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STRUCTURAL ASSEMBLY FOR BATTERY STRUCTURE OF ELECTRIC VEHICLE

Abstract

A structural assembly for a battery structure of a vehicle includes a lower wall and a pair of cross members. The lower wall is configured to support a cell stack. The pair of cross members are spaced apart from each other in a longitudinal direction of the vehicle. Each cross member provides lateral support for a respective side of the cell stack. Each cross member of the pair of cross members includes an outer wall, an inner wall spaced apart from the outer wall, and connecting members. The outer wall, the inner wall, and connecting members cooperate with each other to define an internal cavity.

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Background/Summary

CROSS-REFERENCE TO RELATED APPLICATION [0001] This application is a continuation of and claims the benefit of U.S. application Ser. No. 17/980,212, filed Nov. 3, 2022, and titled "STRUCTURAL ASSEMBLY FOR BATTERY STRUCTURE OF ELECTRIC VEHICLE," the content of which is incorporated herein by reference in its entirety.

FIELD
[0002] The present disclosure relates to a structural assembly for a battery structure of an electric vehicle.
BACKGROUND
[0003] The statements in this section merely provide background information related to the present disclosure and may not constitute prior art.
[0004] Electric vehicles differ from conventional motor vehicles because they are driven by one or more rechargeable battery packs having lithium-ion batteries, for example, or any other suitable electrical power storage units. The battery pack typically powers one or more motors to drive a set of wheels using battery arrays. In some electric vehicles, the battery arrays include a structural assembly that surrounds and cools cell stacks, especially for vehicles capable of traveling long distances (e.g., electric vehicles capable of traveling more than 500 miles). As some types of batteries age (e.g., pouch and prismatic battery cells), gas can be generated within the cells. This gas generation causes increasing internal stress. Additionally, battery packs can be subject to various vehicle loads during driving and other operational events.
[0005] The present disclosure addresses these and other issues related to battery arrays in electric vehicles.
SUMMARY
[0006] This section provides a general summary of the disclosure and is not a comprehensive disclosure of its full scope or all of its features.
[0007] In one form, the present disclosure provides a structural assembly for a battery structure of an electric vehicle. The structural assembly includes a first lower wall and a pair of first cross members. The first lower wall is configured to support a first cell stack. The pair of first cross members are spaced apart from each other in a longitudinal direction of the electric vehicle. Each first cross member provides lateral support for a respective side of the first cell stack. Each first cross member comprises an outer wall, an inner wall spaced apart from the outer wall, and connecting members. The outer wall, the inner wall, and connecting members cooperate with each other to define an internal cavity.
[0008] In variations of the structural assembly of the above paragraph, which can be implemented individually or in any combination: the inner wall of one first cross member of the pair of first cross members comprises internal stiffening members disposed within the internal cavity and extending toward the outer wall of the one first cross member; the outer wall of the one first cross member comprises internal stiffening members disposed within the internal cavity and extending toward the inner wall of the one first cross member; the internal stiffening members of the inner wall of the one first cross member are spaced apart from the internal stiffening members of the outer wall of the one first cross member; the internal stiffening members of the inner wall of the

one first cross member are spaced apart from the outer wall of the one first cross member, and the internal stiffening members of the outer wall of the one first cross member are spaced apart from the inner wall of the one first cross member; the connecting members of each first cross member comprises an upper connecting member and a lower connecting member, each of the upper and lower connecting members defining a channel that slidably receives a respective end of the inner wall of the first cross member; a lid covering the first cell stack and secured to the inner walls of the first cross members; the first cross members extend downwardly past the first lower wall and extend upwardly past the lid; the first lower wall is a cold plate, and wherein the cold plate is in a heat transfer relationship with the first cell stack; a second lower wall configured to support a second cell stack; a pair of second cross members spaced apart from each other in a longitudinal direction of the electric vehicle and secured to ends of the second lower wall, each second cross member providing lateral support for a respective side of the second cell stack and configured to extend substantially an entire width of a battery enclosure, one second cross member of the pair of second cross members is connected to one first cross member of the pair of first cross members; and the inner walls of the first cross members are secured to the first lower wall and slidable relative to the outer walls of the first cross members.

