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BATTERY PACK

Abstract

According to an embodiment of the present invention, a battery pack may include a housing with a plate part and side walls, first to third battery cell assemblies arranged on the plate part in a first direction parallel to an upper surface of the plate part and each including a cell stack with a plurality of battery cells, a first cross-beam, and a second cross-beam spaced apart from the first cross-beam with the cell stack interposed therebetween, and a reinforcement band coupled to the first cross-beam of the first battery module and the second cross-beam of the third battery module. Further, the first cross-beam and the second cross-beam have different shapes.

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Background/Summary

TECHNICAL FIELD

[0001] The present invention relates to a battery pack. The present application claims the benefit of priority based on Korean Patent Application No. 10-2022-0166597, filed on Dec. 2, 2022 and Korean Patent Application No. 10-2023-0035257, filed on Mar. 17, 2023, and the entire contents of the Korean patent applications are incorporated herein by reference.

BACKGROUND ART

[0002] A secondary battery can be charged and discharged a plurality of times unlike a primary battery. Secondary batteries have been widely used as energy sources for various types of wireless devices such as handsets, laptop computers, and cordless vacuum cleaners. Recently, a main use of secondary batteries is moving from mobile devices to mobility, as manufacturing costs per unit capacity of secondary batteries drastically decrease due to improved energy density and economies of scale and a range of battery electric vehicles (BEVs) increases to the same level as fuel vehicles.

[0003] When a secondary battery is repeatedly charged and discharged, a swelling phenomenon that a case of the secondary battery swells occurs due to a chemical reaction of materials inside the secondary battery. The swelling phenomenon is particularly noticeable in pouch type battery cells with relatively low rigidity. Swelling causes a change in physical and chemical properties of pouch type battery cells and thus research is being conducted on various technologies for controlling swelling.

DISCLOSURE

Technical Problem

[0004] The present invention is directed to providing a battery pack with improved reliability.

Technical Solution

[0005] To address the above problem, example embodiments of the present invention may include a battery pack. The battery pack may include a housing having a plate part and side walls, first to third battery cell assemblies arranged on the plate part in a first direction parallel to an upper surface of the plate part and each including a cell stack with a plurality of battery cells, a first cross-beam, and a second cross-beam spaced apart from the first cross-beam with the cell stack interposed therebetween, and a reinforcement band coupled to the first cross-beam of the first battery module and the second cross-beam of the third battery module, wherein the first cross-beam and the second cross-beam have different shapes.

[0006] The reinforcement band may extend in the first direction.

[0007] The battery pack may further include a plurality of reinforcement bands.

[0008] The reinforcement band may be disposed on the first and second battery cell assemblies.

[0009] The battery pack may further include a plurality of fastening members configured to pass through the reinforcement band, and configured to fix the first cross-beam of the first battery module and the second cross-beam of the third battery module to the plate part of the housing.

[0010] The battery pack may further include a plurality of fastening members configured to pass through the reinforcement band, and configured to fix the second cross-beam of the first battery module and the first cross-beam of the second battery module to the plate part of the housing.

[0011] Example embodiments of the present invention may include a battery pack. The battery

pack may include a housing with a plate part and side walls, first to third battery cell assemblies arranged on the plate part in a first direction parallel to an upper surface of the plate part and each including a cell stack with a plurality of battery cells, a first cross-beam, and a second cross-beam spaced apart from the first cross-beam with the cell stack interposed therebetween, and a first reinforcement band coupled to the first cross-beam of the first battery module, the second cross-beam of the first battery module, and the first cross-beam of the second battery module.

[0012] The battery pack may further include a plurality of fastening members configured to pass through the first reinforcement band, and configured to fix the first cross-beam of the first battery module, the second cross-beam of the first battery module, and the first cross-beam of the second battery module to the plate part of the housing.

[0013] The first reinforcement band may be disposed on the first battery module.

[0014] The battery pack may further include a second reinforcement band coupled to the second cross-beam of the first battery module, the first cross-beam of the second battery module, the second cross-beam of the second battery module, and the first cross-beam of the third battery module.

