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POWER STORAGE DEVICE AND VEHICLE

Abstract

A power storage device includes: a first power storage stack and a second power storage stack each including a plurality of power storage cells; a lower case having the first power storage stack and the second power storage stack disposed therein; a cross member extending along a predetermined direction and partitioning a region in the lower case; and an electrical connection member that electrically connects the first power storage stack and the second power storage stack. When viewed in a vertical direction, the electrical connection member at least partially overlaps with the cross member and extends along an extension direction of the cross member.

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Background/Summary

CROSS REFERENCE TO RELATED APPLICATIONS

[0001] This nonprovisional application is based on Japanese Patent Application No. 2024-023824 filed on Feb. 20, 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 and a vehicle including the power storage device.

Description of the Background Art

[0003] As a conventional power storage device, Japanese Patent Laying-Open No. 2023-046945 discloses such a configuration that in an accommodation case accommodating a plurality of battery modules (power storage stacks), a cross member is disposed between the battery modules adjacent to each other, and a mount member supporting an upper case is provided on the cross member.

[0004] A damper is disposed between a portion of the upper case located on the mount member and a body. When a load is input from below the accommodation case, the load is input to the body through the cross member and the mount member. At this time, a part of the load is absorbed by the damper disposed in an input path from the upper case to the body, whereby the load input to the body can be reduced.

SUMMARY

[0005] The plurality of power storage stacks accommodated in the accommodation case are electrically connected by electrical connection members. When a load is input from outside the accommodation case, the electrical connection members and the power storage stacks may interfere with each other.

[0006] The present disclosure has been made in view of the above-described problem, and an object of the present disclosure is to provide a power storage device in which interference between an electrical connection member and a power storage stack when a load is input from outside can be suppressed, and a vehicle including the power storage device.

[0007] A power storage device according to the present disclosure includes: a first power storage stack and a second power storage stack each including a plurality of power storage cells; a lower case having the first power storage stack and the second power storage stack disposed therein; a cross member extending along a predetermined direction and partitioning a region in the lower case; and an electrical connection member that electrically connects the first power storage stack and the second power storage stack. When viewed in a vertical direction, the electrical connection member at least partially overlaps with the cross member and extends along an extension direction of the cross member.

[0008] According to the above-described configuration, in a region where the cross member is fixed, the rigidity of the lower case is high. Therefore, when a load is input to the lower case from outside, deformation of surroundings of the cross member is suppressed. Thus, input of the load to a portion of the electrical connection member overlapping with the cross member and extending along the extension direction of the cross member can be suppressed. As a result, interference between the electrical connection member and the power storage stacks can be suppressed and a short circuit in the power storage stacks can be suppressed.

[0009] In the power storage device according to the present disclosure, in a direction orthogonal to the extension direction, a width of a portion of the electrical connection member overlapping with the cross member and extending along the extension direction of the cross member may be shorter than a width of the cross member.
[0010] According to the above-described configuration, the width of the portion of the electrical connection member overlapping with the cross member and extending along the extension direction of the cross member is shorter than the width of the cross member, whereby interference between the electrical connection member and the power storage stacks can be suppressed more suitably.
[0011] In the power storage device according to the present disclosure, in the extension direction, a length of a portion of the electrical connection member overlapping with the cross member and extending along the extension direction of the cross member may be shorter than a length of the cross member.
[0012] According to the above-described configuration, the length of the portion of the electrical connection member overlapping with the cross member and extending along the extension direction of the cross member is shorter than the length of the cross member, whereby interference between the electrical connection member and the power storage stacks can be suppressed more suitably.
[0013] In the power storage device according to the present disclosure, the cross member may be disposed between the first power storage stack and the second power storage stack. A portion of the electrical connection member overlapping with the cross member and extending along the extension direction of the cross member may be disposed between the first power storage stack and the second power storage stack.
[0014] According to the above-described configuration, even in a situation in which the portion of the electrical connection member overlapping with the cross member and extending along the extension direction of the cross member is disposed between the first power storage stack and the second power storage stack, deformation of surroundings of the cross member is suppressed, whereby interference of the electrical connection member with any of the first power storage stack and the second power storage stack can be suppressed.
[0015] The power storage device according to the present disclosure may further include a holding member fixed to the cross member to extend upward in the vertical direction from the cross member. The holding member may hold a portion of the electrical connection member overlapping with the cross member and extending along the extension direction of the cross member. The holding member may protrude more upward in the vertical direction than the first power storage stack and the second power storage stack.
[0016] According to the above-described configuration, when a load is input from the upper side of the power storage device, downward deformation of a region directly above the holding member can be suppressed. Thus, the electrical connection member can be protected.
[0017] In the power storage device according to the present disclosure, the holding member may include an insertion portion into which the portion of the electrical connection member overlapping with the cross member and extending along the extension direction of the cross member is inserted.
[0018] According to the above-described configuration, the electrical connection member is inserted into the insertion portion, whereby vibration of the electrical connection member can be suppressed.
[0019] In the power storage device according to the present disclosure, the holding member may include a projection on a surface that defines the insertion portion.
[0020] According to the above-described configuration, the projection is provided, whereby slipping-off of the electrical connection member from the insertion portion caused by vibration from outside can be suppressed.
[0021] The power storage device according to the present disclosure may include a cover member