[0009] In another form, the present disclosure provides a structural assembly for a battery structure of an electric vehicle. The structural assembly includes a lower wall and a pair of cross members. The lower wall is configured to support a cell stack and is in a heat transfer relationship with the cell stack. The pair of cross members are spaced apart from each other in a longitudinal direction of the electric vehicle. Each cross member of the pair of cross members provides lateral support for a respective side of the cell stack and comprises an outer wall, an inner wall, an upper connecting member and a lower connecting member. The inner wall is spaced apart from the outer wall and secured to an end of the lower wall. The upper connecting member includes a pair of upper flanges that extend toward the lower connecting member and cooperate with each other to define an upper channel that receives an upper end of the inner wall. The lower connecting member includes a pair of lower flanges that extend toward the upper connecting member and cooperate with each other to define a lower channel that receives a lower end of the inner wall.

[0010] In yet another form, the present disclosure provides a battery structure of an electric vehicle. The battery structure includes a battery housing and a structural assembly disposed within the battery housing and configured to house a plurality of cell stacks. The structural assembly includes a plurality of lower walls and a plurality of cross members. Each lower wall is configured to support a respective cell stack of the plurality of cell stacks and is in a heat transfer relationship with the respective cell stack. The plurality of cross members are spaced apart from each other in a longitudinal direction of the electric vehicle. Each cross member of the plurality of cross members being positioned between a corresponding pair of cell stacks of the plurality of cell stacks. Each cross member of the plurality of cross members provides lateral support for a respective side of the corresponding pair of cell stacks and comprises a pair of outer walls, an intermediate wall, and connecting members. The connecting members of each cross member comprises an upper connecting member defining a pair of upper channels and a lower connecting member defining a pair of lower channels. Each upper channel of the pair of upper channels receives an upper end of a respective outer wall of the pair of outer walls. Each lower channel of the pair of lower channels receives a lower end of a respective outer wall of the pair of outer walls.

[0011] In variations of the battery structure of the above paragraph, the battery structure further includes a plurality of lids. Each lid covers a respective cell stack of the plurality of cell stacks.

[0012] Further areas of applicability will become apparent from the description provided herein. It should be understood that the description and specific examples are intended for purposes of illustration only and are not intended to limit the scope of the present disclosure.

Description

DRAWINGS

[0013] In order that the disclosure may be well understood, there will now be described various forms thereof, given by way of example, reference being made to the accompanying drawings, in which:

[0014] FIG. **1** is a schematic view of a vehicle including a battery housing assembly according to the principles of the present disclosure;

[0015] FIG. **2** is a schematic perspective view of the battery housing assembly of FIG. **1**;

[0016] FIG. **3** is another perspective view of the battery housing assembly of FIG. **1** with a lid of the battery housing assembly removed for clarity of illustration;

[0017] FIG. **4** is a cross-sectional view of a battery array of the battery housing assembly of FIG. **1**; and

[0018] FIG. **5** is a cross-sectional view of an alternate structural assembly that can be incorporated into the battery housing assembly of FIG. **1** according to the principles of the present disclosure.

[0019] The drawings described herein are for illustration purposes only and are not intended to limit the scope of the present disclosure in any way.

DETAILED DESCRIPTION

[0020] The following description is merely exemplary in nature and is not intended to limit the present disclosure, application, or uses. It should be understood that throughout the drawings, corresponding reference numerals indicate like or corresponding parts and features.

[0021] With reference to FIG. **1**, a vehicle **10** such as an electric vehicle is shown. In the example provided, the electric vehicle is a battery electric vehicle (BEV). In other examples, the electric vehicle may be a hybrid electric vehicle (HEV), a plug-in electric vehicle (PHEV), or a fuel cell vehicle, among others. The vehicle **10** includes a vehicle frame **12** and a battery structure or battery housing assembly **14**. The vehicle frame **12** is the main supporting structure of the vehicle **10**, to which various components are attached either directly or indirectly. The vehicle frame **12** includes opposed longitudinal rails **28***a*, **28***b*. The rails **28***a*, **28***b* are spaced apart from each other and may establish a length of the vehicle frame **12**. In the example illustrated, the vehicle **10** is a body on frame vehicle architecture, though other configurations can be used, such as a unibody architecture, for example.

[0022] The battery housing assembly **14** powers a rear motor (not shown) to drive rear wheels **20***a*, **20***b* of a set of rear wheels **20** via a rear axle and/or powers a front motor (not shown) to drive front wheels **24***a*, **24***b* of a set of front wheels **24** via a front axle.