[0015] The battery pack may further include a plurality of fastening members configured to pass through the second reinforcement band, and configured to fix the second cross-beam of the first battery module, the first cross-beam of the second battery module, the second cross-beam of the second battery module, and the first cross-beam of the third battery module to the plate part of the housing.

[0016] The battery pack may further include a third reinforcement band coupled to the second cross-beam of the second battery module, the first cross-beam of the third battery module, and the second cross-beam of the third battery module.

[0017] The battery pack may further include a plurality of fastening members configured to pass through the third reinforcement band, and configured to fix the second cross-beam of the second battery module, the first cross-beam of the third battery module, and the second cross-beam of the third battery module to the plate part of the housing.

Advantageous Effects

[0018] A battery pack according to example embodiments of the present invention includes one or more reinforcement bands coupled to a cross-beam of a battery cell assembly. Accordingly, swelling of a cell stack can be prevented and the reliability of the battery pack can be improved.

[0019] Effects achievable from example embodiments of the present invention are not limited to the above-described effects, and other effects that are not described herein will be clearly derived and understood by those of ordinary skilled in the art to which the example embodiments of the present invention pertain from the following description. That is, unintended effects achieved when the example embodiments of the present invention are implemented are derivable by those of ordinary skilled in the art from the example embodiments of the present invention.

Description

BRIEF DESCRIPTION OF THE DRAWINGS

[0020] FIG. **1** is a plan view of a battery pack according to example embodiments of the present invention.

[0021] FIG. **2** is a cross-sectional view taken along line **1**I-**1**I′ of FIG. **1**.

[0022] FIG. **3** is a plan view of a battery pack according to example embodiments of the present invention.

[0023] FIG. **4** is a cross-sectional view taken along line **3**I-**3**I′ of FIG. **3**.

[0024] FIG. **5** is a plan view of a battery pack according to example embodiments of the present invention.

[0025] FIG. **6** is a plan view of a battery pack according to example embodiments of the present invention.

BEST MODE

[0026] Hereinafter, embodiments of the present invention will be described in detail with reference to the accompanying drawings. Before describing embodiments of the present invention, the terms or expressions used in the present specification and claims should not be construed as being limited to as generally understood or as defined in commonly used dictionaries, and should be understood according to meanings and concepts matching corresponding to the present invention on the basis of the principle that the inventor(s) of the application can appropriately define the terms or expressions to optimally explain the present invention.

[0027] Therefore, embodiments of the present invention set forth herein and configurations illustrated in the drawings are only embodiments of the present invention and do not reflect all the technical ideas of the present invention and thus it should be understood that various equivalents and modifications that replace the configurations would have been made at the filing date of the present application.

[0028] Well-known configurations or functions related to describing the present invention are not described in detail when it is determined that they would obscure the subject matter of the present invention due to unnecessary detail.

[0029] Because embodiments of the present invention are provided to more fully explain the present invention to those of ordinary skill in the art, the shapes, sizes, etc. of components illustrated in the drawings may be exaggerated, omitted, or schematically illustrated for clarity. Therefore, it should not be understood that the sizes or proportions of components fully reflect the actual sizes or proportions thereof.

First Embodiment

[0030] FIG. **1** is a plan view of a battery pack **100** according to example embodiments of the present invention.

[0031] FIG. **2** is a cross-sectional view taken along line **1**I-II′ of FIG. **1**.

[0032] Referring to FIGS. **1** and **2**, the battery pack **100** may include a housing **110**, a plurality of battery cell assemblies **120**, a center beam **130**, a plurality of exhaust devices **140**, a plurality of reinforcement bands **150**, and a plurality of fastening members **160**. The battery pack **100** is a final form of a battery system mounted on a mobility or the like.

[0033] The housing **110** may provide a space for arranging the plurality of battery cell assemblies **120** therein. The housing **110** may include a plate part **111** and side walls **112**, **113**, **114**, and **115**.