that covers the first power storage stack and the second power storage stack from an upper side in the vertical direction. The holding member may be in contact with the cover member.
[0022] According to the above-described configuration, the holding member is in contact with the cover member, whereby the holding member can be sandwiched between the cover member and the cross member and vibration of the holding member can be suppressed.
[0023] A vehicle according to the present disclosure includes: the above-described power storage device; and a vehicle frame member.
[0024] According to the above-described configuration, the vehicle includes the power storage device, whereby interference between the electrical connection member and the power storage stacks can be suppressed and a short circuit in the power storage stacks can be suppressed.
[0025] The vehicle according to the present disclosure may include a buffer member disposed in a gap between the cover member and the vehicle frame member. The buffer member may be disposed above the holding member.
[0026] According to the above-described configuration, a load transmitted to the vehicle frame member when the load is applied to the power storage device from outside can be reduced by the buffer member. Furthermore, when the power storage device is mounted on a vehicle main body, the power storage device is mounted such that the power storage device is pressed against the buffer member, whereby the holding member can be pressed against the cross member with the reaction force.
[0027] Thus, vibration of the holding member can be suppressed and vibration of the electrical connection member held by the holding member can also be suppressed.
[0028] The vehicle according to the present disclosure may include a protection cover that covers a part of the cover member from an upper side of the cover member such that a space is formed between the protection cover and the cover member. The protection cover may include a pair of side wall portions spaced apart from each other in the extension direction of the cross member. In this case, the holding member may be disposed below a lower surface of each of the pair of side wall portions.
[0029] According to the above-described configuration, a load from the protection cover allows the holding member to be pressed against the cross member through the cover member. Thus, vibration of the holding member can be suppressed.
[0030] 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
[0031] FIG. **1** is a schematic view of a vehicle according to a first embodiment.
[0032] FIG. **2** shows a state in which a power storage device according to the first embodiment is fixed to the vehicle.
[0033] FIG. **3** is a schematic exploded perspective view of the power storage device according to the first embodiment.
[0034] FIG. **4** is a schematic plan view showing an inside of the power storage device according to the first embodiment.
[0035] FIG. **5** is a schematic cross-sectional view taken along line V-V shown in FIG. **4**.
[0036] FIG. **6** is a schematic cross-sectional view showing a structure of a cross member and its surroundings in a power storage device according to a second embodiment.
[0037] FIG. **7** is a schematic cross-sectional view showing a structure of a cross member and its surroundings in a power storage device in a vehicle according to a third embodiment.

[0038] FIG. **8** is a schematic cross-sectional view showing a structure of a cross member and its surroundings in a power storage device according to a fourth embodiment.
[0039] FIG. **9** is a schematic cross-sectional view showing a positional relationship between a protection cover of a vehicle and a holding member of a power storage device according to a fifth embodiment.
[0040] FIG. **10** is a schematic plan view showing an inside of a power storage device according to a sixth embodiment.
[0041] FIG. **11** is a schematic plan view showing an inside of a power storage device according to a seventh embodiment.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0042] Hereinafter, embodiments of the present disclosure will be described in detail with reference to the drawings. In the embodiments described below, the same or corresponding portions are denoted by the same reference characters in the drawings, and description thereof will not be repeated.
[0043] When the number, an amount, or the like is mentioned in an embodiment described below, the scope of the present disclosure is not necessarily limited to the number, the amount, or the like unless otherwise specified. Each constituent element in the embodiment below is not necessarily essential to the present disclosure unless otherwise specified. When there are a plurality of embodiments below, combination of features in the embodiments as appropriate is originally intended unless otherwise specified.

First Embodiment

[0044] FIG. **1** is a schematic view of a vehicle according to a first embodiment. FIG. **2** shows a state in which a power storage device according to the first embodiment is fixed to the vehicle. A vehicle **1** according to the first embodiment will be described with reference to FIGS. **1** and **2**.
[0045] Vehicle **1** is a hybrid vehicle that can travel using motive power of at least one of a motor and an engine, or an electrically powered vehicle that travels using driving force obtained by electrical energy.
[0046] Vehicle **1** includes a vehicle main body **2**, a front wheel **3**, a rear wheel **4**, and a power storage device **10**. Vehicle main body **2** includes a frame member **5**. Power storage device **10** has an upper surface **10***a*. Upper surface **10***a* may also function as a floor member that defines a vehicle interior.
[0047] Frame member **5** includes a pair of side members **6** and a pair of side sills **7**. The pair of side sills **7** are disposed at both ends in a width direction of vehicle **1**. The pair of side members **6** are disposed inside the pair of side sills **7** with a distance therebetween. The pair of side members **6** and the pair of side sills **7** extend along a front-rear direction of vehicle **1**.
[0048] The pair of side members **6** are spaced apart from each other in the width direction of vehicle **1**. A main body portion **35** of power storage device **10** is disposed in a gap between the pair of side members **6**. A void space is provided between main body portion **35** and the pair of side members **6**. As a result, even when vehicle **1** experiences side collision, input of the impact to power storage device **10** can be suppressed.
[0049] Fixed portions **36** are provided on both side surfaces of main body portion **35** in the width direction of vehicle **1**. Fixed portions **36** are fixed to the pair of side members **6** by fastening members **8**, respectively.
[0050] Frame member **5** also includes a vehicle-body-side cross member **9**. Vehicle-body-side cross member **9** is provided above power storage device **10** to extend from one side sill **7** to the other side sill **7**. Upper surface **10***a* of power storage device **10** is fixed to vehicle-body-side cross member **9**. Upper surface **10***a* is configured by a cover member **31** described below (see FIG. **3**).
[0051] Although the example in which frame member **5** includes the pair of side members **6** and the pair of side sills **7** has been illustrated and described above, the present disclosure is not limited thereto. The pair of side sills **7** may have the function of the pair of side members **6**. In this case,

