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Cell carrier and vent tray arrangement for a high-voltage battery

Abstract

A cell carrier and vent tray arrangement for high-voltage batteries includes a cell vent tray having a vent tray body having first and second tray ribs extending outward from a top surface of the vent tray body, wherein the tray ribs run along a longitudinal direction and include one or more notches formed in one or both of the tray ribs, and a cell carrier having a carrier body with a plurality of vent holes formed therethrough and a carrier rib extending outward from a bottom surface of the carrier body, wherein the carrier rib runs along the longitudinal direction and includes one or more cross-members extending in the transverse direction. The cell vent tray and cell carrier are configured for engagement with each other in an assembled configuration with the carrier rib being disposed between the first and second tray ribs and the cross-members being seated within the notches.

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Background/Summary

INTRODUCTION

(1) This disclosure relates generally to cell carrier and vent tray arrangements for high-voltage batteries.

(2) In the assembly of high-voltage batteries, it is customary practice to include a cell carrier and a cell vent tray to support and ventilate the battery cells. Ordinarily, the cell carrier and cell vent tray may be made entirely out of metal (e.g., aluminum), or they may be made of reinforced composites and polymers but with certain connection points made of metal, with the cell carrier and cell vent tray attached to each other at these connection points. However, it would be desirable to provide a cell carrier and a cell vent tray which offers increased design flexibility, such as providing the ability to avoid the use of metal connection points, reduce overall weight, etc.

SUMMARY

(3) According to one embodiment, a cell carrier and vent tray arrangement for a high-voltage battery includes a cell vent tray and a cell carrier. The cell vent tray has a generally planar vent tray body defining a longitudinal direction and a transverse direction perpendicular to the longitudinal direction, and further has first and second tray ribs extending outward from a top surface of the vent tray body. The first and second tray ribs run along the longitudinal direction and include one or more notches formed in one or both of the tray ribs. The cell carrier has a generally planar carrier body with a plurality of vent holes formed therethrough and a carrier rib extending outward from a bottom surface of the carrier body. The carrier rib runs along the longitudinal direction and includes one or more cross-members extending in the transverse direction. The cell vent tray and cell carrier are configured for engagement with each other in an assembled configuration with the carrier rib being disposed between the first and second tray ribs and the one or more cross-members

being seated within the one or more notches.
(4) The one or more notches and the one or more cross-members may be configured for engagement with each other to form one or more mortise and tenon joints. The first and second tray ribs may extend a first height outward from the top surface of the vent tray body and the carrier rib may extend a second height outward from the bottom surface of the carrier body. The first and second heights may be approximately equal to each other, or the first height may be greater than the second height. The one or more cross-members may extend from the bottom surface of the carrier body to a third height that is less than the second height.
(5) The one or more notches may include a first notch in the first tray rib and a second notch in the second tray rib, and the one or more cross-members may include a first cross-member and a second cross-member, wherein the first and second notches may be transversely aligned with each other and the first and second cross-members may be transversely aligned with each other. In the assembled configuration, the cell vent tray and the cell carrier may be precluded from relative movement with respect to each other in the longitudinal direction.
(6) The cell vent tray may include a third tray rib extending outward from the top surface of the vent tray body and running along the longitudinal direction. In this configuration, one or more of the first, second and third tray ribs may include one or more weepage slots formed therein. This configuration may further include an adhesive interposed between the first, second and/or third tray rib and the bottom surface of the carrier body.
(7) According to another embodiment, a cell carrier and vent tray arrangement for a high-voltage battery includes: (i) a cell vent tray having a generally planar vent tray body defining a longitudinal direction and a transverse direction perpendicular to the longitudinal direction and further having first and second tray ribs extending outward from a top surface of the vent tray body, wherein the tray ribs run along the longitudinal direction and include a first notch in the first tray rib and a second notch in the second tray rib, wherein the first and second notches are transversely aligned with each other; and (ii) a cell carrier having a generally planar carrier body with a plurality of vent holes formed therethrough and a carrier rib extending outward from a bottom surface of the carrier body, wherein the carrier rib runs along the longitudinal direction and includes a first cross-member and a second cross-member extending in the transverse direction and being transversely aligned with each other. The cell vent tray and cell carrier are configured for engagement with each other in an assembled configuration with the carrier rib being disposed between the first and second tray ribs and the first and second cross-members being seated within the first and second notches, respectively. In the assembled configuration, the cell vent tray and the cell carrier are precluded from relative movement with respect to each other in the longitudinal direction.
(8) The first and second tray ribs may extend a first height outward from the top surface of the vent tray body and the carrier rib may extend a second height outward from the bottom surface of the carrier body. The first and second heights may be approximately equal to each other, or the first height may be greater than the second height. The cell vent tray may include a third tray rib extending outward from the top surface of the vent tray body and running along the longitudinal direction, and one or more of the first, second and third tray ribs may include one or more weepage slots formed therein. The arrangement may further include an adhesive interposed between the first, second and/or third tray rib and the bottom surface of the carrier body.
(9) According to yet another embodiment, a cell carrying and venting arrangement for high-voltage batteries includes a cell vent tray and a cell carrier. The cell vent tray has a generally planar vent tray body defining a longitudinal direction and a transverse direction perpendicular to the longitudinal direction and further has a first plurality of tray ribs arranged in pairs and extending outward from a top surface of the vent tray body, wherein the tray ribs run along the longitudinal direction and include one or more notches formed in one or both of the tray ribs of each pair. The cell carrier has a generally planar carrier body with a plurality of vent holes formed therethrough and a second plurality of carrier ribs arranged in singles and extending outward from a bottom