[0023] With reference to FIGS. **2** and **3**, the battery housing assembly **14** includes a battery tray or housing **30** and one or more battery arrays **32** (FIG. **3**). The battery housing **30** is an enclosure which provides a structural surrounding and sealed compartment for the battery arrays **32** and other battery components such as cooling lines, support brackets, and wiring disposed therein or extending therethrough. The battery housing **30** may disposed at various locations of the vehicle **10** and is mounted to the vehicle frame **12**. In this way, the battery housing **30** is supported by the vehicle frame **12** and is remote from a passenger cabin (not shown) and cargo compartments (not shown) of the vehicle **10**, therefore, not occupying space that would otherwise be available for passengers or cargo. The battery housing **30** includes a cover or lid **34**, a body **36**, and a seal (not shown). The lid **34** may optionally be removably coupled to the body **36** via mechanical fasteners such as bolts or screws (not shown), for example. In this way, the lid **34** may be removed to service the battery arrays **32** disposed within the battery housing **30**.

[0024] The body **36** includes a plurality of side walls or panels **36***a* and a bottom wall or panel **36***b*. The side walls **36***a* may be manufactured via stamping, for example, and extend in a vertical direction Z. The side walls **36***a* define an outer boundary of the battery housing **30** and are secured

to each other via welding or an adhesive, for example. The bottom wall **36***b* supports the battery arrays **32** disposed within the battery housing **30** and is secured to lower portions of the side walls **36***a*. The seal is disposed around a periphery of the body **36** and is engaged with the body **36** and the lid **34**. In this way, fluids, debris and other materials are inhibited from entering into the battery housing **30**.

[0025] With additional reference to FIG. **4**, each battery array **32** may be rechargeable and may include one or more cell stacks **39** formed by battery cells **40** (e.g., lithium-ion batteries such as those in which the cell components are enclosed in an aluminum-coated plastic film, or any other suitable electrical power storage units). In the example illustrated, the cell stacks **39** are formed by battery cells **40** arranged in a side-by-side configuration. In some forms, the cell stacks may be formed by battery cells stacked on each other in a vertical arrangement. Each battery array **32** comprises a structural assembly **42** surrounding and supporting the cell stack **39**. In some forms, the battery arrays **32** are in fluid communication with each other via connecting lines (not shown). In this way, fluid such as glycol, for example, is allowed to flow through the structural assembly **42** of each battery array **32**, thereby cooling the battery cells **40**.

[0026] Each structural assembly **42** is in the form of a modular structure that can be installed within and removed from the battery housing **30**. Each structural assembly **42** also spans substantially an entire width of the battery housing **30** and is configured to transfer loads from one side of the battery housing **30** to an opposite side of the battery housing **30**, for example, during certain abrupt lateral loads. Stated differently, each modular structural assembly **42** is configured to house the battery cells **40** and transfer loads away from the battery cells **40** during certain lateral loading use cases.

[0027] Each structural assembly **42** may be removably coupled to the battery housing **30** and includes a cold plate **44**, a lid **48** and a pair of cross members **50**. In the example illustrated, the cold plate **44** is manufactured via a stamping process, for example, and is made of a metal material. In some forms, the cold plate **44** may be manufactured via other manufacturing processes such as an extrusion process, for example. In the example illustrated, the cold plate **44** is a lower wall configured to support the cell stack **39** and in a heat transfer relationship with the cell stack **39**. In some forms, the cold plate **44** may be a wall supporting a respective side of the cell stack **39** or a wall covering a top of the cell stack **39**. In one example, an upper surface of the cold plate **44** contacts a lower end of the cell stack **39** such that heat generated by the cell stack **39** is transferred to the cold plate **44**. As used herein, the term “heat transfer relationship” should be construed to mean an arrangement in which heat from the cell stack **39** is directly or indirectly transferred to one or more cold plates of the structural assembly **42** via thermal conduction. In the example illustrated, the cold plate **44** is also secured to the pair of cross members **50**. The cold plate **44** has a uniform thickness and includes a support portion **44***a* and a pair of flanges **44***b*. The support portion **44***a* extends in a horizontal direction and supports the cell stack **39**. Each flange **44***b* extends downward in a vertical direction from a respective end of the support portion **44***a* and is secured to a respective cross member **50** of the pair of cross members **50** (i.e., each flange **44***b* extends perpendicular from the support portion **44***a*). In the example illustrated, each flange **44***b* is secured to the respective cross member **50** by welding. In some forms, each flange **44***b* may be secured to the respective cross member **50** by mechanical fasteners (not shown) such as rivets, screws, or bolts, for example.