the pair of side members **6** can be omitted and fixed portions **36** described above may be fixed to the pair of side sills **7**.

[0052] FIG. **3** is a schematic exploded perspective view of the power storage device according to the first embodiment. FIG. **4** is a schematic plan view showing an inside of the power storage device according to the first embodiment. Details of power storage device **10** will be described with reference to FIGS. **3** and **4**. For the sake of convenience, the fixed portions shown in FIG. **3** are not shown in FIG. **4**.

[0053] As shown in FIGS. **3** and **4**, power storage device **10** includes a plurality of power storage stacks **20**, an accommodation case **30**, a cross member **40**, a plurality of holding members **50**, a plurality of electrical connection members **60**, and an electronic device **95**.

[0054] Each of the plurality of power storage stacks **20** includes a plurality of power storage cells **25**. The plurality of power storage cells **25** are arranged in a first direction (DR**1**). In the present embodiment, the first direction is parallel to the width direction of vehicle **1** in a mounted state in which power storage device **10** is mounted on vehicle main body **2**.

[0055] Each of power storage cells **25** is, for example, a secondary battery such as a nickel-metal hydride battery or a lithium ion battery. Each of power storage cells **25** may be a power storage cell including a liquid electrolyte, or may be a power storage cell including a solid electrolyte. Each of power storage cells **25** may be a chargeable and dischargeable capacitor.

[0056] Specifically, each of power storage cells **25** includes a housing **28** (see FIG. **5**) and an electrode assembly **29** (see FIG. **5**). Electrode assembly **29** is accommodated in housing **28**. Electrode assembly **29** may be a stacked electrode assembly in which a negative electrode sheet, a separator and a positive electrode sheet are stacked, or may be a wound electrode assembly in which a negative electrode sheet, a separator and a positive electrode sheet are wound.

[0057] Each of power storage cells **25** includes a positive electrode external terminal **26** and a negative electrode external terminal **27**. In each of power storage stacks **20**, the plurality of power storage cells **25** are connected in series by a bus bar. The plurality of power storage cells **25** are disposed such that positive electrode external terminals **26** and negative electrode external terminals **27** are alternately arranged side by side in the first direction. In each of power storage stacks **20**, the plurality of power storage cells **25** are arranged.

[0058] The plurality of power storage stacks **20** are arranged side by side in a second direction (DR**2**). The second direction is a direction orthogonal to the first direction.

[0059] In the present embodiment, the second direction is parallel to the front-rear direction of vehicle **1** in the above-described mounted state.

[0060] Accommodation case **30** includes a cover member **31** and a lower case **32**. Lower case **32** has a substantially box shape that is opened upward. The plurality of power storage stacks **20** are disposed in lower case **32**.

[0061] Lower case **32** includes main body portion **35** and fixed portions **36**. Main body portion **35** has a bottom wall portion **321**, a first wall portion **322**, a second wall portion **323**, and side wall portions **324** and **325**. First wall portion **322**, second wall portion **323**, and side wall portions **324** and **325** are provided to rise from a perimeter edge of bottom wall portion **321**.

[0062] First wall portion **322** and second wall portion **323** face each other in the second direction. Side wall portions **324** and **325** face each other in the first direction. Fixed portions **36** are provided on outer surfaces of side wall portions **324** and **325**.

[0063] Cover member **31** has a substantially flat plate shape. Cover member **31** covers the plurality of power storage stacks **20** and closes an open space of lower case **32**. A sealing member may be filled into a gap between cover member **31** and power storage stacks **20**. The sealing member may have insulating properties. Cover member **31** may have the function as a floor panel, in addition to the function as a lid member that closes the open space of lower case **32** as described above.

[0064] Cross member **40** is fixed to lower case **32**. Cross member **40** is made of, for example, a metal member such as SUS. Cross member **40** extends along a predetermined direction and

partitions a region in lower case **32**. Specifically, cross member **40** extends along the first direction. Cross member **40** divides the region in lower case **32** into two regions and two power storage stacks **20** are disposed in each divided region.

[0065] The plurality of power storage stacks **20** described above include a first power storage stack **21** and a second power storage stack **22** spaced apart from each other in the second direction. First power storage stack **21** and second power storage stack **22** are disposed to be adjacent to each other in the second direction, and cross member **40** is disposed in a gap between first power storage stack **21** and second power storage stack **22**.