surface of the carrier body, wherein the carrier ribs run along the longitudinal direction and wherein each carrier rib includes one or more cross-members extending in the transverse direction. The cell vent tray and cell carrier are configured for engagement with each other in an assembled configuration with each of the carrier ribs being disposed between a respective pair of the tray ribs and each of the one or more cross-members being seated within a respective one of the one or more notches.

(10) The one or more notches may include a respective first notch formed in a first of the tray ribs in each pair and a respective second notch formed in a second of the tray ribs in each pair, and the one or more cross-members may include a respective first cross-member and a respective second cross-member formed in each of the carrier ribs, wherein the respective first and second notches of each pair of tray ribs are transversely aligned with each other and the respective first and second cross-members of each carrier rib are transversely aligned with each other. In the assembled configuration, the cell vent tray and the cell carrier may be precluded from relative movement with respect to each other in the longitudinal direction. The cell vent tray may include a third plurality of tray ribs extending outward from the top surface of the vent tray body and running along the longitudinal direction, wherein one or more of the first, second and third pluralities of tray ribs may include one or more weepage slots formed therein.

(11) The above features and advantages, and other features and advantages, of the present teachings are readily apparent from the following detailed description of some of the best modes and other embodiments for carrying out the present teachings, as defined in the appended claims, when taken in connection with the accompanying drawings.

Description

BRIEF DESCRIPTION OF THE DRAWINGS

(1) FIG. **1** is a top perspective view of a cell vent tray.

(2) FIG. **2** is a bottom perspective view of a cell carrier.

(3) FIG. **3** is a top perspective view of a cell carrier and vent tray arrangement in an assembled configuration.

(4) FIG. **4** is a cross-sectional view of portions of the cell carrier and the cell vent tray prior to being assembled together.

(5) FIG. **5** is a cross-sectional view of the portions of the cell carrier and the cell vent tray of FIG. **4** after being assembled together.

(6) FIG. **6** is a top plan view of an embodiment of the cell vent tray.

(7) FIG. **7** is a bottom plan view of an embodiment of the cell carrier.

(8) FIG. **8** is a top plan view of one embodiment of a portion of the cell vent tray.

(9) FIG. **9** is a top plan view of another embodiment of a portion of the cell vent tray.

(10) FIG. **10** is a bottom plan view of an embodiment of the cell carrier.

(11) FIG. **11** is an elevation view of the weepage slots as viewed along line **11**-**11** of FIG. **6**.

(12) FIG. **12** is an elevation view of the notches as viewed along line **12**-**12** of FIG. **6**.

(13) FIG. **13** is an elevation view of the cross-members as viewed along line **13**-**13** of FIG. **7**.

(14) FIG. **14** is a perspective view of a mortise and tenon joint type of joint formed by notches and cross-members in the assembled configuration, but with the carrier body removed.

DETAILED DESCRIPTION

(15) Referring now to the drawings, wherein like numerals indicate like parts in the several views, a cell carrier and vent tray arrangement **20** for a high-voltage battery is shown and described herein. The cell carrier and vent tray arrangement **20** includes a cell vent tray **22** (FIG. **1**) and a cell carrier **54** (FIG. **2**) that may be assembled together to form an assembled configuration **76** (FIG. **3**). Note that a customary x-y-z coordinate system which follows the right-hand rule is shown in the

drawings, with the positive z-direction pointing “upward” and the negative z-direction pointing “downward”.

