United States Patent Application Publication	20250266550
Kind Code	A1
Publication Date	August 21, 2025
Inventor(s)	SUGIE; Kazuki et al.

POWER STORAGE DEVICE

Abstract

A power storage device includes power storage modules that charge and discharge electric power, a power storage device case that accommodates the power storage modules, and a protective plate disposed outside a lower surface of the power storage device case. The protective plate includes a connection portion connected to the power storage device case. The connection portion is higher in at least one of rigidity and strength than a portion of the protective plate which is located around the connection portion. This can suppress an input of an external force, applied to the protective plate, to the power storage device case that accommodates the power storage modules more than when the portion of the protective plate which is located around the connection portion is connected to the power storage device case. An input of the external force from the protective plate to the power storage modules can be suppressed.

Inventors: **SUGIE; Kazuki (Miyoshi-shi, JP), MORI; Akio (Toyota-shi, JP), KAMO; Yoshiro (Ashigarakami-gun, JP), NAKANO; Takahiko (Nagoya-shi, JP), SHIMONAKA; Toshihiro (Toyota-shi, JP), KOHASHI; Kenichi (Sunto-gun, JP), SODA; Yuki (Nagoya-shi, JP)**

Applicant: **TOYOTA JIDOSHA KABUSHIKI KAISHA** (Toyota-shi, JP)

Family ID: **1000008406131**

Assignee: **TOYOTA JIDOSHA KABUSHIKI KAISHA (Toyota-shi, JP)**

Appl. No.: **19/008832**

Filed: **January 03, 2025**

Foreign Application Priority Data

JP	2024-022907	Feb. 19, 2024

Publication Classification

Int. Cl.: **H01M50/242** (20210101); **B60L50/64** (20190101); **H01M50/209** (20210101); **H01M50/258** (20210101); **H01M50/289** (20210101); **H01M50/548** (20210101)

U.S. Cl.:

CPC **H01M50/242** (20210101); **H01M50/209** (20210101); **H01M50/258** (20210101); **H01M50/289** (20210101); **H01M50/548** (20210101); B60L50/64 (20190201); H01M2220/20 (20130101)

Background/Summary

CROSS REFERENCE TO RELATED APPLICATIONS

[0001] This nonprovisional application is based on Japanese Patent Application No. 2024-022907 filed on Feb. 19, 2024 with the Japan Patent Office, the entire contents of which are hereby incorporated by reference.

BACKGROUND

Field

[0002] The present disclosure relates to a power storage device.

Description of the Background Art

[0003] In a conventional elongated secondary-battery power storage module, a plurality of laminate-type battery cells, each having electrodes at the opposite ends in the longitudinal direction, are sealed in an elongated case while being connected in series in the longitudinal direction. For example, in Japanese National Patent Publication No. 2023-502698, a plurality of battery cells are connected to each other in series with a laminated film removed. A battery pack including a stack of such elongated power storage modules in the transverse direction is disclosed in, for example, FIG. 18 of Japanese National Patent Publication No. 2023-502698.

SUMMARY

[0004] In such an elongated power storage module, the case deforms more than a power storage module, which is not elongated, by the action of an external force caused by vibrations or the like. It is thus necessary to suppress an input of the external force to the power storage module via an accommodation case from a protective plate disposed outside the lower surface of the accommodation case.

[0005] The present disclosure has been made to solve the problem described above. An object of the present disclosure is to provide a power storage device that can suppress an input of an external force from a protective plate to a power storage module.

[0006] A power storage device according to the present disclosure includes a plurality of power storage modules that charge and discharge electric power, an accommodation case that accommodates the plurality of power storage modules, and a protective plate disposed outside a lower surface of the accommodation case. The protective plate includes a connection portion connected to the accommodation case. The connection portion is higher in at least one of rigidity and strength than a portion of the protective plate, the portion being located around the connection portion.