[0066] The plurality of holding members **50** are fixed to cross member **40** to extend upward in a vertical direction from cross member **40**. The vertical direction is a direction orthogonal to the above-described first and second directions. The plurality of holding members **50** are spaced apart from each other in the first direction.

[0067] Electronic device **95** is disposed on one side in the second direction relative to the plurality of power storage stacks **20**. Electronic device **95** is a battery ECU (Electronic Control Unit), for example.

[0068] The plurality of electrical connection members **60** electrically connect, in series, the plurality of power storage stacks **20** arranged side by side in the second direction. The plurality of electrical connection members **60** include electrical connection members **61**, **62**, **63**, **64**, and **65**.

[0069] Electrical connection member **61** connects a negative electrode in a battery module configured by a plurality of power storage stacks **20** and electronic device **95** to each other, for example. Electrical connection member **62** electrically connects, in series, two power storage stacks **20** disposed in a region located on one side in the second direction relative to cross member **40**.

[0070] Electrical connection member **63** electrically connects above-described first power storage stack **21** and second power storage stack **22** to each other. More particularly, electrical connection member **63** electrically connects a first power storage module configured by two power storage stacks **20** disposed in the region located on one side in the second direction relative to cross member **40** and a second power storage module configured by two power storage stacks **20** disposed in a region located on the other side in the second direction relative to cross member **40**.

[0071] When viewed in the vertical direction, electrical connection member **63** at least partially overlaps with cross member **40** and extends along an extension direction of cross member **40**. Specifically, electrical connection member **63** has a first routing portion **631**, an overlapping portion **632** and a second routing portion **633**. First routing portion **631** extends from first power storage stack **21** toward cross member **40** along the first direction.

[0072] Overlapping portion **632** is a portion of electrical connection member **63** overlapping with cross member **40** and extending along the extension direction of cross member **40** when viewed in the vertical direction. In a direction orthogonal to the extension direction, a width of overlapping portion **632** is shorter than a width of cross member **40**. In the above-described extension direction, a length of overlapping portion **632** is shorter than a length of cross member **40**.

[0073] Second routing portion **633** extends toward second power storage stack **22** along the first direction on a side opposite to a side where first routing portion **631** is located in the first direction.

[0074] Electrical connection member **64** electrically connects, in series, two power storage stacks **20** disposed in the region located on the other side in the second direction relative to cross member **40**. Electrical connection member **65** connects a positive electrode in a battery module configured by a plurality of power storage stacks **20** and electronic device **95** to each other, for example.

[0075] FIG. **5** is a schematic cross-sectional view taken along line V-V shown in FIG. **4**. Details of cross member **40** and holding member **50** will be described with reference to FIG. **5**.

[0076] As shown in FIG. **5**, cross member **40** has a hollow structure. Cross member **40** includes a pair of side wall portions **41** and **42**, and an upper wall portion **43**. The pair of side wall portions **41** and **42** face each other in the direction in which first power storage stack **21** and second power

storage stack **22** are arranged side by side, i.e., the second direction.
[0077] Side wall portion **41** is located on the first power storage stack **21** side. A flange portion **41***f* extending toward the first power storage stack **21** side is provided at a lower end of side wall portion **41**. Side wall portion **42** is located on the second power storage stack **22** side. A flange portion **42***f* extending toward the second power storage stack **22** side is provided at a lower end of side wall portion **42**.
[0078] Above-described flange portions **41***f* and **42***f* are fixed to bottom wall portion **321** of lower case **32** by welding, fastening or the like, whereby cross member **40** is fixed to lower case **32**.
[0079] Upper wall portion **43** connects upper ends of the pair of side wall portions **41** and **42** to each other. A through hole **43***h* is provided in upper wall portion **43**. An engagement portion **53***p* described below is inserted into through hole **43***h*.
[0080] Holding member **50** holds above-described overlapping portion **632**. Holding member **50** has an insertion portion **50***c* into which overlapping portion **632** is inserted. Overlapping portion **632** is inserted into insertion portion **50***c*, whereby overlapping portion **632** is held. "Overlapping portion **632** is held" is not limited to a state in which overlapping portion **632** is maintained in contact with a surface of holding member **50** that defines insertion portion **50***c*, and also means that overlapping portion **632** is separated from the surface and located within insertion portion **50***c*. That is, "overlapping portion **632** is held" means that a state in which overlapping portion **632** is located within a space partitioned by the surface of holding member **50** that defines insertion portion **50***c* is maintained. An upper end **50***a* of holding member **50** abuts on cover member **31**. Thus, vibration of holding member **50** can be suppressed.
[0081] Holding member **50** has a substantially U shape. Holding member **50** has a pair of wall portions **51** and **52** that face each other in the second direction, and a bottom portion **53**. The pair of wall portions **51** and **52** are spaced apart from each other in the second direction. The pair of wall portions **51** and **52** are provided to protrude upward from both ends of bottom portion **53** in the second direction. Above bottom portion **53**, a space is formed between the pair of wall portions **51** and **52**, and this space constitutes above-described insertion portion **50***c*.
[0082] A part of overlapping portion **632** is inserted into the space between the pair of wall portions **51** and **52**, and overlapping portion **632** is sandwiched between the pair of wall portions **51** and **52**. Thus, vibration of overlapping portion **632** can be suppressed. In addition, projections **54** and **55** are provided on the inner surface of holding member **50** that defines insertion portion **50***c*. Projections **54** and **55** are spaced apart from each other in the second direction. Projection **54** is provided on an inner surface of one wall portion **51** of the pair of wall portions **51**, and projection **55** is provided on an inner surface of the other wall portion **52** of the pair of wall portions **51**.
[0083] Projections **54** and **55** are disposed above overlapping portion **632** in a state where overlapping portion **632** is inserted into insertion portion **50***c*. Thus, upward slipping-off of overlapping portion **632** can be suppressed.
[0084] Projections **54** and **55** may press overlapping portion **632** downward, whereby overlapping portion **632** may be sandwiched between projections **54** and **55** and bottom portion **53**. In this case as well, vibration of overlapping portion **632** can be suppressed.
[0085] Upper ends **51***a* and **52***a* of the pair of wall portions **51** and **52** abut on cover member **31**. The load of cover member **31** is received by the pair of wall portions **51** and **52**, whereby opening of the pair of wall portions **51** and **52** can be suppressed. Using this load, above-described projections **54** and **55** may press overlapping portion **632** against bottom portion **53**.
[0086] In the above-described inserted state, a gap may be provided between projections **54** and **55** and overlapping portion **632**. In this case, transmission of a load to overlapping portion **632** when the load such as impact is applied from the upper side of cover member **31** can be suppressed. Thus, breakage of overlapping portion **632** can be suppressed.
[0087] Engagement portion **53***p* protruding downward is provided on a lower surface of bottom portion **53**. Engagement portion **53***p* engages with a portion of above-described upper wall portion