(16) In contrast with customary approaches, the cell carrier and vent tray arrangement **20** of the present disclosure solves the technical problem of having to use metal connection points to connect the cell vent tray **22** and cell carrier **54** together. This is accomplished by the technical effect of utilizing an arrangement of ribs **30**, **32**, **34**, **60**, notches **44**, and cross-members **66** to form mortise and tenon-like joints **78**, along with optional adhesive and/or other optional joining methods, to connect the cell vent tray **22** and cell carrier **54** together. This arrangement **20** provides significant benefits and technical advantages over other known approaches, such as providing the ability to utilize plastic materials for the entirety of the cell vent tray **22** and the cell carrier **54**, thus avoiding the use of metal connection points and reducing the overall weight of the assembled arrangement **20**. Additionally, in automotive vehicle operations in which the cell carrier and vent tray arrangement **20** is utilized to support a high-voltage battery pack, the arrangement **20** allows side vehicle loads to be managed in a peel orientation rather than a shear orientation and allows load transfer into other parts of the high-voltage battery pack. Furthermore, the arrangement **20** provides built-in vent channels **79** which may be utilized for ventilating the battery pack.

(17) FIG. **1** shows a top perspective view of one embodiment of the cell vent tray **22**. The cell vent tray **22** has a generally planar vent tray body **24** which defines a longitudinal direction **26** and a transverse direction **28** that is perpendicular to the longitudinal direction **26** and lies within the plane of the vent tray body **24**. The vent tray body **24** may be generally rectangular as shown, or it may assume other suitable shapes and geometries. For example, when the vent tray body **24** is presented in the rectangular shape as shown in FIG. **1**, the vent tray body **24** may have a length along which the longitudinal direction **26** is defined and a width along which the transverse direction **28** is defined. The vent tray body **24** has a generally planar overall shape which may be presented as a generally flat plane, a generally curved plane or a combination of flat and curved planes.

(18) The cell vent tray **22** also includes first and second tray ribs **30**, **32** extending outward (e.g., upward) from a top surface **36** of the vent tray body **24** and running along the longitudinal direction **26**. As illustrated in FIG. **1**, there may be a plurality of first tray ribs **30** and second tray ribs **32**, and the first and second tray ribs **30**, **32** may be arranged in pairs across the top surface **36** of the vent tray body **24**. For example, one pair may include a first tray rib **30** and a second tray rib **32** disposed closely together, another pair may include another first tray rib **30** and another second tray rib **32** disposed closely together, and so forth, with each pair being spaced apart from neighboring pairs.

(19) The cell vent tray **22** may also include one or more third tray ribs **34** extending outward from the top surface **36** of the vent tray body **24** and running along the longitudinal direction **26** (i.e., parallel to the first and second tray ribs **30**, **32**). As shown in FIG. **1**, the third tray ribs **34** may be arranged in pairs across the top surface **36** of the vent tray body **24**, but the third tray ribs **34** may also be arranged in singles or in groups of three or more. For example, as exemplified in FIG. **1**, two third tray ribs **34** may be disposed close to each other in a pair, with a pair of first and second tray ribs **30**, **32** disposed on either side of each pair of third tray ribs **34**. As described in more detail below in connection with FIGS. **4-5**, the first, second and third tray ribs **30**, **32**, **34** may be sized and shaped so as to be similar to each other, but they may also assume sizes and shapes that are different from each other as well.

(20) Note that one or more notches **44** may be formed in one or both of the first and second tray ribs **30**, **32**. As illustrated in FIGS. **1**, **6**, **8** and **9**, one or more first notches **46** may be formed in the first tray rib **30** and one or more second notches **48** may be formed in the second tray rib **32**, but notches **44** may be omitted altogether from the third tray ribs **34**.

(21) As a first example, as shown in FIG. **8**, a first notch **46** may be formed in a first tray rib **30** at a first notch location **50**, without any second notch **48** being formed in the neighboring second tray

