the side of a lateral surface of positive electrode collector plate **37**. This can suppress external leakage of the electrolyte provided inside power storage cell **30**, intrusion of foreign matters into power storage cell **30**, and the like.
(72) In FIG. **12**, a portion of major surface **46** of positive electrode collector plate **37** is exposed through exposure hole **92**A and hole **71**A. A portion of major surface **47** is exposed through exposure hole **92**B and hole **76**A. Negative electrode collector plate **38** also has major surfaces **48** and **49** partially exposed from laminate film **36**.
(73) FIG. **13** is a plan view of exposure hole **92**A and hole **71**A. Hole **71**A of adhesive material **70**A extends along exposure hole **92**A of flange **87**A, and adhesive material **70**A is formed along exposure hole **92**A. Exposure hole **92**A has an opening area larger than that of hole **71**A. When viewed at a position away from stacking direction H, hole **71**A is located in exposure hole **92**A. As a result, intrusion of foreign matters into laminate film **36** is suppressed.

(74) Although power storage cell **30** has been described above, power storage cells **31** and **32** are also configured to be similar to power storage cell **30**.
(75) In FIGS. **2** and **3**, power storage cell **31** includes an electrode assembly **135**, a laminate film **136**, a positive electrode collector plate **137**, and a negative electrode collector plate **138**. In power storage cell **31** as well, positive electrode collector plate **137** includes a pair of major surfaces, and a portion exposed from laminate film **136** is formed on each major surface. Similarly, a portion exposed from laminate film **136** is formed on each major surface of negative electrode collector plate **138**.
(76) Power storage cell **32** includes an electrode assembly **235**, a laminate film **236**, a positive electrode collector plate **237**, and a negative electrode collector plate **238**. A portion exposed from laminate film **236** is formed on each major surface of positive electrode collector plate **237**. A portion exposed from laminate film **236** is formed on each major surface of negative electrode collector plate **238**.
(77) On the side of lateral surface **42** of electrode assembly **35**, positive electrode collector plate **37**, negative electrode collector plate **138**, and positive electrode collector plate **237** are aligned in stacking direction H. On the side of lateral surface **43**, negative electrode collector plate **38**, positive electrode collector plate **137**, and negative electrode collector plate **238** are aligned in stacking direction H.
(78) Bus bar **21** is welded to a portion of negative electrode collector plate **38** exposed from laminate film **36**. Bus bar **22** is welded to a portion of positive electrode collector plate **237** exposed from laminate film **236**. Bus bar **21** is connected to the negative electrode's external terminal **4**, and bus bar **22** is connected to positive electrode's external terminal **3**.
(79) Connecting member **33** is formed to extend in longitudinal direction L. Connecting member **33** is disposed between positive and negative electrode collector plates **37** and **138**, and interconnects positive and negative electrode collector plates **37** and **138**.
(80) Connecting member **33** is welded to a portion of positive electrode collector plate **37** exposed from laminate film **36**, and connecting member **33** is welded to a portion of negative electrode collector plate **138** exposed from laminate film **136**.
(81) Connecting member **34** is disposed between positive and negative electrode collector plates **137** and **238**, and interconnects positive and negative electrode collector plates **137** and **238**. Connecting member **34** is welded to a portion of positive electrode collector plate **137** exposed from laminate film **136**.
(82) Thus, power storage cells **30**, **31** and **32** are electrically connected in series by connecting members **33** and **34**.
(83) Insulating member **25** is introduced to reach power storage module **20** from lateral wall **12**. Insulating member **25** is formed to contact connecting member **33** and also cover positive electrode collector plate **37**, negative electrode collector plate **138**, and positive electrode collector plate **237**.
(84) Therefore, when power storage device **1** is charged/discharged and power storage module **20** thus generates heat, the heat of power storage module **20** can be radiated to cooling device **5** through connecting member **33**, positive electrode collector plate **37**, negative electrode collector plate **138**, positive electrode collector plate **237**, and insulating member **25**.
(85) Insulating member **26** is introduced to reach power storage module **20** from lateral wall **13**. Insulating member **26** is formed to contact connecting member **34** and also cover negative electrode collector plate **38**, positive electrode collector plate **137**, and negative electrode collector plate **238**. This allows power storage module **20** to radiate heat to cooling device **6** satisfactorily.
(86) Expansion absorbing materials **23** and **24** include a dilatancy material and a sealing member that seals the dilatancy material. Expansion absorbing material **23** is disposed between power storage module **20** and top plate **10**, and expansion absorbing material **24** is disposed between power storage module **20** and bottom plate **11**.
(87) When power storage device **1** is charged/discharged, power storage module **20** deforms so as