43 located at a circumferential edge of through hole **43***h*, in a state where engagement portion **53***p* is inserted into through hole **43***h* provided in cross member **40**. Thus, holding member **50** is fixed to cross member **40**. With such a configuration, holding member **50** can be easily fixed. Holding member **50** may be fixed to cross member **40** by welding, fastening or the like.

[0088] Electrical connection member **63** is configured by a bus bar. In the present embodiment, electrical connection member **63** is configured by a metal member and holding member **50** is configured by an insulating member. The other electrical connection members may be configured similarly to electrical connection member **63**.

[0089] As described above, in power storage device **10** according to the first embodiment, cross member **40** is provided between first power storage stack **21** and second power storage stack **22** adjacent to each other in the second direction, and electrical connection member **63** that connects first power storage stack **21** and second power storage stack **22** includes overlapping portion **632** overlapping with cross member **40** and extending along the extension direction of cross member **40** when viewed in the vertical direction.

[0090] In the region where cross member **40** is fixed, the rigidity of lower case **32** is high. Therefore, when a load is input to lower case **32** from outside, deformation of surroundings of cross member **40** is suppressed. For example, when vehicle **1** experiences side collision and the impact is input in the width direction (first direction) of the vehicle, cross member **40** receives the impact. Therefore, in the region where cross member **40** is disposed, inward deformation of the side wall portions of lower case **32** is suppressed and deformation of cross member **40** itself is also suppressed. Thus, input of the load to overlapping portion **632** extending along the extension direction of cross member **40** and overlapping with cross member **40** can be suppressed. As a result, interference between electrical connection member **63** and first and second power storage stacks **21** and **22** can be suppressed and a short circuit in first power storage stack **21** and second power storage stack **22** can be suppressed.

[0091] When vehicle **1** experiences front collision or rear collision and the impact is input in the front-rear direction (first direction) of vehicle **1**, a reduction of the gap between first power storage stack **21** and second power storage stack **22** is suppressed due to the inertia. Thus, it is also possible to suppress a situation in which overlapping portion **632** overlapping with cross member **40** disposed in the gap between first power storage stack **21** and second power storage stack **22** is sandwiched between first power storage stack **21** and second power storage stack **22**. As a result, interference between electrical connection member **63** and first and second power storage stacks **21** and **22** can be suppressed and a short circuit in first power storage stack **21** and second power storage stack **22** can be suppressed.

[0092] Furthermore, since the width of overlapping portion **632** is shorter than the width of cross member **40** as described above, interference between electrical connection member **63** and first and second power storage stacks **21** and **22** can be suppressed more effectively.

[0093] In addition, since the length of overlapping portion **632** along the extension direction of cross member **40** is shorter than the length of cross member **40** as described above, hitting of the side wall portions of lower case **32** against electrical connection member **63** when vehicle **1** experiences side collision can be suppressed. As a result, interference between electrical connection member **63** and first and second power storage stacks **21** and **22** can be suppressed more effectively.

Second Embodiment

[0094] FIG. **6** is a schematic cross-sectional view showing a structure of a cross member and its surroundings in a power storage device according to a second embodiment. A power storage device **10**A according to the second embodiment will be described with reference to FIG. **6**.

[0095] As shown in FIG. **6**, power storage device **10**A according to the second embodiment is different from power storage device **10** according to the first embodiment in terms of the configuration of electrical connection member **63**. Power storage device **10**A according to the

second embodiment is otherwise substantially the same as power storage device **10** according to the first embodiment.