rib **32**.
(22) As a second example, as shown in FIGS. **1** and **6**, a first notch **46** may be formed in a first tray rib **30** at a first notch location **50** and a second notch **48** may be formed in a neighboring second tray rib **32** at a second notch location **52**, with the first and second notches **46**, **48** being transversely aligned with each other. (As used herein, two elements being "transversely aligned with each other" may mean that a line running through the respective centers of the two elements runs parallel with the transverse direction **28** and the y-direction. Additionally or alternatively, two elements being "transversely aligned with each other" may mean that the respective locations of the two elements extend to the same extent as each other in the longitudinal direction **26** and the x-direction as measured from a given reference point. Thus, the first and second notches **46**, **48** being transversely aligned with each other means that a line running through the respective centers of the two notches **46**, **48** runs parallel with the transverse direction **28** and the y-direction, and/or that the respective locations **50**, **52** of the two notches **46**, **48** extend to the same extent as each other in the longitudinal direction **26** and the x-direction as measured from a given reference point, such as from a free edge **37** of the vent tray body **24**.)
(23) As a third example, as shown in FIG. **9**, a first notch **46** may be formed in a first tray rib **30** at a first notch location **50** and a second notch **48** may be formed in a neighboring second tray rib **32** at a second notch location **52**, with the first and second notches **46**, **48** not being transversely aligned with each other. In this arrangement, the first and second notch locations **50**, **52** are also not transversely aligned with each other
(24) FIG. **2** shows a bottom perspective view of one embodiment of the cell carrier **54**. The cell carrier **54** has a generally planar carrier body **56** with a plurality of vent holes **58** formed therethrough and one or more carrier ribs **60** extending outward (e.g., downward) from a bottom surface **62** of the carrier body **56**. The vent holes **58** are shown as being circular, evenly spaced and sized such that each vent hole **58** spans across most of the spacing between neighboring carrier ribs **60**, but any shape, size, placement or arrangement of vent holes **58** may be used. As with the vent tray body **24** described above, the carrier body **56** may be generally rectangular as shown, or it may assume other suitable shapes and geometries, and the generally planar overall shape of the carrier body **56** may be presented as a generally flat plane, a generally curved plane or a combination of flat and curved planes.
(25) The one or more carrier ribs **60** are disposed so as to run along the longitudinal direction **26**. As illustrated in FIGS. **2** and **7**, there may be a plurality of carrier ribs **60**, which may be arranged in singles (i.e., singular units, as opposed to pairs or groups of three or more) across the bottom surface **62** of the carrier body **56**. One or more of the carrier ribs **60** include one or more cross-members **66** formed therewith, with each cross-member **66** extending in the transverse direction **28** (e.g., in the positive or negative y-direction).
(26) For example, as shown in FIGS. **2** and **7**, selected carrier ribs **60** may each have multiple pairs of cross-members **66** distributed along the longitudinal direction **26**, with each pair including a first cross-member **68** located at a first cross-member location **72** and extending in the negative y-direction, and a second cross-member **70** located at a second cross-member location **74** and extending in the positive y-direction, with the first and second cross-members **68**, **70** in each pair being transversely aligned with each other. (That is, a line running through the respective centers of the two cross-members **66** in each pair runs parallel with the transverse direction **28** and the y-direction, and/or the respective locations **72**, **74** of the cross-members **66** in each pair extend to the same extent as each other in the longitudinal direction **26** and the x-direction as measured from a given reference point, such as from a free edge **63** of the carrier body **56**.)
(27) Alternatively, a carrier rib **60** may include a first cross-member **68** at a given location along the longitudinal direction **26** without any second cross-member **70** provided nearby, or a second cross-member **70** at a given location along the longitudinal direction **26** without any first cross-member **68** provided nearby.