[0007] With such a configuration, the connection portion of the protective plate, which is higher in at least one of rigidity and strength than the portion of the protective plate located around the connection portion, is connected to the accommodation case that accommodates the power storage modules. This can suppress an input of the external force, applied to the protective plate, to the accommodation case that accommodates the power storage modules more than when the portion of the protective plate which is located around the connection portion is connected to the

accommodation case. As a result, a power storage device can be provided that can suppress an input of an external force from the protective plate to the power storage modules.
[0008] The accommodation case may include a fixing portion connected to the connection portion of the protective plate. Each of the plurality of power storage modules may be fixed to a portion of an inner surface of the accommodation case, the portion being located above the fixing portion.
[0009] With such a configuration, the fixing portion of the accommodation case is connected to the connection portion of the protective plate which is higher in at least one of rigidity and strength than the portion of the protective plate which is located around the connection portion. This can suppress an input of the external force, applied to the protective plate, to the fixing portion of the accommodation case that accommodates the power storage modules more than when the accommodation case is connected to the portion of the protective plate which is located around the connection portion. As a result, an input of the external force from the protective plate to the power storage modules can be suppressed.
[0010] The power storage device may further include an adhesive that bonds each of the plurality of power storage modules to the accommodation case. The adhesive may be provided at a portion of the inner surface of the accommodation case, the portion being located above the fixing portion.
[0011] With such a configuration, the power storage modules are bonded to the portion located above the fixing portion with the adhesive. As a result, the power storage modules can be fixed more firmly to the robust portion of the accommodation case than when the power storage modules are bonded to the portion of the accommodation case which is different from the portion located above the fixing portion.
[0012] Each of the plurality of power storage modules may include a plurality of power storage cells including a first power storage cell and a second power storage cell arranged in one direction, a coupling portion, and a module case that accommodates the plurality of power storage cells and the coupling portion. The first power storage cell may include a first end adjacent to the second power storage cell, and a first terminal provided at the first end. The second power storage cell may include a second end adjacent to the first power storage cell, and a second terminal provided at the second end. The coupling portion may be formed by connection of the first terminal and the second terminal. Each of the plurality of the power storage modules may be fixed to the accommodation case in a portion of an outer surface of the module case, the portion being located outside the coupling portion.
[0013] With such a configuration, the power storage modules are fixed to the accommodation case in the portion, located outside the coupling portion, of the outer surface of the module case for the power storage modules at which the first terminal of the first power storage cell is connected to the second terminal of the second power storage cell. As a result, the coupling portion can be effectively fixed to the accommodation case.
[0014] The module case may include a top plate and a bottom plate arranged in an upward-downward direction. Each of the plurality of power storage modules may include a partition member provided in the module case and provided at the coupling portion. The partition member may be disposed across the top plate and the bottom plate.
[0015] With such a configuration, the coupling portion of the power storage module which is fixed to the accommodation case can be made robust by the partition member.
[0016] The protective plate may include a body portion shaped into a plate, and a rib formed to protrude upward from the body portion. The connection portion may be the rib.
[0017] Thus, the connection portion of the protective plate which is connected to the power storage device case can be made robust. Also, the protective plate itself can be made robust.
[0018] 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

[0019] FIG. **1** is a side view showing a general shape of a vehicle according to an embodiment of the present disclosure.

[0020] FIG. **2** is a perspective view showing an outline of a configuration of a power storage device mounted in the vehicle according to the present embodiment.

[0021] FIG. **3** is a perspective view showing a general shape of a power storage module included in the power storage device of the present embodiment.

[0022] FIG. **4** is an exploded perspective view of the power storage module of the present embodiment.

[0023] FIG. **5** is an exploded perspective view of a power storage cell included in the power storage module of the present embodiment.

[0024] FIG. **6** is a sectional view of the power storage device of the present embodiment, which is taken along the A-A cross section.

[0025] FIG. **7** is a sectional view of the power storage module of the present embodiment, which is taken along the B-B cross section.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0026] Embodiments of the present disclosure will be described with reference to the drawings. In the drawings referred to below, the same or corresponding portions in the drawings are denoted by the same reference characters.