[0096] Electrical connection member **63** includes an electrically conductive member **63**A and a protection member **63**B. Protection member **63**B is configured by an insulating member and has a hollow structure. Electrically conductive member **63**A is disposed in a hollow portion of protection member **63**B. Electrically conductive member **63**A is separated from protection member **63**B and disposed within protection member **63**B. That is, a gap is formed between protection member **63**B and electrically conductive member **63**A. The other electrical connection members may also be configured similarly to electrical connection member **63**.

[0097] With the above-described configuration as well, power storage device **10**A according to the second embodiment can obtain substantially the same effect as that of the first embodiment. Since electrically conductive member **63**A is separated from protection member **63**B, transmission of a load applied to protection member **63**B to electrically conductive member **63**A can be suppressed. As a result, breakage of electrically conductive member **63**A can be suppressed and interference between electrical connection member **63** and first and second power storage stacks **21** and **22** can be suppressed more effectively. Furthermore, since protection member **63**B is held by holding member **50**, protection member **63**B also functions as a strut that supports cover member **31**. As a result, deformation of cover member **31** or bottom wall portion **321** when a load is applied from the upper side of cover member **31** or from the lower side of bottom wall portion **321** can be suppressed.

Third Embodiment

[0098] FIG. **7** is a schematic cross-sectional view showing a structure of a cross member and its surroundings in a power storage device in a vehicle according to a third embodiment. A power storage device **10**B according to the third embodiment will be described with reference to FIG. **7**.

[0099] As shown in FIG. **7**, the vehicle according to the third embodiment is different from a vehicle including power storage device **10**A according to the second embodiment in that the vehicle according to the third embodiment includes a buffer member **70** between vehicle main body **2** and cover member **31**. The vehicle according to the third embodiment is otherwise substantially the same as the vehicle including power storage device **10**A according to the second embodiment.

[0100] Above holding member **50**, buffer member **70** is sandwiched between frame member **5** and cover member **31**. More particularly, buffer member **70** is disposed between vehicle-body-side cross member **9** and cover member **31**.

[0101] With the above-described configuration as well, the vehicle according to the third embodiment can obtain substantially the same effect as that of the vehicle including power storage device **10**A according to the second embodiment. In addition, since the vehicle according to the third embodiment includes buffer member **70**, a load transmitted to the vehicle frame member when the load is applied to power storage device **10**B from outside can be reduced by the buffer member. In addition, when power storage device **10**B is mounted on vehicle main body **2**, power storage device **10**B is mounted such that power storage device **10**B is pressed against buffer member **70**, whereby holding member **50** can be pressed against cross member **40** with the reaction force. Thus, vibration of holding member **50** can be suppressed and vibration of overlapping portion **632** held by holding member **50** can also be suppressed.

Fourth Embodiment

[0102] FIG. **8** is a schematic cross-sectional view showing a structure of a cross member and its surroundings in a power storage device according to a fourth embodiment. A power storage device **10**C according to the fourth embodiment will be described with reference to FIG. **8**.

[0103] As shown in FIG. **8**, power storage device **10**C according to the fourth embodiment is different from power storage device **10**A according to the second embodiment mainly in terms of the configuration of electrical connection member **63**. Power storage device **10**C according to the fourth embodiment is otherwise substantially the same as power storage device **10**A according to

the second embodiment.
[0104] Electrical connection member **63** includes a wire portion **63**A**1** and protection member **63**B. In the present embodiment as well, protection member **63**B is configured by an insulating member and has a hollow structure. Wire portion **63**A**1** is disposed in a hollow portion of protection member **63**B. A gap is formed between protection member **63**B and wire portion **63**A**1**. Wire portion **63**A**1** has a substantially columnar shape and protection member **63**B has a substantially cylindrical shape. Wire portion **63**A**1** is configured by a wire harness, for example. Overlapping portion **632** of electrical connection member **63** is sandwiched between the pair of projections **54** and **55** and bottom portion **53**.
[0105] With the above-described configuration as well, power storage device **10**C according to the third embodiment can obtain substantially the same effect as that of power storage device **10**A according to the second embodiment.
Fifth Embodiment
[0106] FIG. **9** is a schematic cross-sectional view showing a positional relationship between a protection cover of a vehicle and a holding member of a power storage device according to a fifth embodiment. A vehicle **1**D according to the fifth embodiment will be described with reference to FIG. **9**.
[0107] As shown in FIG. **9**, vehicle **1**D according to the fifth embodiment is different from vehicle **1** according to the first embodiment in terms of a protection cover **80** and a wire **85**, and the position of holding member **50**. Vehicle **1**D according to the fifth embodiment is otherwise substantially the same as vehicle **1** according to the first embodiment.
[0108] Protection cover **80** protects wire **85** routed above cover member **31**. Protection cover **80** covers a part of cover member **31** from the upper side of cover member **31** such that a space S is formed between protection cover **80** and cover member **31**. Wire **85** is located within space S. Protection cover **80** is disposed to overlap with a part of cross member **40** when viewed in the vertical direction. For example, protection cover **80** is disposed to overlap with a central portion of cross member **40** in the extension direction of cross member **40** when viewed in the vertical direction. Protection cover **80** extends along a direction intersecting the above-described extension direction. Specifically, protection cover **80** extends along the second direction.
[0109] Protection cover **80** has a pair of side wall portions **81** and **82** and a ceiling portion **83**. The pair of side wall portions **81** and **82** are spaced apart from each other in the extension direction of cross member **40**. The pair of side wall portions **81** and **82** have lower surfaces **81***a* and **82***a*, respectively. Ceiling portion **83** connects upper ends of the pair of side wall portions **81** and **82** to each other.
[0110] Holding members **50** are disposed below lower surfaces **81***a* and **82***a* of the pair of side wall portions **81** and **82**, respectively. Below lower surfaces **81***a* and **82***a*, holding members **50** are sandwiched between cover member **31** and cross member **40**.
[0111] With the above-described configuration as well, the vehicle according to the fifth embodiment can obtain substantially the same effect as that of vehicle **1** including power storage device **10** according to the first embodiment. In addition, since holding members **50** are disposed below lower surfaces **81***a* and **82***a* of the pair of side wall portions **81** and **82**, respectively, a load from protection cover **80** allows holding members **50** to be pressed against cross member **40** through cover member **31**. Thus, vibration of holding member **50** can be suppressed.
Sixth Embodiment
[0112] FIG. **10** is a schematic plan view showing an inside of a power storage device according to a sixth embodiment. A power storage device **10**E according to the sixth embodiment will be described with reference to FIG. **10**.
[0113] As shown in FIG. **10**, power storage device **10**E according to the sixth embodiment is different from power storage device **10** according to the first embodiment mainly in terms of the arrangement of the plurality of power storage stacks **20** and the routing path of electrical