(28) As a further alternative, a carrier rib **60** may include a first cross-member **68** and a second cross-member **70** at or near a given location along the longitudinal direction **26**, but with the two cross-members **68**, **70** not being transversely aligned with each other, as illustrated in FIG. **10**. Here, the first cross-member **68** is located at a first cross-member location **72** and the second cross-member **70** is located at a second cross-member location **74**, wherein the first and second cross-member locations **72**, **74** are not transversely aligned with each other.
(29) FIG. **3** shows a top perspective view of the cell carrier and vent tray arrangement **20** in an assembled configuration **76**. In this arrangement **20**, the cell carrier **54** has been placed on top of the cell vent tray **22**, with the top surface **36** of the cell vent tray **22** facing upward and the bottom surface **62** of the cell carrier **54** facing downward. The cell vent tray **22** and cell carrier **54** are configured for engagement with each other in an assembled configuration **76** with each carrier rib **60** being disposed between a respective pair of first and second tray ribs **30**, **32** and each set of the one or more cross-members **66** being seated within a respective set of the one or more notches **44**.
(30) The one or more notches **44** and the one or more cross-members **66** may be configured for engagement with each other to form one or more mortise and tenon joints **78**. (These joints **78** may also be referred to as “mortise and tenon-like joints” and as “mortise and tenon type of joints”.) In the assembled configuration **76**, the cell vent tray **22** and the cell carrier **54** may be precluded from relative movement with respect to each other in the longitudinal direction **26**, due to the geometries of the notches **44** and cross-members **66** which are interposed or interlocked with each other.
(31) As illustrated in FIGS. **2**-**3**, multiple cell carriers **54** may be connected together to effectively form a single cell carrier **54** across a single cell vent tray **22**. For example, FIG. **2** shows an individual cell carrier **54** in which each of the two opposing free edges **63** includes multiple inwardly extending portions **63**, and multiple outwardly extending portion **613** which are sized and shaped such that two or more of these individual cell carriers **54** may be snapped, fitted or otherwise connected together to form what is effectively a single cell carrier **54** (see FIG. **3**). Similarly, as shown in FIGS. **1** and **3**, the cell vent tray **22** may have two opposing free edges **37** with each free edge **37** including multiple inwardly extending portions **37**, and multiple outwardly extending portion **370**, so as to permit two or more cell vent trays **22** to be snapped, fitted or otherwise connected together.
(32) As exemplified in FIGS. **1**-**3**, the cell vent tray **22** may include two opposing vent tray flaps **43** which extend upward in the positive z-direction, and the cell carrier **54** may include two opposing carrier flaps **65** which extend downward in the negative z-direction. These flaps **43**, **65** may be dimensioned so as to be snapped, fitted or otherwise connected together, thus aiding in connecting the cell vent tray **22** and the cell carrier **54** with each other and adding to the overall structural integrity of the cell carrier and vent tray arrangement **20**.
(33) FIG. **4** shows a cross-sectional close-up view of selected portions of the cell vent tray **22** and the cell carrier **54** prior to being assembled together, and FIG. **5** shows the resulting assembled configuration **76** after the cell vent tray **22** and the cell carrier **54** have been assembled together. The respective distal ends **38**, **40**, **42** of the first, second and third tray ribs **30**, **32**, **34** may extend a first height H.sub.1 outward (e.g., upward) from the top surface **36** of the vent tray body **24**, and the distal end **64** of each carrier rib **60** may extend a second height H.sub.2 outward (e.g., downward) from the bottom surface **62** of the carrier body **56**.
(34) In some configurations, the first and second heights H.sub.1, H.sub.2 may be approximately equal to each other (i.e., H.sub.1≈H.sub.2), such that in the assembled configuration **76** the distal end **64** of the carrier rib **60** rests on the portion of the top surface **36** of the vent tray body **24** that is between the first and second tray ribs **30**, **32**. Alternatively, the first height H.sub.1 may be greater than the second height H.sub.2 (i.e., H.sub.1>H.sub.2), as illustrated in FIGS. **4**-**5**, such that in the assembled configuration **76** a gap **80** is provided between the distal end **64** of the carrier rib **60** and the portion of the top surface **36** of the vent tray body **24** that is between the first and second tray ribs **30**, **32**. In the assembled configuration **76**, the aforementioned gap **80** may optionally extend

around some or all of the second height H.sub.2 of the carrier rib **60**; alternatively, a snug fit may be provided between the carrier rib **60** and the first and second tray ribs **30**, **32** such that little or no gap **80** extends along the second height H.sub.2. When assembled in the assembled configuration **76**, the cell carrier and vent tray arrangement **20** may include an adhesive interposed between the first, second and/or third tray rib **30**, **32**, **34** and the bottom surface **62** of the carrier body **56**, including within some or all of any gap **80**. Optionally, the assembled arrangement **20** may additionally or alternatively include one or more other joining methods for fastening the cell vent tray **22** and cell carrier **54** together, such as heat staking/heat stake welding, sonic/ultrasonic welding and the like.

(35) In the assembled configuration **76** as illustrated in FIGS. **3** and **5**, note that a plurality of vent channels **79** are formed along the longitudinal direction **26**. These vent channels **79** are defined and bounded by various combinations of a first tray rib **30**, a second tray rib **32**, a third tray rib **34**, the top surface **36** of the vent tray body **24**, and the bottom surface **62** of the carrier body **56**.

(36) FIG. **11** is an elevation view along line **11-11** of FIG. **6**. As shown here, as well as in FIGS. **1** and **6**, one or more weepage slots **82** may be formed in one or more of the first tray ribs **30**, one or more of the second tray ribs **32** and/or one or more of the third tray ribs **34**. These weepage slots **82** may be provided to accommodate the application of adhesive between the distal ends **38**, **40**, **42** of the tray ribs **30**, **32**, **34** and the bottom surface **62** of the cell carrier **54**. That is, the weepage slots **82** may provide overflow points for the adhesive so that the tray ribs **30**, **32**, **34** and the bottom surface **62** may be pressed against each to a predetermined or desired degree, in order to facilitate optimum bonding between the cell vent tray **22** and the cell carrier **54**. Note that the weepage slots **82** may optionally be relatively short in height (e.g., much less than the first height H.sub.1 of the tray ribs **30**, **32**, **34**), and may be defined in the distal ends **38**, **40**, **42** of the tray ribs **30**, **32**, **34**.