[0027] FIG. **1** is a side view showing a general shape of a vehicle **10** according to the present embodiment of the present disclosure. FIG. **2** is a perspective view showing an outlie of a configuration of a power storage device **11** mounted in vehicle **10** of the present embodiment. FIG. **3** is a perspective view showing a general shape of a power storage module **15** included in power storage device **11** of the present embodiment. FIG. **4** is an exploded perspective view of power storage module **15** of the present embodiment. FIG. **5** is an exploded perspective view of a power storage cell **100** included in power storage module **15** of the present embodiment. FIG. **6** is a sectional view of power storage device **11** of the present embodiment, which is taken along the A-A cross section. FIG. **7** is a sectional view of power storage module **15** of the present embodiment, which is taken along the B-B cross section.

[0028] Referring to FIGS. **1** to **7**, the front direction, rear direction, upward direction, downward direction, right direction, and left direction are the front direction, rear direction, upward direction, downward direction, right direction, and left direction, respectively, of vehicle **10**. The axes in the front-rear direction, upward-downward direction, and left-right direction are orthogonal to one another.

[0029] Vehicle **10** is an electrically-powered vehicle. The electrically-powered vehicle may be a battery electric vehicle (BEV), a plug-in hybrid electric vehicle (PHEV), a hybrid electric vehicle (HEV), or a fuel cell electric vehicle (FCEV). As shown in FIG. **1**, vehicle **10** includes power storage device **11**. Power storage device **11** is a device that can charge and discharge electric power for driving vehicle **10**. Power storage device **11** is mounted at the bottom of the body of vehicle **10** and forms part of the floor of the vehicle cabin. However, the present disclosure is not limited thereto, and power storage device **11** may be mounted under the floor of the vehicle cabin.

[0030] As shown in FIG. **2**, power storage device **11** includes an upper case **12**, a lower case **13**, a temperature control device **14**, a plurality of power storage modules **15**, and a reinforcing member **16**.

[0031] Upper case **12** and lower case **13** are formed of steel material (e.g., steel plate). Upper case **12** and lower case **13** are joined together at the flanged portions thereof (e.g., fastened together with bolts and nuts at the flange portions) to be integrally formed into a power storage device case **17**. A

space is formed in power storage device case **17**. Upper case **12** is positioned above lower case **13**. Power storage device case **17** is attached to vehicle **10** such that the thickness direction thereof is aligned with the upward-downward direction of vehicle **10**. The longitudinal and transverse directions of power storage device case **17**, which are orthogonal to the thickness direction thereof, are aligned with the front-rear and left-right directions, respectively, of vehicle **10**. Power storage device case **17** is several times longer in the longitudinal and transverse directions than in the thickness direction.

[0032] As shown in FIG. **3**, power storage module **15** is a module capable of charging and discharging electric power, and has an approximately parallelepiped rectangular shape. The side of power storage module **15** in the longitudinal direction is several times longer than the side thereof in the transverse direction, which is the longer of the remaining two sides. The side of power storage module **15** in the transverse direction is several times longer than the side thereof in the thickness direction, which is the shorter of the remaining two sides. The longitudinal, transverse, and thickness directions of power storage module **15** correspond to the left-right, upward-downward, and front-rear directions, respectively, of vehicle **10**.

[0033] As shown in FIG. **2**, power storage module **15** is accommodated in the internal space of power storage device case **17**. Power storage module **15** is accommodated such that the longitudinal, transverse, and thickness directions thereof are aligned with the transverse, thickness, and longitudinal directions, respectively, of power storage device case **17**. Power storage modules **15** are accommodated so as to be stacked in the thickness direction. Reinforcing member **16** is a member that reinforces lower case **13**, has an external shape that is approximately the same as that of power storage module **15**, and is attached to the middle of lower case **13** in the longitudinal direction. In other words, reinforcing member **16** is provided in the middle of power storage modules **15** in the direction in which the power storage modules **15** are stacked.