[0028] The lid **48** is made of a metal material and covers the cell stack **39**. The lid **48** has a solid structure and includes a uniform thickness that is less than a thickness of the cross members **50**. The lid **48** is secured to the pair of cross members **50** and is disposed between the pair cross members **50**. In the example illustrated, the lid **48** is welded to the pair of cross members **50**. In some forms, the lid **48** may be secured to the pair of cross members **50** by mechanical fasteners (not shown) such as rivets, screws, or bolts, example. The lid **48** extends in a horizontal direction and covers a top of the cell stack **39**. In the example illustrated, the cross members **50** extend

upward past the lid **48**. Stated differently, the lid **48** is secured to the cross member **50** at a location below an uppermost end of the cross members **50**.

[0029] The pair of cross members **50** are spaced apart from each other in the longitudinal direction of the vehicle **10** and extends in a transverse direction relative to the longitudinal direction of the vehicle **10**. Each cross member **50** supports a respective side of the cell stack **39** and is made of a metal material such as aluminum, for example. In the example illustrated, each cross member **50** extends downward past the cold plate **44**.

[0030] Each cross member **50** includes an outer wall **60**, an inner wall **62**, connecting members **64***a*, **64***b*, and a plurality of internal stiffening members **66***a*, **66***b*. The outer wall **60** extends in a vertical direction and defines an outer boundary of the battery array **32**. The inner wall **62** is spaced apart from the outer wall **60** and extends in a vertical direction. In the example illustrated, the inner walls **62** of the pair of cross members **50** are secured to the lid **48** and the cold plate **44** to define a container that the cell stack **39** is disposed in. In the example illustrated, the cold plate **44** is secured to the inner walls **62** of the pair of cross members **50** at a location above the connecting members **64***b* and the lid **48** is secured to the inner walls **62** of the pair of cross members **50** at a location below the connecting members **64***a*. In the example illustrated, the inner wall **62** of each cross member **50** is a single component that extends substantially an entire width of the battery structure **14**. In some configurations, the inner wall **62** of each cross member **50** is made of two or more adjacent components that together extend substantially an entire width of the battery structure **14**. In some forms of the above configuration, the two or more adjacent components of the inner wall **62** of each cross member **50** may be separate (distinct) from each other. In other forms of the above configuration, the two or more adjacent components of the inner wall **62** of each cross member **50** may be joined to each other by welding, adhesives, fasteners, or any other suitable attachment means.

[0031] The connecting member **64***a* connects the upper section of the inner wall **62** with an upper section of the outer wall **60**. The connecting member **64***a* includes a body portion **65***a*, an outer flange portion **65***b*, and an inner flange portion **65***c*. The body portion **65***a* extends in a horizontal from the outer wall **60** of a respective cross member **50** past the inner wall **62** of the respective cross member **50**. The outer flange portion **65***b* extends downward in a vertical direction from an end of the body portion **65***a*. The outer flange portion **65***b* is also located above and is spaced apart from a respective end of the lid **48**. The inner flange portion **65***c* extends downward in a vertical direction from the body portion **65***a* and is located between the outer wall **60** and the outer flange portion **65***b*. In the example illustrated, the inner flange portion **65***c* is adjacent the outer flange portion **65***b* (i.e., the inner flange portion **65***c* is closer toward the outer flange portion **65***b* than the outer wall **60**) such that the inner flange portion **65***c* and the outer flange portion **65***b* define a channel **67** that an upper end of the inner wall **62** is slidably received in. The inner flange portion **65***c* also extends downward past the outer flange portion **65***b*.

[0032] The connecting member **64***b* connects the lower section of the inner wall **62** with a lower section of the outer wall **60**. The connecting member **64***b* includes a body portion **69***a*, an outer flange portion **69***b*, and an inner flange portion **69***c*. The body portion **69***a* extends in a horizontal from the outer wall **60** of a respective cross member **50** past the inner wall **62** of the respective cross member **50**. The outer flange portion **69***b* extends upward in a vertical direction from an end of the body portion **69***a*. The outer flange portion **69***b* is also located below a respective flange **44***b* of the cold plate **44**. The outer flange portion **69***b* is spaced apart from the respective flange **44***b* of the cold plate **44**. The inner flange portion **69***c* extends upward in a vertical direction from the body portion **69***a* and is located between the outer wall **60** and the outer flange portion **69***b*. In the example illustrated, the inner flange portion **69***c* is adjacent the outer flange portion **69***b* such that the inner flange portion **69***c* and the outer flange portion **69***b* define a channel **71** that a lower end of the inner wall **62** is slidably received in (i.e., the inner flange portion **69***c* is closer toward the outer flange portion **69***b* than the outer wall **60**). The inner flange portion **69***c* also extends upward