connection member **60**. Power storage device **10**E according to the sixth embodiment is otherwise substantially the same as power storage device **10** according to the first embodiment.

[0114] In the present embodiment, the first direction in which the plurality of power storage cells **25** are arranged is parallel to the front-rear direction of the vehicle, and the second direction orthogonal to the first direction is parallel to the width direction of the vehicle.

[0115] The plurality of power storage stacks **20** are disposed in a matrix shape. For example, the plurality of power storage stacks **20** are disposed in a matrix with 4 rows and 2 columns, in which the first direction is a row direction and the second direction orthogonal to the first direction is a column direction. More particularly, when one power storage unit is formed by arranging, side by side in the above-described second direction, four power storage stacks **20** each including the plurality of power storage cells **25** arranged in the first direction, a first power storage unit **91** and a second power storage unit **92** are spaced apart from each other and arranged side by side in the first direction. Each of power storage stacks **20** includes the even number of power storage cells **25**.

[0116] Each of first power storage unit **91** and second power storage unit **92** has two sets of first power storage stack **21** and second power storage stack **22** disposed in the second direction to be adjacent to each other.

[0117] Cross member **40** is disposed in a gap between first power storage unit **91** and second power storage unit **92**. Cross member **40** extends along the second direction.

[0118] The plurality of electrical connection members **60** include electrical connection members **61**, **62**, **63**, **64**, **65**, **66**, **67**, and **68**, and electrically connect the plurality of power storage stacks **20** in series.

[0119] Each of electrical connection members **62**, **64**, **66**, and **67** connects first power storage stack **21** and second power storage stack **22** adjacent to each other.

[0120] Specifically, electrical connection member **62** electrically connects one set of first power storage stack **21** and second power storage stack **22**, of two sets of first power storage stack **21** and second power storage stack **22** included in first power storage unit **91**. Electrical connection member **64** electrically connects the other set of first power storage stack **21** and second power storage stack **22**, of two sets of first power storage stack **21** and second power storage stack **22** included in first power storage unit **91**.

[0121] Electrical connection member **66** electrically connects one set of first power storage stack **21** and second power storage stack **22**, of two sets of first power storage stack **21** and second power storage stack **22** included in second power storage unit **92**. Electrical connection member **67** electrically connects the other set of first power storage stack **21** and second power storage stack **22**, of two sets of first power storage stack **21** and second power storage stack **22** included in second power storage unit **92**.

[0122] Electrical connection members **62**, **64**, **66**, and **67** have overlapping portions **62**E, **64**E, **66**E, and **67**E overlapping with cross member **40** and extending along the extension direction of cross member **40**, respectively, when viewed in the vertical direction.

[0123] Two holding members **50** are spaced apart from each other and arranged side by side in the second direction, for example. One holding member **50** of two holding members **50** holds overlapping portions **62**E and **67**E, and the other holding member **50** of two holding members **50** holds overlapping portions **64**E and **66**E.

[0124] In the present embodiment, two sets of first power storage stack **21** and second power storage stack **22** are arranged side by side in two rows in the first direction, and the electrical connection members that electrically connect the respective sets of first power storage stack **21** and second power storage stack **22** are held by one common holding member **50**.

[0125] With the above-described configuration as well, power storage device **10**E according to the sixth embodiment can obtain substantially the same effect as that of power storage device **10** according to the first embodiment.