(37) FIG. **12** is an elevation view of the notches **44** as viewed along line **12-12** of FIG. **6**, FIG. **13** is an elevation view of the cross-members **66** as viewed along line **13-13** of FIG. **7**, and FIG. **14** is a perspective view of a mortise and tenon type of joint **78** formed by the notches **44** and cross-members **66** in the assembled configuration **76**, but with the carrier body **56** removed. Note that the notches **44** may extend from the top surface **36** of the vent tray body **24** to the full first height H.sub.1 of the tray ribs **30**, **32** as shown in FIG. **12**, or they may optionally extend to a height that is less than the first height H.sub.1. Similarly, the cross-members **66** may extend from the bottom surface **62** of the carrier body **56** to the full second height H.sub.2 of the carrier ribs **60** as shown in FIG. **13**, or they may optionally extend to a third height H.sub.3 that is less than the second height H.sub.2 (i.e., H.sub.3<H.sub.2), such as up to the dashed line shown in FIG. **13**.

(38) It may be noted that while the longitudinal and transverse directions **26**, **28** are described above as being defined with respect to the vent tray body **24** (e.g., FIGS. **1** and/or **6**), these directions **26**, **28** may additionally or alternatively be defined with respect to the carrier body **56** (e.g., FIGS. **2** and/or **7**) and/or with respect to the assembled configuration **76** of the overall cell carrier and vent tray arrangement **20** (e.g., FIG. **3**).

(39) According to another embodiment, a cell carrier and vent tray arrangement **20** for a high-voltage battery includes: (i) a cell vent tray **22** having a generally planar vent tray body **24** defining a longitudinal direction **26** and a transverse direction **28** perpendicular to the longitudinal direction **26** and further having first and second tray ribs **30**, **32** extending outward from a top surface **36** of the vent tray body **24**, wherein the tray ribs **30**, **32** run along the longitudinal direction **26** and include a first notch **46** in the first tray rib **30** and a second notch **48** in the second tray rib **32**, wherein the first and second notches **46**, **48** are transversely aligned with each other; and (ii) a cell carrier **54** having a generally planar carrier body **56** with a plurality of vent holes **58** formed therethrough and a carrier rib **60** extending outward from a bottom surface **62** of the carrier body **56**, wherein the carrier rib **60** runs along the longitudinal direction **26** and includes a first cross-member **68** and a second cross-member **70** each extending in the transverse direction **28** and being transversely aligned with each other. The cell vent tray **22** and cell carrier **54** are configured for

engagement with each other in an assembled configuration **76** with the carrier rib **60** being disposed between the first and second tray ribs **30**, **32** and the first and second cross-members **68**, **70** being seated within the first and second notches **46**, **48**, respectively. In the assembled configuration **76**, the cell vent tray **22** and the cell carrier **54** are precluded from relative movement with respect to each other in the longitudinal direction **26**.

(40) The first and second tray ribs **30**, **32** may extend a first height H.sub.1 outward from the top surface **36** of the vent tray body **24** and the carrier rib **60** may extend a second height H.sub.2 outward from the bottom surface **62** of the carrier body **56**. The first and second heights H.sub.1, H.sub.2 may be approximately equal to each other (i.e., H.sub.1≈H.sub.2), or the first height H.sub.1 may be greater than the second height H.sub.2 (i.e., H.sub.1>H.sub.2). The cell vent tray **22** may include a third tray rib **34** extending outward from the top surface **36** of the vent tray body **24** and running along the longitudinal direction **26**, and one or more of the first, second and third tray ribs **30**, **32**, **34** may include one or more weepage slots **82** formed therein. The arrangement may further include an adhesive interposed between the first, second and/or third tray rib **30**, **32**, **34** and the bottom surface **62** of the carrier body **56**.

(41) According to yet another embodiment, a cell carrying and venting arrangement **20** for high-voltage batteries includes a cell vent tray **22** and a cell carrier **54**. The cell vent tray **22** has a generally planar vent tray body **24** defining a longitudinal direction **26** and a transverse direction **28** perpendicular to the longitudinal direction **26**. The cell vent tray **22** further has a first plurality of tray ribs **30**, **32** arranged in pairs and extending outward from a top surface **36** of the vent tray body **24**. The tray ribs **30**, **32** run along the longitudinal direction **26** and include one or more notches **44** formed in one or both of the tray ribs **30**, **32** of each pair of tray ribs **30**, **32**. The cell carrier **54** has a generally planar carrier body **56** with a plurality of vent holes **58** formed therethrough and a second plurality of carrier ribs **60** arranged in singles and extending outward from a bottom surface **62** of the carrier body **56**. The carrier ribs **60** run along the longitudinal direction **26** and each carrier rib **60** includes one or more cross-members **66** extending in the transverse direction **28**. The cell vent tray **22** and the cell carrier **54** are configured for engagement with each other in an assembled configuration **76** with each of the carrier ribs **60** being disposed between a respective pair of the tray ribs **30**, **32** and each of the one or more cross-members **66** being seated within a respective one of the one or more notches **44**.