[0034] Temperature control device **14** is a device that controls the temperature of power storage module **15** by heating or cooling power storage module **15**. As shown in FIG. **2**, temperature control device **14** is shaped into an approximately flat plate. The longitudinal and transverse directions of temperature control device **14** are shorter than the longitudinal and transverse directions of the inner surfaces of upper case **12** and lower case **13**, respectively, and are aligned with these directions, respectively. Temperature control device **14** is attached to power storage modules **15** with an adhesive, for example, such that the surface thereof defined by the longitudinal direction and transverse directions of temperature control device **14** is in contact with the surface defined by the thickness and longitudinal directions of power storage modules **15**. Temperature control device **14** may be attached to power storage modules **15** with an adhesive, as well as by any other method. Temperature control device **14** is accommodated in the internal space of power storage device case **17** together with power storage modules **15**.

[0035] As shown in FIGS. **3** and **4**, power storage module **15** includes a plurality of power storage cells **100** (power storage cells **100**A, **100**B in FIG. **4**, power storage cells **100**A to **100**C in FIG. **6**), a module case **300**, and an external terminal **400**. Module case **300** is composed of a case body **310** and a lid **320**. Case body **310** and lid **320** are made of, for example, aluminum. Case body **310** has an approximately rectangular parallelepiped shape with a hollow in the longitudinal direction. Lid **320** is shaped into a rectangular flat plate that closes the opening of case body **310**. The external shapes of case body **310** and lid **320** constitute part of the external shape of power storage module **15** described above. Lid **320** is joined to case body **310** by welding so as to cover the opening of case body **310**. The joining method is not limited thereto, and may be another method, such as using an adhesive.

[0036] Power storage cell **100** is formed of a lithium-ion battery. However, the present disclosure is not limited thereto, and power storage cell **100** may be formed of any other type of secondary battery, such as all-solid-state battery. As shown in FIG. **4**, the external shape of power storage cell **100** is an approximately rectangular parallelepiped shape. Power storage cells **100** are arranged in a

single row such that the longitudinal direction of power storage cell **100** is aligned with the longitudinal direction of module case **300**, and are accommodated in module case **300**. Power storage cell **100** has current collector terminals **140** at the opposite ends in the longitudinal direction. Current collector terminal **140** provided at one end of power storage cell **100** in the longitudinal direction is a positive electrode terminal, and current collector terminal **140** provided at the other end is a negative electrode terminal. As adjacent power storage cells **100** are electrically connected to each other at current collector terminals **140** thereof (one is the positive electrode terminal, and the other is the negative electrode terminal), a coupling portion **190** of power storage cell **100** is formed.

[0037] As shown in FIGS. **3** and **4**, external terminals **400** are provided on lids **320** at the opposite ends of power storage module **15** in the longitudinal direction. One of external terminals **400** at the opposite ends is a positive electrode terminal, and the other is a negative electrode terminal. Positive external terminal **400** is electrically connected to positive current collector terminal **140** of power storage cell **100** closest to positive external terminal **400**, thereby forming a coupling portion **180**. Negative external terminal **400** is electrically connected to negative current collector terminal **140** of power storage cell **100** closest to negative external terminal **400**, thereby forming a coupling portion **170**.

[0038] As shown in FIGS. **4**, **5** and **7**, power storage cell **100** includes at least one electrode body **110**, an interposed member **120**, a conductive film **130**, current collector terminal **140**, a cover **150**, and a laminated outer body **160**. Laminated outer body **160** is shown in power storage cell **100**A in FIG. **4** and in FIG. **7**, but laminated outer body **160** is not shown in power storage cell **100**B in FIG. **4** and in FIG. **5**.