past the outer flange portion **69***b*. The inner walls **62** of the pair cross members **50**, the cold plate **44**, and the lid **48** are secured to each other to define a container that houses the cell stack **39** and is slidable relative to the outer walls **60** of the pair of cross members **50**.
[0033] The outer wall **60**, the inner wall **62** and the connecting members **64***a*, **64***b* cooperate to define an internal cavity **80**. The internal stiffening members **66***a* are disposed within the internal cavity **80** and extend in a horizontal direction from the outer wall **60** toward the inner wall **62**. In the example illustrated, the internal stiffening members **66***a* are spaced apart from each other in a vertical direction and are spaced apart from the inner wall **62** of the cross member **50**. The internal stiffening members **66***b* are disposed within the internal cavity **80** and extend in a horizontal direction from the inner wall **62** toward the outer wall **60**. In the example illustrated, the internal stiffening members **66***b* are spaced apart from each other in a vertical direction and are spaced apart from the outer wall **60** of the cross member **50**. In this way, sliding of the inner walls **62** of the cross members **50** relative to the outer walls **60** of the cross members **50** are facilitated. In the example illustrated, the internal stiffening members **66***a* and the internal stiffening members **66***b* are arranged in an alternating configuration.
[0034] As shown in FIG. **3**, a first end wall **82** is oriented vertically and is secured to the structural assembly **42**. In one example, the first end wall **82** is secured to one or both of the pair of cross members **50**, the lid **48** and/or the cold plate **44**. The first end wall **82** covers and supports a first end of the cell stack **39** (FIG. **4**). Similarly, a second end wall **84** that is opposite the first end wall **82** is oriented vertically and is secured to the structural assembly **42**. In one example, the second end wall **84** is secured to one or both of the pair of cross members **50**, the lid **48** and/or the cold plate **44**. The second end wall **84** covers and supports a second end of the cell stack **39** (FIG. **4**) that is opposite the first end of the cell stack **39** (FIG. **4**). The end walls **82**, **84** are secured to the structural assembly **42** such that the end walls **82**, **84** and the structural assembly **42** cooperate to form a structural surrounding and sealed compartment for the cell stack **39** (FIG. **4**). In one example, the first and second end walls **82**, **84** are secured to gussets (not shown), which are, in turn, secured to the battery housing **30**.
[0035] The structural assembly **42** of the present disclosure provides multiple functions such as load paths, heat transfer, and fluid flow paths. In one example, the cross members **50** of each structural assembly **42** are configured to house the battery cells **40** and transfer loads across the battery housing **30** away from the battery cells **40** during certain lateral loading vehicle events. In some forms, the structural assembly **42** may be additively manufactured in which one or more walls include an internal lattice structure to provide fluid flow paths for cooling fluid flowing through the structural assembly **42**.
[0036] With reference to FIG. **5**, a structural assembly **142** is illustrated. The structural assembly **142** may be incorporated into the battery housing assembly **14** described above, instead of, the structural assembly **42**. The structure and function of the structural assembly **142** may be similar or identical to the structural assembly **42** described above, apart for any differences noted below.
[0037] The structural assembly **142** surrounds and supports a plurality cell stacks **139**. The structural assembly **142** includes a plurality of cold plates **144**, a plurality of lids **148**, and a plurality of cross members **150**.
[0038] The structure and function of the cold plates **144** and the lids **148** may be similar or identical to that of the cold plate **44** and the lid **48**, respectively, described above, and therefore, will not be described again in detail.
[0039] Each cross member **150** is disposed between two adjacent cell stacks **139** and supports a respective side of the two cell stacks **139**. Each cross member **150** includes a pair of outer walls **160**, an intermediate wall **162**, connecting members **164***a*, **164***b*, and a plurality of internal stiffening members **166**. Each outer wall **160** is spaced apart from the intermediate wall **162** and extends in a vertical direction. In the example illustrated, each outer wall **160** is secured to a respective lid **148** and a respective cold plate **144** to define a container that a respective cell stack

139 is disposed in. Each outer wall **160** is also slidable relative to the intermediate wall **162** and the connecting members **164***a*, **164***b*. The intermediate wall **162** extends in a vertical direction and is disposed between the pair of outer walls **160**. The intermediate wall **162** also extends from the connecting member **164***a* to the connecting member **164***b*.