[0034] The plate part **111** may include an upper surface **111**U and a lower surface **111**L that are substantially parallel to each other. The upper surface **111**U and the lower surface **111**L may be opposite to each other. Two directions substantially parallel to the upper surface **111**U of the plate part **111** are defined as an X-axis direction and a Y-axis direction, and a direction substantially perpendicular to the upper surface **111**U of the plate part **111** is defined as a Z-axis direction. The X-axis direction, the Y-axis direction, and the Z-axis direction may be substantially perpendicular to one another. Unless otherwise mentioned, the definition of directions will apply to the following drawings.

[0035] According to example embodiments of the present invention, the plate part **111** may include a plurality of plates welded together by friction stir welding. When the plate part **111** is formed by friction stir welding, the plate part **111** may include a boundary surface between different plates. According to example embodiments of the present invention, the plate part **111** may be configured as a single plate.

[0036] The plate part **111** may include a plurality of cooling channels that are flow paths of a cooling fluid. The plate part **111** may include a plurality of cavities for reducing the weight of the plate part **111**. Each of the plurality of cooling channels and the plurality of cavities may extend in the X-axis direction.

[0037] The side walls **112**, **113**, **114**, and **115** may be coupled to the plate part **111**. The side walls **112**, **113**, **114**, and **115** may extend in the Z-axis direction. The side walls **112**, **113**, **114**, and **115** may include empty spaces therein and thus the weight of the side walls **112**, **113**, **114**, and **115** may decrease.
[0038] The plurality of battery cell assemblies **120** may be disposed on the upper surface **111**U of the plate part **111**. The plate part **111** may support the plurality of battery cell assemblies **120**. The side walls **112**, **113**, **114**, and **115** may horizontally surround the plurality of battery cell assemblies **120**.
[0039] Each of the plurality of battery cell assemblies **120** may include a cell stack **121**, a first cross-beam **125***a*, and a second cross-beam **125***b*. The cell stack **121** may include a plurality of battery cells.
[0040] A battery cell is a basic unit of a lithium ion battery, i.e., a secondary battery. The battery cell includes an electrode assembly, an electrolyte, and a case. Battery cells are classified into a lithium ion battery, a lithium ion polymer battery, a lithium polymer battery, etc. according to a configuration of an electrode assembly and an electrolyte. A market share of lithium ion polymer batteries in the field of secondary battery is increasing due to a low possibility of leakage of an electrolyte and easiness in manufacturing.
[0041] A battery cell may be one of a cylindrical battery cell, a prismatic battery cell, and a pouch type battery cell. An electrode assembly of the cylindrical battery cell is embedded in a cylindrical metal can. An electrode assembly of the prismatic battery cell is embedded in a prismatic metal can. An electrode assembly of the pouch type battery cell is embedded in a pouch case including an aluminum laminate sheet.
[0042] An electrode assembly included in a battery case includes a positive electrode, a negative electrode, and a separator interposed between the positive electrode and the negative electrode. The electrode assembly may be classified as a jelly-roll type electrode assembly or a stack type electrode assembly according to a form of assembly. The jelly roll type electrode assembly is manufactured by winding a positive electrode, a negative electrode, and a separator interposed therebetween. The stack type electrode assembly includes a plurality of positive electrodes, a plurality of negative electrodes, and a plurality of separators interposed therebetween that are stacked sequentially.
[0043] According to example embodiments of the present invention, the plurality of battery cells of the cell stack **121** may be connected in series and/or in parallel. For example, the plurality of battery cells may be connected to each other in series. As another example, the plurality of battery cells may be connected to each other in parallel. As another example, the cell stack **121** may include a plurality of banks connected to each other in series and in parallel, and each of the plurality of banks may include a plurality of battery cells connected to each other in parallel.
[0044] According to example embodiments of the present invention, the cell stack **121** may further include a plurality of separators. The plurality of separators may horizontally support the plurality of battery cells to prevent swelling of the plurality of battery cells. According to embodiments of the present invention, the plurality of separators may be thermal barriers. According to example embodiments of the present invention, each of the plurality of separators may have a high melting temperature and a low thermal conductivity. According to example embodiments of the present invention, each of the plurality of separators may include a flame retardant material such as a ceramic and a coated glass material. According to example embodiments of the present invention, the plurality of separators may be configured to emit a fire retarding material and a fire extinguishing agent when a thermal runaway event occurs.
[0045] The first cross-beam **125***a* and the second cross-beam **125***b* of the plurality of battery cell assembly **120** may be spaced apart from each other with the cell stack **121** interposed therebetween. The first cross-beam **125***a* and the second cross-beam **125***b* may cover laterial sides of the cell stack **121**. The first cross-beam **125***a* and the second cross-beam **125***b* may be fixed to the cell