[0039] In the present embodiment, power storage cell **100** includes two electrode bodies **110**. However, the number of electrode bodies **110** included in power storage cell **100** is not limited to two. Electrode body **110** is formed of a wound body including a positive electrode sheet and a negative electrode sheet wound with a separator in between. However, electrode body **110** may be formed of a stack including the positive electrode sheet and the negative electrode sheet stacked with a separator in between. Two electrode bodies **110** are adjacent to each other in the stacking direction (the front-rear direction in FIG. **5**) in which the positive electrode sheet and the negative electrode sheet are stacked on each other. Electrode body **110** is shaped to be long in the left-right direction in FIG. **5**.

[0040] Electrode body **110** includes a coating portion **112** and an electrode tab **114**. Coating portion **112** is a region of an electrode foil in the positive electrode sheet or the negative electrode sheet where an active material layer is provided. Electrode tab **114** is a region of the electrode foil in the positive electrode sheet or the negative electrode sheet where the active material layer is not provided, that is, an uncoated portion where the electrode foil is exposed.

[0041] Interposed member **120** is disposed between a pair of adjacent electrode tabs **114**. Interposed member **120** is made of insulating material (e.g., synthetic resin). As shown in FIGS. **3** and **5**, interposed member **120** includes a spacer portion **122** and a support portion **124**.

[0042] Spacer portion **122** is adjacent to the boundary of a pair of adjacent coating portions **112** in the orthogonal direction and is adjacent to a pair of adjacent electrode tabs **114** in the stacking direction. Spacer portion **122** has a shape in which the dimension in the stacking direction gradually increases as it is away from the boundary of the pair of coating portions **112** in the orthogonal direction. Spacer portion **122** is shaped into an approximately triangular prism.

[0043] Support portion **124** supports each electrode tab **114**. Support portion **124** protrudes outward in the orthogonal direction from spacer portion **122**. Support portion **124** is formed of the same material as that of spacer portion **122** to be integral with spacer portion **122**. Support portion **124** is shaped into an approximately quadrangular prism.

[0044] Conductive film **130** is made of metal (e.g., copper, aluminum). Conductive film **130** is provided on the surface of interposed member **120**. Conductive film **130** is connected to each

electrode tab **114**. Conductive film **130** includes a pair of connection bases **132** and a coupling portion **134**.

[0045] Each connection base **132** is a portion that is connected to electrode tab **114**. Each connection base **132** is provided between support portion **124** and electrode tab **114**. Each connection base **132** covers the outer surface of support portion **124** in the stacking direction.

[0046] Coupling portion **134** connects the pair of connection bases **132** to each other. Coupling portion **134** covers the outer surface of support portion **124** in the orthogonal direction. The thickness of coupling portion **134** may be the same as or different from the thickness of each connection base **132**.

[0047] Current collector terminal **140** is connected to conductive film **130**. Current collector terminal **140**, which is electrically connected to positive electrode tab **114** via conductive film **130**, is made of aluminum, for example. Current collector terminal **140**, which is electrically connected to negative electrode tab **114** via conductive film **130**, is made of copper, for example. Current collector terminal **140** includes a connection portion **142** and a protrusion **144**.

[0048] Connection portion **142** is connected to coupling portion **134** by welding, but it may be connected by any other method such as soldering. Connection portion **142** is shaped into a flat plate. The thickness of connection portion **142** may be greater than the thickness of conductive film **130**.

[0049] Protrusion **144** protrudes outward in the orthogonal direction from connection portion **142**. Protrusion **144** is shaped into a flat plate. The thickness of protrusion **144** may be greater than the thickness of conductive film **130**. As shown in FIG. **4**, protrusion **144** of current collector terminal **140** in power storage cell **100**A is connected to protrusion **144** of current collector terminal **140** in its adjacent power storage cell **100**B.

[0050] Cover **150** covers the end of electrode body **110** in the longitudinal direction, more specifically, electrode tab **114**. Cover **150** is made of insulating material (e.g., synthetic resin). As shown in FIGS. **4**, **5** and **7**, cover **150** has a through-hole h that causes protrusion **144** to pass therethrough.