(42) The one or more notches **44** may include a respective first notch **46** formed in a first of the tray ribs **30**, **32** in each pair (e.g., in the first tray rib **30**) and a respective second notch **48** formed in a second of the tray ribs **30**, **32** in each pair (e.g., in the second tray rib **32**), and the one or more cross-members **66** may include a respective first cross-member **68** and a respective second cross-member **70** formed in each of the carrier ribs **60**, wherein the respective first and second notches **46**, **48** of each pair of tray ribs **30**, **32** are transversely aligned with each other and the respective first and second cross-members **68**, **70** of each carrier rib **60** are transversely aligned with each other. In the assembled configuration **76**, the cell vent tray **22** and the cell carrier **54** may be precluded from relative movement with respect to each other in the longitudinal direction **26**. The cell vent tray **22** may include a third plurality of tray ribs **34** extending outward from the top surface **36** of the vent tray body **24** and running along the longitudinal direction **26**, wherein one or more of the first, second and third pluralities of tray ribs **30**, **32**, **34** may include one or more weepage slots **82** formed therein.

(43) (It may be noted that at some points throughout the present disclosure, reference may be made to a singular input, output, element, etc., while at other points reference may be made to plural/multiple inputs, outputs, elements, etc. Thus, weight should not be given to whether the input(s), output(s), element(s), etc. are used in the singular or plural form at any particular point in the present disclosure, as the singular and plural uses of such words should be viewed as being interchangeable, unless the specific context dictates otherwise.)

(44) The above description is intended to be illustrative, and not restrictive. While the dimensions

and types of materials described herein are intended to be illustrative, they are by no means limiting and are exemplary embodiments. In the following claims, use of the terms “first”, “second”, “top”, “bottom”, etc. are used merely as labels, and are not intended to impose numerical or positional requirements on their objects. As used herein, an element or step recited in the singular and preceded by the word “a” or “an” should be understood as not excluding plural of such elements or steps, unless such exclusion is explicitly stated. Additionally, the phrase “at least one of A and B” and the phrase “A and/or B” should each be understood to mean “only A, only B, or both A and B”. Moreover, unless explicitly stated to the contrary, embodiments “comprising” or “having” an element or a plurality of elements having a particular property may include additional such elements not having that property. And when broadly descriptive adverbs such as “substantially” and “generally” are used herein to modify an adjective, these adverbs mean “mostly”, “mainly”, “for the most part”, “to a significant extent”, “to a large degree” and/or “at least 51 to 99% out of a possible extent of 100%”, and do not necessarily mean “perfectly”, “completely”, “strictly”, “entirely” or “100%”. Additionally, the word “proximate” may be used herein to describe the location of an object or portion thereof with respect to another object or portion thereof, and/or to describe the positional relationship of two objects or their respective portions thereof with respect to each other, and may mean “near”, “adjacent”, “close to”, “close by”, “at” or the like.

(45) This written description uses examples, including the best mode, to enable those skilled in the art to make and use devices, systems and compositions of matter, and to perform methods, according to this disclosure. It is the following claims, including equivalents, which define the scope of the present disclosure.

Claims

1. A cell carrier and vent tray arrangement for a high-voltage battery, comprising: a cell vent tray having a generally planar vent tray body defining a longitudinal direction and a transverse direction perpendicular to the longitudinal direction and further having first and second tray ribs extending outward from a top surface of the vent tray body, wherein the tray ribs run along the longitudinal direction and include one or more notches formed in one or both of the tray ribs; and a cell carrier having a generally planar carrier body with a plurality of vent holes formed therethrough and a carrier rib extending outward from a bottom surface of the carrier body, wherein the carrier rib runs along the longitudinal direction and includes one or more cross-members extending in the transverse direction; wherein the cell vent tray and cell carrier are configured for engagement with each other in an assembled configuration with the carrier rib being disposed between the first and second tray ribs and the one or more cross-members being seated within the one or more notches.

2. The cell carrier and vent tray arrangement of claim 1, wherein the one or more notches and the one or more cross-members are configured for engagement with each other to form one or more mortise and tenon joints.

3. The cell carrier and vent tray arrangement of claim 1, wherein the first and second tray ribs extend a first height outward from the top surface of the vent tray body and the carrier rib extends a second height outward from the bottom surface of the carrier body.

4. The cell carrier and vent tray arrangement of claim 3, wherein the first and second heights are approximately equal to each other.

5. The cell carrier and vent tray arrangement of claim 3, wherein the first height is greater than the second height.

6. The cell carrier and vent tray arrangement of claim 3, wherein the one or more cross-members extend from the bottom surface of the carrier body to a third height that is less than the second height.