stack **121** by an adhesive material or the like.
[0046] The plurality of battery cell assemblies **120** may include a first battery cell assembly **120_1**, a second battery cell assembly **120_2**, and a third battery cell assembly **120_3**. The first to third battery cell assemblies **120_1**, **120_2**, and **120_3** may be arranged in the X-axis direction. The first to third battery cell assemblies **120_1**, **120_2**, and **120_3** may be arranged sequentially.
[0047] The first cross-beam **125***a* and the second cross-beam **125***b* may have different shapes. The first cross-beam **125***a* and the second cross-beam **125***b* may have complementary shapes.
[0048] The first cross-beam **125***a* of the first battery cell assembly **120_1** may be coupled to a support **116** on the plate part **111**. The plurality of fastening members **160** may pass through the reinforcement bands **150**, the first cross-beam **125***a*, and the support **116**. The plurality of fastening members **160** may include a mechanical coupling means such as a bolt or the like. The fastening members **160** may be coupled to the plate part **111**. Accordingly, the first cross-beam **125***a* and the first battery cell assembly **120_1** may be fixed to the plate part **111** of the housing **110**.
[0049] The second cross-beam **125***b* of the first battery cell assembly **120_1** may be coupled to the first cross-beam **125***a* of the second battery cell assembly **120-2**. The second cross-beam **125***b* of the first battery cell assembly **120_1** may be engaged with the first cross-beam **125***a* of the second battery cell assembly **120_2**. The second cross-beam **125***b* of the first battery cell assembly **120_1** and the first cross-beam **125***a* of the second battery cell assembly **120_2** may form a cross-beam assembly CBA.
[0050] The second cross-beam **125***b* of the second battery cell assembly **120_2** may be coupled to the first cross-beam **125***a* of the third battery cell assembly **120_3**. The second cross-beam **125***b* of the second battery cell assembly **120_2** may be engaged with the first cross-beam **125***a* of the third battery cell assembly **120_3**. The second cross-beam **125***b* of the second battery cell assembly **120_2** and the first cross-beam **125***a* of the third battery cell assembly **120_3** may form a cross-beam assembly CBA.
[0051] The plurality of fastening members **160** may be coupled to the plate part **111** of the housing **110** while passing through the reinforcement bands **150** and the second cross-beam **125***b* of the third battery cell assembly **120_3**. Accordingly, the reinforcement bands **150** and the second cross-beam **125***b* of the third battery cell assembly **120_3** may be fixed to the plate part **111** of the housing **110**.
[0052] The cross-beam assembly CBA may be interposed between adjacent cell stacks **121**. The cross-beam assembly CBA may extend in a direction perpendicular to the center beam **130** (i.e., the Y-axis direction). The cross-beam assembly CBA may isolate the cell stacks **121** in the X-axis direction.
[0053] According to example embodiments of the present invention, each of the reinforcement bands **150** may include an elastic material. According to other example embodiments of the present invention, each of the reinforcement bands **150** may include a soft material such as a metal. Each of the reinforcement bands **150** is coupled to the first cross-beam **125***a* of the first battery cell assembly **120_1** and the second cross-beam **125***b* of the third battery cell assembly **120_3** and thus swelling of battery cells of the cell stack **121** of each of the first to third battery cell assemblies **120_1**, **120_2**, and **120_3** may be prevented. FIG. **1** illustrates that two reinforcement bands **150** are disposed on the plurality of battery cell assemblies **120** but three or more reinforcement bands **150** may be disposed on each of the plurality of battery cell assemblies **120**.
[0054] The plurality of battery cell assemblies **120** may be arranged in the X-axis direction and the Y-axis direction. In FIG. **1**, the number of battery cell assemblies **120** arranged in the X-axis direction is three, and the number of battery cell assemblies **120** arranged in the Y-axis direction is two. Accordingly, an array of the plurality of battery cell assemblies **120** may be a 3×2 array. The plurality of battery cell assemblies **120** arranged in an array of M×N will be easily derived by those of ordinary skill in the art, based on the above description. Here, M and N are each an integer of 2 or more.