[0051] Laminated outer body **160** accommodates two electrode bodies **110**, interposed member **120**, conductive film **130**, part of current collector terminal **140**, and cover **150**. Laminated outer body **160** is formed of a laminated film. As shown in FIG. **7**, laminated outer body **160** has an edge **162**. Edge **162** is formed of the laminated films connected (welded) to each other. Protrusion **144** protrudes outward in the longitudinal direction of power storage cell **100** from edge **162** of laminated outer body **160**.

[0052] In the case of an elongated power storage module **15** as described above, module case **300** deforms more by the action of an external force such as vibration than in the case of a power storage module that is not elongated. For this reason, it is necessary to suppress an input of an external force to power storage module **15** via power storage device case **17** from protective plate **500** (also called a “share panel”) shown in FIG. **6**, which is disposed outside the bottom surface of power storage device case **17**.

[0053] Thus, protective plate **500** includes a rib **501** connected to power storage device case **17**. Rib **501** is higher in at least one of rigidity and strength than the portion of protective plate **500** which is located around rib **501**. The high-rigidity portion is a portion that deforms less easily upon application of a force. The high-strength portion is a portion that breaks less easily upon application of a force.

[0054] As a result, rib **501** of protective plate **500** is connected to power storage device case **17** that accommodates power storage modules **15**, the rib **501** being higher in at least one of rigidity and strength than the portion of protective plate **500** which is located around rib **501**. This can suppress an input of an external force, applied to protective plate **500**, to power storage device case **17** that accommodates power storage modules **15** more than when the portion of protective plate **500** which is located around rib **501** is connected to power storage device case **17**. As a result, an input

of an external force from protective plate **500** to power storage modules **15** can be suppressed.
[0055] As shown in FIGS. **4**, **6** and **7**, partition members **610**, **620** are provided at coupling portions **170**, **180**, **190** of power storage cell **100** so as to sandwich the connection portions of current collector terminals **140** on the opposite sides or the connection portions between current collector terminal **140** and external terminal **400**. Partition members **610**, **620** are quadrangular prisms that are hollow in the upward-downward direction, which is the longitudinal direction. Partition members **610**, **620** may be made of synthetic resin or metal. Case body **310** of module case **300** is composed of a top plate and a bottom plate that are orthogonal to each other in the upward-downward direction, and two side plates that are orthogonal to each other in the front-rear direction. The longitudinal lengths of partition members **610**, **620** are the same as the widths of the inner surfaces of the top plate and the bottom plate of case body **310**. As a result, partition members **610**, **620** function as reinforcing members (so-called support rods) between the top plate and the bottom plate of coupling portions **170**, **180**, **190** of case body **310**.
[0056] The outer surface of case body **310** of module case **300** below coupling portions **170**, **180**, **190** and the inner surface of lower case **13** of power storage device case **17** are joined together with the adhesive of an adhesive joining portion **330**. As a result, power storage module **15** is fixed to power storage device case **17** with the adhesive below coupling portions **170**, **180**, **190**.
[0057] Power storage device **11** further includes a reinforcement **510**. Reinforcement **510** is provided below coupling portions **170**, **180**, **190**. Reinforcement **510** is formed of steel material (e.g., steel plate). Reinforcement **510** is joined to lower case **13** of power storage device case **17** by welding. Reinforcement **510** is provided across the width of lower case **13** in the longitudinal direction.
[0058] Power storage device **11** further includes a protective plate **500**. Protective plate **500** is provided below lower case **13** of power storage device case **17**. Protective plate **500** is formed of steel material (e.g., steel plate). Rib **501** is provided below coupling portions **170**, **180**, **190** in protective plate **500** across the width of lower case **13** in the longitudinal direction. The rib **501** portion of protective plate **500** is configured to be higher in rigidity and strength than the portion located around rib **501**. Rib **501** is used as a connection portion to reinforcement **510**. Rib **501** and reinforcement **510** are fastened together at the connection portion with bolts and nuts. However, the present disclosure is not limited thereto, and rib **501** and reinforcement **510** may be joined by any other method, such as welding or bonding. [0059] (1) In the embodiment described above, as shown in FIG. **6**, module case **300** of power storage module **15** includes three power storage cells **100**. However, the number of power storage cells **100** included in module case **300** is not limited thereto, and may be two or may be four or more. [0060] (2) In the embodiment described above, as shown in FIG. **6**, power storage device case **17** includes reinforcement **510** as a fixing portion connected to the connection portion of protective plate **500**. However, the present disclosure is not limited thereto, and the fixing portion may be provided in power storage device case **17** itself. In other words, power storage device case **17** and protective plate **500** may be joined together without using reinforcement **510** in between. [0061] (3) In the embodiment described above, as shown in FIG. **6**, the connection portion of protective plate **500** which is connected to power storage device case **17** is formed of rib **501**. However, the present disclosure is not limited thereto, and such a connection portion may have a structure different from that of rib **501**, as long as the connection portion is higher in at least one of rigidity and strength than the portion of protective plate **500** which is located around the connection portion, for example, a structure in which a reinforcing member is welded to protective plate **500**.
Concluding Description
[0062] (1) As shown in FIGS. **1**, **2** and **6**, power storage device **11** includes power storage modules **15** that can charge and discharge electric power, power storage device case **17** that accommodates power storage modules **15**, and protective plate **500** disposed outside the bottom surface of power storage device case **17**. As shown in FIG. **6**, protective plate **500** includes a connection portion