7. The cell carrier and vent tray arrangement of claim 1, wherein the one or more notches comprise

a first notch in the first tray rib and a second notch in the second tray rib, and the one or more cross-members comprise a first cross-member and a second cross-member, wherein the first and second notches are transversely aligned with each other and the first and second cross-members are transversely aligned with each other.
8. The cell carrier and vent tray arrangement of claim 1, wherein in the assembled configuration, the cell vent tray and the cell carrier are precluded from relative movement with respect to each other in the longitudinal direction.
9. The cell carrier and vent tray arrangement of claim 1, wherein the cell vent tray includes a third tray rib extending outward from the top surface of the vent tray body and running along the longitudinal direction, and wherein one or more of the first, second and third tray ribs include one or more weepage slots formed therein.
10. The cell carrier and vent tray arrangement of claim 9, further including an adhesive interposed between the first, second and/or third tray rib and the bottom surface of the carrier body.
11. A cell carrier and vent tray arrangement for a high-voltage battery, comprising: a cell vent tray having a generally planar vent tray body defining a longitudinal direction and a transverse direction perpendicular to the longitudinal direction and further having first and second tray ribs extending outward from a top surface of the vent tray body, wherein the tray ribs run along the longitudinal direction and include a first notch in the first tray rib and a second notch in the second tray rib, wherein the first and second notches are transversely aligned with each other; and a cell carrier having a generally planar carrier body with a plurality of vent holes formed therethrough and a carrier rib extending outward from a bottom surface of the carrier body, wherein the carrier rib runs along the longitudinal direction and includes a first cross-member and a second cross-member extending in the transverse direction and being transversely aligned with each other; wherein the cell vent tray and cell carrier are configured for engagement with each other in an assembled configuration with the carrier rib being disposed between the first and second tray ribs and the first and second cross-members being seated within the first and second notches, respectively; wherein in the assembled configuration, the cell vent tray and the cell carrier are precluded from relative movement with respect to each other in the longitudinal direction.
12. The cell carrier and vent tray arrangement of claim 11, wherein the first and second tray ribs extend a first height outward from the top surface of the vent tray body and the carrier rib extends a second height outward from the bottom surface of the carrier body.
13. The cell carrier and vent tray arrangement of claim 12, wherein the first and second heights are approximately equal to each other.
14. The cell carrier and vent tray arrangement of claim 12, wherein the first height is greater than the second height.
15. The cell carrier and vent tray arrangement of claim 11, wherein the cell vent tray includes a third tray rib extending outward from the top surface of the vent tray body and running along the longitudinal direction, and wherein one or more of the first, second and third tray ribs include one or more weepage slots formed therein.
16. The cell carrier and vent tray arrangement of claim 15, further including an adhesive interposed between the first, second and/or third tray rib and the bottom surface of the carrier body.
17. A cell carrying and venting arrangement for high-voltage batteries, comprising: a cell vent tray having a generally planar vent tray body defining a longitudinal direction and a transverse direction perpendicular to the longitudinal direction and further having a first plurality of tray ribs arranged in pairs and extending outward from a top surface of the vent tray body, wherein the tray ribs run along the longitudinal direction and include one or more notches formed in one or both of the tray ribs of each pair; and a cell carrier having a generally planar carrier body with a plurality of vent holes formed therethrough and a second plurality of carrier ribs arranged in singles and extending outward from a bottom surface of the carrier body, wherein the carrier ribs run along the longitudinal direction and wherein each carrier rib includes one or more cross-members extending

in the transverse direction; the cell vent tray and cell carrier being configured for engagement with each other in an assembled configuration with each of the carrier ribs being disposed between a respective pair of the tray ribs and each of the one or more cross-members being seated within a respective one of the one or more notches.

18. The cell carrying and venting arrangement of claim 17, wherein the one or more notches comprise a respective first notch formed in a first of the tray ribs in each pair and a respective second notch formed in a second of the tray ribs in each pair, and the one or more cross-members comprise a respective first cross-member and a respective second cross-member formed in each of the carrier ribs, wherein the respective first and second notches of each pair of tray ribs are transversely aligned with each other and the respective first and second cross-members of each carrier rib are transversely aligned with each other.

19. The cell carrying and venting arrangement of claim 17, wherein in the assembled configuration, the cell vent tray and the cell carrier are precluded from relative movement with respect to each other in the longitudinal direction.

20. The cell carrying and venting arrangement of claim 17, wherein the cell vent tray includes a third plurality of tray ribs extending outward from the top surface of the vent tray body and running along the longitudinal direction, and wherein one or more of the first, second and third pluralities of tray ribs include one or more weepage slots formed therein.