[0040] The connecting member **164***a* connects the upper section of the intermediate wall **162** with upper sections of the outer walls **160**. The connecting member **164***a* includes a body portion **165***a*, a pair of outer flange portions **165***b*, and a pair of inner flange portions **165***c*. Each outer flange portion **165***b* extends downward in a vertical direction from a respective end of the body portion **165***a*. Each outer flange portion **165***b* is also located above and is spaced apart from a respective end of the lid **148**. Each inner flange portion **165***c* extends downward in a vertical direction from the body portion **165***a* and is located between the intermediate wall **162** and a respective outer flange portion **165***b*. In the example illustrated, the inner flange portion **165***c* is adjacent the respective outer flange portion **165***b* such that the inner flange portion **165***c* and the respective outer flange portion **165***b* define a channel **167** that an upper end of a respective outer wall **162** is slidably received in. The inner flange portion **165***c* also extends downward past the respective outer flange portion **165***b*.

[0041] The connecting member **164***b* connects the lower section of the intermediate wall **162** with lower sections of the outer walls **160**. The connecting member **164***b* includes a body portion **169***a*, a pair of outer flange portions **169***b*, and a pair of inner flange portions **169***c*. Each outer flange portion **169***b* extends upward in a vertical direction from a respective end of the body portion **169***a*. Each outer flange portion **169***b* is also located below and is spaced apart from a respective end of the cold plate **144**. Each inner flange portion **169***c* extends upward in a vertical direction from the body portion **169***a* and is located between the intermediate wall **162** and a respective outer flange portion **169***b*. In the example illustrated, the inner flange portion **169***c* is adjacent the respective outer flange portion **169***b* such that the inner flange portion **169***c* and the respective outer flange portion **169***b* define a channel **171** that a lower end of a respective outer wall **162** is slidably received in. The inner flange portion **169***c* also extends upward past the respective outer flange portion **169***b*.

[0042] The outer walls **160**, the intermediate wall **162** and the connecting members **164***a*, **164***b* cooperate to define an internal cavity **180**. The internal stiffening members **166** are disposed within the internal cavity **180** and extend in a horizontal direction. That is, a plurality of the internal stiffening members **166** extend from the intermediate wall **162** toward one outer wall **160** of the pair of outer walls **160** and a plurality of the internal stiffening members **166** extend from the intermediate wall **162** toward the other outer wall **160** of the pair of outer walls **160**. In the example illustrated, the internal stiffening members **166** are spaced apart from the outer walls **162** of the cross member **150**. In this way, sliding of the outer walls **160** of the cross members **150** relative to the intermediate walls **162** of the cross members **150** is facilitated.

[0043] Unless otherwise expressly indicated herein, all numerical values indicating mechanical/thermal properties, compositional percentages, dimensions and/or tolerances, or other characteristics are to be understood as modified by the word “about” or “approximately” in describing the scope of the present disclosure. This modification is desired for various reasons including industrial practice, material, manufacturing, and assembly tolerances, and testing capability.

[0044] As used herein, the phrase at least one of A, B, and C should be construed to mean a logical (A OR B OR C), using a non-exclusive logical OR, and should not be construed to mean “at least one of A, at least one of B, and at least one of C.”

[0045] The description of the disclosure is merely exemplary in nature and, thus, variations that do not depart from the substance of the disclosure are intended to be within the scope of the disclosure. Such variations are not to be regarded as a departure from the spirit and scope of the disclosure.