(e.g., rib **501**) connected to power storage device case **17**. The connection portion is higher in at least one of rigidity and strength than a portion of protective plate **500** which is located around the connection portion.
[0063] Thus, the connection portion of protective plate **500**, which is higher in at least one of rigidity and strength than the portion of protective plate **500** which is located around the connection portion, is connected to power storage device case **17** that accommodates power storage modules **15**. This can suppress an input of an external force, applied to protective plate **500**, to power storage device case **17** that accommodates power storage modules **15** more than when the portion of protective plate **500** which is located around the connection portion is connected to power storage device case **17**. As a result, the input of an external force from protective plate **500** to power storage modules **15** can be suppressed. [0064] (2) As shown in FIG. **6**, power storage device case **17** may include a fixing portion (e.g., reinforcement **510**) connected to the connection portion of protective plate **500**. Each of power storage modules **15** may be fixed to the portion of the inner surface of power storage device case **17** which is located above the fixing portion.
[0065] Thus, the fixing portion of power storage device case **17** is connected to the connection portion of protective plate **500** which is higher in at least one of rigidity and strength than the portion of protective plate **500** which is located around the connection portion. This can suppress an input of an external force, applied to protective plate **500**, to the fixing portion of power storage device case **17** that accommodates power storage modules **15** more than when power storage device case **17** is connected to the portion of protective plate **500** which is located around the connection portion. As a result, the input of an external force from protective plate **500** to power storage modules **15** can be suppressed. [0066] (3) As shown in FIG. **6**, the power storage device may further include an adhesive of adhesive joining portion **330** which bonds each of power storage modules **15** to power storage device case **17**. The adhesive may be provided at the portion of the inner surface of power storage device case **17** which is located above the fixing portion.
[0067] Thus, power storage module **15** is bonded to the portion located above the fixing portion with the adhesive. As a result, power storage module **15** can be more firmly fixed to the robust portion of power storage device case **17** than when power storage module **15** is bonded to the portion of power storage device case **17** which is different from the portion located above the fixing portion. [0068] (4) As shown in FIGS. **3** to **7**, each of power storage modules **15** may include power storage cells **100** including a first power storage cell (e.g., power storage cell **100**A) and a second power storage cell (e.g., power storage cell **100**B) arranged in one direction, and coupling portion **170**, **180**, **190**, and module case **300** that accommodates power storage cells **100** and coupling portion **170**, **180**, **190**. The first power storage cell may include a first end (e.g., cover **150**) adjacent to the second power storage cell and a first terminal (e.g., current collector terminal **140**) provided at the first end. The second power storage cell may include a second end (e.g., cover **150**) adjacent to the first power storage cell and a second terminal (e.g., current collector terminal **140**) provided at the second end. Coupling portion **170**, **180**, **190** may be formed by connection of the first terminal and the second terminal. Each of power storage modules **15** may be fixed to power storage device case **17** in the portion of the outer surface of module case **300** which is located outside of coupling portion **170**, **180**, **190**.
[0069] Thus, power storage module **15** is fixed to power storage device case **17** in the portion of the outer surface of module case **300** of power storage module **15** which is located outside coupling portion **170**, **180**, **190** at which the first terminal of the first power storage cell is connected to the second terminal of the second power storage cell. As a result, coupling portion **170**, **180**, **190** can be effectively fixed to power storage device case **17**. [0070] (5) As shown in FIGS. **4**, **6**, and **7**, module case **300** may include a top plate and a bottom plate arranged in the upward-downward direction. Each of power storage modules **15** may include partition member **610**, **620** provided in module case **300** and provided in coupling portion **170**, **180**, **190**. Partition member **610**, **620** may be disposed across the top plate and bottom plate.