[0055] The center beam **130** may isolate elements disposed on the housing **110** from each other. Accordingly, the center beam **130** may prevent an undesired short circuit from occurring between the plurality of battery cell assemblies **120** while protecting the plurality of battery cell assemblies **120**.
[0056] The center beam **130** may extend between side walls **112**, **113**, **114**, and **115** facing each other. The center beam **130** may extend in the X-axis direction. The center beam **130** may be in contact with one of the side walls **112**, **113**, **114**, and **115**. The center beam **130** may isolate the plurality of battery cell assemblies **120** from each other. The center beam **130** may be interposed between the plurality of battery cell assemblies **120**.
[0057] The plurality of exhaust devices **140** may be coupled to the side wall **115**. At least a part of the side walls **112**, **113**, **114**, and **115** may include an exhaust path connected to the plurality of exhaust devices **140**. The plurality of exhaust devices **140** may be configured to delay thermal propagation by discharging a high-temperature gas from the inside of the battery pack **100** to the outside when at least one of the plurality of battery cell assemblies **120** is in a thermal runway state.
[0058] Here, the thermal runaway state of the plurality of battery cell assemblies **120** is a state in which a change of temperature of the plurality of battery cell assemblies **120** accelerates the change of temperature, i.e., an uncontrollable positive feedback. The temperature of the plurality of battery cell assemblies **120** that are in the thermal runaway state sharply increase, and a large amount of high-pressure gas and combustion debris are discharged.
[0059] The battery pack **100** may further include electronic components. The electronic components may be disposed on the housing **110**. The electronic components may be disposed between the side wall **112** on which the exhaust devices **140** are installed and the plurality of battery cell assemblies **120**. The electronic components may include an electronic device required to drive a battery pack.
[0060] The electronic components may include, for example, a battery management system (BMS). The BMS may be configured to monitor, balance, and control the battery pack. Monitoring of the battery pack **100** may include measuring voltages and currents of certain nodes inside the plurality of battery cell assemblies **120** and measuring temperatures at set positions in the battery pack **100**. The battery pack **100** may include measuring instruments for measuring voltages, currents, and temperatures as described above.
[0061] Balancing of the battery pack **100** is an operation of reducing a deviation between the plurality of battery cell assemblies **120**. Controlling of the battery pack **100** includes preventing overcharging, over-discharging, and overcurrent. Through monitoring, balancing, and controlling, the battery pack **100** may be operated under optimal conditions, thereby preventing the lifespan of each of the plurality of battery cell assemblies **120** from being shortened.
[0062] The electronic components may further include a cooling device, a power relay assembly (PRA), a safety plug, etc. The cooling device may include a cooling fan. The cooling fan may circulate air in the battery pack **100** to prevent overheating of each of the plurality of battery cell assemblies **120**. The PRA may be configured to supply or cut off power from a high-voltage battery to an external load (e.g., a motor of a vehicle). The PRA may cut off power supply to an external load (e.g., a motor of a vehicle) to protect the plurality of battery cell assemblies **120** and an external load (e.g., a motor of a vehicle), when abnormal voltage such as voltage surges occurs.
[0063] The battery pack **100** may further include a plurality of bus bars configured to electrically connect the plurality of battery cell assemblies **120**. The plurality of battery cell assemblies **120** may be connected in series by the plurality of bus bars. Accordingly, the battery pack **100** may be configured to output a high voltage to an external load (e.g., a motor of a vehicle).
[0064] The battery pack **100** may further include a lid plate coupled to the side walls **112**, **113**, **114**, and **115**. The lid plate may cover elements disposed inside the battery pack **100** such as the battery cell assemblies **120** and the electronic components. The lid plate may be fixed to the battery pack **100** by a mechanical coupling means, e.g., a bolt.