to bulge in stacking direction H. Since power storage module **20** deforms at a small rate, expansion absorbing materials **23** and **24** deform so as to permit deformation of power storage module **20**.
(88) Thus, even when power storage module **20** deforms so as to bulge, application of a load to accommodation case **2**, and hence deformation of accommodation case **2** can be suppressed.
(89) When battery pack **100** is mounted in a vehicle or the like, and the vehicle travels or the like, power storage device **1** is vibrated. When power storage device **1** vibrates, for example, power storage device **1** may vibrate so that the center of power storage device **1** serves as an antinode.
(90) A deformation rate when power storage device **1** vibrates is faster than a rate at which power storage module **20** deforms as power storage device **1** is charged/discharged.
(91) For such a fast deformation rate, expansion absorbing materials **23** and **24** including the dilatancy material are increased in rigidity and thus resistant to deformation. This can suppress vibration of power storage device **1**.
(92) FIG. **14** is a perspective view of a power storage cell **30**A according to a comparative example. Power storage cell **30**A includes an electrode assembly **35**A, a laminate film **36**A, a positive electrode collector plate **37**A, and a negative electrode collector plate **38**A.
(93) Laminate film **36**A has a peripheral edge portion generally in a rectangle. The peripheral edge portion of laminate film **36**A includes longer sides **305** and **306** and shorter sides **307** and **308**.
(94) Positive electrode collector plate **37**A projects from shorter side **307** to an outside of laminate film **36**A, and negative electrode collector plate **38**A projects from shorter side **308** to an outside of laminate film **36**A.
(95) FIG. **15** is a cross-sectional view of power storage cell **30**A. Electrode assembly **35**A includes a plurality of positive electrode sheets **50**A, a plurality of separators **51**A, and a plurality of negative electrode sheets **52**A.
(96) FIG. **16** is a perspective view of positive electrode sheet **50**A. Positive electrode sheet **50**A includes an aluminum foil **54**A and a positive electrode composite material layer **55**A.
(97) Positive electrode composite material layer **55**A is formed on the front and back surfaces of aluminum foil **54**A. Aluminum foil **54**A is formed in a rectangle. Aluminum foil **54**A has an exposed portion **56**A free of positive electrode composite material layer **55**A. Exposed portion **56**A is located at a shorter side portion of aluminum foil **54**A. Positive electrode sheet **50**A includes a connecting piece **57**A projecting from exposed portion **56**A.
(98) FIG. **17** is a perspective view of negative electrode sheet **52**A. Negative electrode sheet **52**A includes a copper foil **60**A and a negative electrode composite material layer **61**A. Negative electrode composite material layer **61**A is formed on the front and back surfaces of copper foil **60**A. Copper foil **60**A is also formed in a rectangle. Copper foil **60**A has a shorter side portion free of negative electrode composite material layer **61**A, that is, an exposed portion **62**A. Negative electrode sheet **52**A includes a connecting piece **63**A projecting from exposed portion **62**A.
(99) Referring back to FIG. **15**, laminate film **36**A includes an upper film **304**A and a lower film **304**B.
(100) Upper film **304**A is provided so as to cover electrode assembly **35**A from above, and lower film **304**B is provided so as to cover electrode assembly **35**A from below.
(101) Positive electrode collector plate **37**A is formed in a flat plate and includes a major surface **46**A and a major surface **47**A. Major surface **46**A is an upper surface, and major surface **47**A is a lower surface.
(102) A welding portion **310** and an adhesive material **300** are provided on major surface **46**A of positive electrode collector plate **37**A, and an adhesive material **301** is provided on major surface **47**A.
(103) A plurality of connecting pieces **57**A are welded at welding portion **310**. Adhesive material **300** adheres upper film **304**A and positive electrode collector plate **37**A together. Adhesive material **301** adheres lower film **304**B and positive electrode collector plate **37**A together. Adhesive materials **300** and **301** are disposed opposite to each other with positive electrode collector plate