[0071] Thus, coupling portion **170**, **180**, **190** of each of power storage modules **15** which is fixed to power storage device case **17** can be made robust due to partition member **610**, **620**. [0072] (6) As shown in FIG. **6**, protective plate **500** may include a main body shaped into a plate and rib **501** formed to protrude upward from the main body. The connection portion may be rib **501**.
[0073] Thus, the connection portion of protective plate **500** which is connected to power storage device case **17** can be made robust. Also, protective plate **500** itself can be made robust.
[0074] Although the present embodiments of the present disclosure have been described, it should be understood that the present embodiments disclosed herein are illustrative and non-restrictive in every respect. The scope of the present disclosure is defined by the terms of the claims and is intended to include any modifications within the scope and meaning equivalent to the terms of the claims.

Claims

1. A power storage device comprising: a plurality of power storage modules that charge and discharge electric power; an accommodation case that accommodates the plurality of power storage modules; and a protective plate disposed outside a lower surface of the accommodation case, wherein the protective plate includes a connection portion connected to the accommodation case, and the connection portion is higher in at least one of rigidity and strength than a portion of the protective plate, the portion being located around the connection portion.
2. The power storage device according to claim 1, wherein the accommodation case includes a fixing portion connected to the connection portion of the protective plate, and each of the plurality of power storage modules is fixed to a portion of an inner surface of the accommodation case, the portion being located above the fixing portion.
3. The power storage device according to claim 2, further comprising an adhesive that bonds each of the plurality of power storage modules to the accommodation case, wherein the adhesive is provided at a portion of the inner surface of the accommodation case, the portion being located above the fixing portion.
4. The power storage device according to claim 2, wherein each of the plurality of power storage modules includes a plurality of power storage cells including a first power storage cell and a second power storage cell arranged in one direction, a coupling portion, and a module case that accommodates the plurality of power storage cells and the coupling portion, the first power storage cell includes a first end adjacent to the second power storage cell, and a first terminal provided at the first end, the second power storage cell includes a second end adjacent to the first power storage cell, and a second terminal provided at the second end, the coupling portion is formed by connection of the first terminal and the second terminal, and each of the plurality of power storage modules is fixed to the accommodation case in a portion of an outer surface of the module case, the portion being located outside the coupling portion.
5. The power storage device according to claim 4, wherein the module case includes a top plate and a bottom plate arranged in an upward-downward direction, each of the plurality of power storage modules includes a partition member provided in the module case and provided at the coupling portion, and the partition member is disposed across the top plate and the bottom plate.
6. The power storage device according to claim 1, wherein the protective plate incudes a body portion shaped into a plate, and a rib formed to protrude upward from the body portion, and the connection portion is the rib.