Claims

1. A structural assembly for a battery structure of an electric vehicle, the structural assembly comprising: a first lower wall configured to support a first cell stack; and a pair of first cross members spaced apart from each other in a longitudinal direction of the electric vehicle, each first cross member providing lateral support for a respective side of the first cell stack, wherein each first cross member comprises an outer wall, an inner wall spaced apart from the outer wall, and connecting members, the outer wall, the inner wall, and connecting members cooperate with each other to define an internal cavity.
2. The structural assembly of claim 1, wherein the inner wall of one first cross member of the pair of first cross members comprises internal stiffening members disposed within the internal cavity and extending toward the outer wall of the one first cross member.
3. The structural assembly of claim 2, wherein the outer wall of the one first cross member comprises internal stiffening members disposed within the internal cavity and extending toward the inner wall of the one first cross member.
4. The structural assembly of claim 3, wherein the internal stiffening members of the inner wall of the one first cross member are spaced apart from the internal stiffening members of the outer wall of the one first cross member.
5. The structural assembly of claim 1, wherein the inner walls of the first cross members are secured to the first lower wall.
6. The structural assembly of claim 1, wherein the inner walls of the first cross members are slidable relative to the outer walls of the first cross members
7. The structural assembly of claim 1, wherein the connecting members of each first cross member comprises an upper connecting member and a lower connecting member, each of the upper and lower connecting members defining a channel that slidably receives a respective end of the inner wall of the first cross member.
8. The structural assembly of claim 1, further comprising a battery enclosure housing the structural assembly, each first cross member extend substantially an entire width of the battery enclosure.
9. The structural assembly of claim 1, wherein the first lower wall is a cold plate, and wherein the cold plate is in a heat transfer relationship with the first cell stack.
10. The structural assembly of claim 1, further comprising: a second lower wall configured to support a second cell stack; and a pair of second cross members spaced apart from each other in a longitudinal direction of the electric vehicle and secured to ends of the second lower wall, each second cross member providing lateral support for a respective side of the second cell stack and configured to extend substantially an entire width of a battery enclosure, wherein one second cross member of the pair of second cross members is connected to one first cross member of the pair of first cross members.
11. A structural assembly for a battery structure of an electric vehicle, the structural assembly comprising: a lower wall configured to support a cell stack and in a heat transfer relationship with the cell stack; and a pair of cross members spaced apart from each other in a longitudinal direction of the electric vehicle, each cross member of the pair of cross members providing lateral support for a respective side of the cell stack and comprising an outer wall, an inner wall, an upper connecting member and a lower connecting member, the inner wall spaced apart from the outer wall and secured to an end of the lower wall, the upper connecting member includes a pair of upper flanges that extend toward the lower connecting member and cooperate with each other to define an upper channel that receives an upper end of the inner wall, the lower connecting member includes a pair of lower flanges that extend toward the upper connecting member and cooperate with each other to define a lower channel that receives a lower end of the inner wall.
12. The structural assembly of claim 11, wherein the inner wall of a respective cross member

comprises internal stiffening members extending toward the outer wall of the respective cross member.

13. The structural assembly of claim 12, wherein the outer wall of the respective cross member comprises internal stiffening members extending toward the inner wall of the respective cross member.

14. The structural assembly of claim 13, wherein the internal stiffening members of the inner wall are spaced apart from the internal stiffening members of the outer wall.

15. The structural assembly of claim 11, wherein the outer wall of the respective cross member comprises internal stiffening members extending toward the inner wall of the respective cross member.

16. The structural assembly of claim 11, further comprising a lid covering the cell stack and secured to the inner walls of the pair of cross members.

17. The structural assembly of claim 16, wherein the lid and the lower wall are secured to the inner walls of the pair of cross members to form a unitized structure that houses the cell stack.

18. The structural assembly of claim 16, wherein the inner wall of each cross member of the pair of cross members extends downwardly past the lower wall and extends upwardly past the lid.

19. A battery structure for an electric vehicle, the battery structure comprising: a battery housing; and a structural assembly disposed within the battery housing and configured to house a plurality of cell stacks, the structural assembly comprising: a plurality of lower walls, each lower wall configured to support a respective cell stack of the plurality of cell stacks and in a heat transfer relationship with the respective cell stack; and a plurality cross members spaced apart from each other in a longitudinal direction of the electric vehicle, each cross member of the plurality of cross members being positioned between a corresponding pair of cell stacks of the plurality of cell stacks, each cross member of the plurality of cross members providing lateral support for a respective side of the corresponding pair of cell stacks and comprising a pair of outer walls, an intermediate wall, and connecting members, wherein the connecting members of each cross member comprises an upper connecting member defining a pair of upper channels and a lower connecting member defining a pair of lower channels, each upper channel of the pair of upper channels receiving an upper end of a respective outer wall of the pair of outer walls, each lower channel of the pair of lower channels receiving a lower end of a respective outer wall of the pair of outer walls.

20. The battery structure of claim 19, further comprising a plurality of lids, each lid covering a respective cell stack of the plurality of cell stacks.