37A interposed therebetween.
(104) A welding portion **311** and an adhesive material **302** are provided on major surface **48**A of negative electrode collector plate **38**A, and an adhesive material **303** is provided on major surface **49**A. Adhesive materials **302** and **303** are disposed opposite to each other with negative electrode collector plate **38**A interposed therebetween. Welding portion **311** welds a plurality of connecting pieces **63**A to major surface **48**A. Adhesive material **302** adheres upper film **304**A to negative electrode collector plate **38**A, and adhesive material **303** adheres lower film **304**B to negative electrode collector plate **38**A.
(105) FIG. **18** is a plan view of major surface **46**A of positive electrode collector plate **37**A. Adhesive material **300** is located on the side of an outer side **67**A, and welding portion **310** is located on the side of an inner side **68**A. A space is present between adhesive material **300** and welding portion **310** in direction D**1** from inner side **68**A toward outer side **67**A.
(106) In contrast, as shown in FIG. **8**, power storage cell **30** according to the present embodiment has adhesive material **70**A, welding portion **58**A, adhesive material **70**B, welding portion **58**B, adhesive material **70**C, welding portion **58**C, and adhesive material **70**D aligned in direction D**2**.
(107) This suppresses formation of a space in direction D**1** by adhesive materials **70**A, **70**B, **70**C, **70**D and welding portions **58**A, **58**B, **58**C.
(108) Thus, an occupancy inside laminate film **36** by electrode assembly **35** for power storage cell **30** of the present embodiment is larger than an occupancy by electrode assembly **35**A for power storage module **20**A of the comparative example.
(109) Further, in FIG. **8**, welding portions **58**A, **58**B, **58**C are formed such that they are spaced, and the plurality of connecting pieces **57** are welded to positive electrode collector plate **37** by welding portions **58**A, **58**B, **58**C.
(110) This allows charging/discharging to be done while achieving a uniform distribution of a current in positive electrode sheet **50** and can minimize a locally degraded portion in positive electrode sheet **50**.
(111) FIG. **19** is a plan view of major surface **48**A of negative electrode collector plate **38**A. In direction D**3** from an inner side **69**A toward an outer side **59**A, adhesive material **302** and welding portion **311** are spaced from each other. Accordingly, a space is created between adhesive material **302** and welding portion **311** in direction D**3**.
(112) In contrast, as shown in FIG. **10**, for power storage cell **30**, the plurality of adhesive materials **77**A, **77**B, **77**C and **77**D and the plurality of welding portions **58**D, **58**E, **58**F are aligned in direction D**4**, which suppresses formation of a space in direction D**3**. Power storage cell **30** of the present embodiment thus has an increased occupancy inside laminate film **36** by electrode assembly **35**. While the above embodiment has been described for an example with each power storage cell accommodating electrolyte therein, the art according to the present disclosure is also applicable when each power storage cell is a solid-state battery.
(113) While an embodiment of the present disclosure has been described, it should be understood that the embodiment disclosed herein has been described for the purpose of illustration only and in a non-restrictive manner in any respect. The scope of the present disclosure is defined by the terms of the claims, and is intended to include any modifications within the meaning and scope equivalent to the terms of the claims.

Claims

1. A power storage cell comprising: an electrode assembly that is composed of a plurality of first electrode sheets, a plurality of separators and a plurality of second electrode sheets stacked in layers; a collector plate that is disposed adjacent to the electrode assembly and has the first electrode sheet connected thereto; a laminate film that seals the electrode assembly and the collector plate inside, wherein the laminate film has a structure composed of a resin film, an

aluminum foil, and a resin film stacked in layers, the laminate film includes a first film that covers the electrode assembly on one side and a second film that covers the electrode assembly on another side, the collector plate has a peripheral edge portion including an inner side located closer to the electrode assembly and an outer side located on a side opposite to the electrode assembly with respect to the inner side, the collector plate is provided with a welding portion having a plurality of connecting pieces welded thereto, and at least one adhesive portion that adheres the laminate film, each of the plurality of first electrode sheets has a metal foil including one of the plurality of connecting pieces, and when a direction from the inner side toward the outer side is defined as a first direction and a direction intersecting the first direction is defined as a second direction, the welding portion and the adhesive portion are aligned in the second direction; and a fusing portion that fuses a peripheral portion of the first film and a peripheral portion of the second film together, wherein the fusing portion is located outwardly of the collector plate and the electrode assembly, and formed annularly along the peripheral portion of the first film and the peripheral portion of the second film, the adhesive portion has a hole that exposes a portion of the collector plate, a portion of the laminate film has an exposure hole that faces the hole, and a portion of the collector plate is externally exposed through the hole and the exposure hole.