Second Embodiment

[0065] FIG. **3** is a plan view of a battery pack **101** according to example embodiments of the present invention.

[0066] FIG. **4** is a cross-sectional view taken along line **31**-**31**′ of FIG. **3**.

[0067] Referring to FIGS. **3** and **4**, the battery pack **101** may include a housing **110**, a plurality of battery cell assemblies **120**, a center beam **130**, a plurality of exhaust devices **140**, a plurality of reinforcement bands **150**, and a plurality of fastening members **160**.

[0068] The housing **110**, the plurality of battery cell assemblies **120**, the center beam **130**, the plurality of exhaust devices **140**, and the plurality of reinforcement bands **150** are substantially the same as those described above with reference to FIGS. **1** and **2**, and thus, a redundant descriptions thereof is omitted herein.

[0069] Some of the plurality of fastening members **160** may be coupled to a plate part **111** of the housing **110** while passing through the reinforcement bands **150** and a cross-beam assembly CBA. Some of the plurality of fastening members **160** may be fixed to the plate part **111** of the housing **110** while passing through the reinforcement bands **150**, a second cross-beam **125***b* of a first battery cell assembly **120_1**, and a first cross-beam **125***a* of a second battery cell assembly **120_2**. Some of the plurality of fastening members **160** may be fixed to the plate part **111** of the housing **110** while passing through the reinforcement bands **150**, a second cross-beam **125***b* of the second battery cell assembly **120_2**, and a first cross-beam **125***a* of a third battery cell assembly **120_3**.

[0070] According to example embodiments of the present invention, each of the reinforcement bands **150** may be fixed to each of the first and second cross-beams **125***a* and **125***b* through the plurality of fastening members **160**, thereby preventing swelling of battery cells of the plurality of battery cell assemblies **120**.

Third Embodiment

[0071] FIG. **5** is a plan view of a battery pack **102** according to example embodiments of the present invention.

[0072] Referring to FIG. **5**, the battery pack **102** may include a housing **110**, a plurality of battery cell assemblies **120**, a center beam **130**, a plurality of exhaust devices **140**, reinforcement bands **150**, and a plurality of fastening members **160**. The battery pack **102** of FIG. **5** is the same as the battery pack of FIG. **1** except that each of the plurality of battery cell assemblies **120** overlaps a reinforcement band **150**.

Fourth Embodiment

[0073] FIG. **6** is a plan view of a battery pack **103** according to example embodiments of the present invention.

[0074] Referring to FIG. **6**, the battery pack **103** may include a housing **110**, a plurality of battery cell assemblies **120**, a center beam **130**, a plurality of exhaust devices **140**, first to third reinforcement bands **151**, **152** and **153**, and a plurality of fastening members **160**.

[0075] The housing **110**, the plurality of battery cell assemblies **120**, the center beam **130**, and the plurality of exhaust devices **140***b* are substantially the same as those described above with reference to FIGS. **1** and **2**, and thus, a redundant descriptions thereof is omitted herein.

[0076] The first reinforcement bands **151** may overlap a first battery cell assembly **120_1**. The first reinforcement bands **151** may be coupled to first and second cross-beams **125***a* and **125***b* of the first battery cell assembly **120_1** and a first cross-beam **125***a* of a second battery cell assembly **120_2** by the plurality of fastening members **160**.

[0077] The second reinforcement bands **152** may overlap the second battery cell assembly **120_2**. The second reinforcement bands **152** may be coupled to the second cross-beam **125***b* of the first battery cell assembly **120_1**, the first and second cross-beams **125***a* and **125***b* of the second battery cell assembly **120_2**, and a first cross-beam **125***a* of a third battery cell assembly **120_3** by the plurality of fastening members **160**.