Seventh Embodiment

[0126] FIG. **11** is a schematic plan view showing an inside of a power storage device according to a seventh embodiment. A power storage device **10**F according to the seventh embodiment will be described with reference to FIG. **11**.
[0127] As shown in FIG. **11**, power storage device **10**F according to the seventh embodiment is different from power storage device **10** according to the first embodiment mainly in terms of the arrangement of the plurality of power storage stacks **20**, the arrangement of cross member **40**, and the routing path of electrical connection member **60**. Power storage device **10**F according to the seventh embodiment is otherwise substantially the same as power storage device **10** according to the first embodiment.
[0128] In the present embodiment, the first direction in which the plurality of power storage cells **25** are arranged is parallel to the width direction of the vehicle, and the second direction orthogonal to the first direction is parallel to be front-rear direction of the vehicle.
[0129] The plurality of power storage stacks **20** are disposed in a matrix shape. For example, the plurality of power storage stacks **20** are disposed in a matrix with 3 rows and 2 columns, in which the first direction is a column direction and the second direction orthogonal to the first direction is a row direction.
[0130] More particularly, when one power storage unit is formed by arranging, side by side in the above-described second direction, three power storage stacks **20** each including the plurality of power storage cells **25** arranged in the first direction, first power storage unit **91** and second power storage unit **92** are spaced apart from each other and arranged side by side in the first direction. Each of power storage stacks **20** includes the even number of power storage cells **25**.
[0131] Each of first power storage unit **91** and second power storage unit **92** has one set of first power storage stack **21** and second power storage stack **22** disposed in the second direction to be adjacent to each other.
[0132] Cross member **40** is disposed in a gap between first power storage unit **91** and second power storage unit **92**. Cross member **40** extends along the second direction.
[0133] The plurality of electrical connection members **60** include electrical connection members **61**, **62**, **63**, **64**, and **65**, and electrically connect the plurality of power storage stacks **20** in series.
[0134] Each of electrical connection members **62** and **64** connects first power storage stack **21** and second power storage stack **22** adjacent to each other.
[0135] Specifically, electrical connection member **62** electrically connects first power storage stack **21** and second power storage stack **22** included in first power storage unit **91**. Electrical connection member **64** electrically connects first power storage stack **21** and second power storage stack **22** included in second power storage unit **92**.
[0136] Electrical connection members **62** and **64** have overlapping portions **62**F and **64**F overlapping with cross member **40** and extending along the extension direction of cross member **40**, respectively, when viewed in the vertical direction.
[0137] In the present embodiment as well, two sets of first power storage stack **21** and second power storage stack **22** are arranged side by side in two rows in the first direction, and the electrical connection members that electrically connect the respective sets of first power storage stack **21** and second power storage stack **22** are held by one common holding member **50**.
[0138] With the above-described configuration as well, power storage device **10**F according to the seventh embodiment can obtain substantially the same effect as that of power storage device **10** according to the first embodiment.
[0139] Although the embodiments of the present disclosure have been described, it should be understood that the 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 first power storage stack and a second power storage stack each including a plurality of power storage cells; a lower case having the first power storage stack and the second power storage stack disposed therein; a cross member extending along a predetermined direction and partitioning a region in the lower case; and an electrical connection member that electrically connects the first power storage stack and the second power storage stack, wherein when viewed in a vertical direction, the electrical connection member at least partially overlaps with the cross member and extends along an extension direction of the cross member.
2. The power storage device according to claim 1, wherein in a direction orthogonal to the extension direction, a width of a portion of the electrical connection member overlapping with the cross member and extending along the extension direction of the cross member is shorter than a width of the cross member.
3. The power storage device according to claim 1, wherein in the extension direction, a length of a portion of the electrical connection member overlapping with the cross member and extending along the extension direction of the cross member is shorter than a length of the cross member.
4. The power storage device according to claim 1, wherein the cross member is disposed between the first power storage stack and the second power storage stack, and a portion of the electrical connection member overlapping with the cross member and extending along the extension direction of the cross member is disposed between the first power storage stack and the second power storage stack.
5. The power storage device according to claim 1, further comprising a holding member fixed to the cross member to extend upward in the vertical direction from the cross member, wherein the holding member holds a portion of the electrical connection member overlapping with the cross member and extending along the extension direction of the cross member, and the holding member protrudes more upward in the vertical direction than the first power storage stack and the second power storage stack.
6. The power storage device according to claim 5, wherein the holding member includes an insertion portion into which the portion of the electrical connection member overlapping with the cross member and extending along the extension direction of the cross member is inserted.
7. The power storage device according to claim 6, wherein the holding member includes a projection on a surface that defines the insertion portion.
8. The power storage device according to claim 5, comprising a cover member that covers the first power storage stack and the second power storage stack from an upper side in the vertical direction, wherein the holding member is in contact with the cover member.
9. A vehicle comprising: the power storage device as recited in claim **8**; and a vehicle frame member.
10. The vehicle according to claim 9, comprising a buffer member disposed in a gap between the cover member and the vehicle frame member, wherein the buffer member is disposed above the holding member.
11. The vehicle according to claim 9, comprising a protection cover that covers a part of the cover member from an upper side of the cover member such that a space is formed between the protection cover and the cover member, wherein the protection cover includes a pair of side wall portions spaced apart from each other in the extension direction of the cross member, and the holding member is disposed below a lower surface of each of the pair of side wall portions.