[0078] The third reinforcement bands **153** may overlap the third battery cell assembly **120_3**. The

third reinforcement bands **153** may be coupled to the second cross-beam **125***b* of the second battery cell assembly **120_2** and the first and second cross-beams **125***a* and **125***b* of the third battery cell assembly **120_3** by the plurality of fastening members **160**.
[0079] The second reinforcement bands **152** and the first reinforcement bands **151** may be arranged in a staggered form. The second reinforcement bands **152** may not overlap the first reinforcement bands **151** in the X-axis direction. The third reinforcement bands **132** and the second reinforcement bands **152** may be arranged in a staggered form. The third reinforcement bands **153** may not overlap the second reinforcement bands **152** in the X-axis direction. According to example embodiments of the present invention, each of the battery cell assemblies **120** is reinforced by one of the first to third reinforcement bands **151**, **152**, and **153** to prevent swelling of battery cells of the battery cell assemblies **120**.
[0080] The present invention has been described above in more detail with reference to the drawings, the embodiments, etc. However, the configurations illustrated in the drawings or embodiments described in the present specification are only embodiments of the present invention and do not reflect all the technical ideas of the present invention and thus it should be understood that various equivalents and modifications that replace the configurations would have been made at the filing date of the present application.

Claims

1. A battery pack comprising: a housing having a plate part and side walls; first to third battery cell assemblies arranged on the plate part in a first direction parallel to an upper surface of the plate part and each including a cell stack with a plurality of battery cells, a first cross-beam, and a second cross-beam spaced apart from the first cross-beam with the cell stack interposed therebetween; and a reinforcement band coupled to the first cross-beam of the first battery module and the second cross-beam of the third battery module, wherein the first cross-beam and the second cross-beam have different shapes.
2. The battery pack of claim 1, wherein the reinforcement band extends in the first direction.
3. The battery pack of claim 1, further comprising a plurality of reinforcement bands.
4. The battery pack of claim 1, wherein the reinforcement band is disposed on the first and second battery cell assemblies.
5. The battery pack of claim 1, further comprising a plurality of fastening members passing through the reinforcement band, and configured to fix the first cross-beam of the first battery module and the second cross-beam of the third battery module to the plate part of the housing.
6. The battery pack of claim 1, further comprising a plurality of fastening members passing through the reinforcement band, and configured to fix the second cross-beam of the first battery module and the first cross-beam of the second battery module to the plate part of the housing.
7. A battery pack comprising: a housing having a plate part and side walls; first to third battery cell assemblies arranged on the plate part in a first direction parallel to an upper surface of the plate part and each including a cell stack with a plurality of battery cells, a first cross-beam, and a second cross-beam spaced apart from the first cross-beam with the cell stack interposed therebetween; and a first reinforcement band coupled to the first cross-beam of the first battery module, the second cross-beam of the first battery module, and the first cross-beam of the second battery module.
8. The battery pack of claim 7, further comprising a plurality of fastening members passing through the first reinforcement band, and configured to fix the first cross-beam of the first battery module, the second cross-beam of the first battery module, and the first cross-beam of the second battery module to the plate part of the housing.
9. The battery pack of claim 7, wherein the first reinforcement band is disposed on the first battery module.
10. The battery pack of claim 7, further comprising a second reinforcement band coupled to the

second cross-beam of the first battery module, the first cross-beam of the second battery module, the second cross-beam of the second battery module, and the first cross-beam of the third battery module.

11. The battery pack of claim 10, further comprising a plurality of fastening members passing through the second reinforcement band, and configured to fix the second cross-beam of the first battery module, the first cross-beam of the second battery module, the second cross-beam of the second battery module, and the first cross-beam of the third battery module to the plate part of the housing.

12. The battery pack of claim 7, further comprising a third reinforcement band coupled to the second cross-beam of the second battery module, the first cross-beam of the third battery module, and the second cross-beam of the third battery module.

13. The battery pack of claim 12, further comprising a plurality of fastening members passing through the third reinforcement band, and configured to fix the second cross-beam of the second battery module, the first cross-beam of the third battery module, and the second cross-beam of the third battery module to the plate part of the housing.