

CLAIMS

1. A ballistic resistant case for a secondary battery comprising:

a rectangular metal case having: a front wall and two side walls and a rear wall extending up from a bottom wall; a panel connected to said bottom wall and the side walls to divide the internal space of the case into cell pack receiving bays; and a cover to seal the cell pack receiving bays;

a bus bar extending from the front wall, across the top of the panel, to the rear wall; and

a connector to secure the cover to the panel with the bus bar sandwiched therebetween, whereby the bus bar reinforces a central portion of the cover and prevents the panel and the walls from deflecting to provide ballistic protection for the cell packs.

2. A ballistic resistant case according to claim 1, wherein the connector includes one or more bolts and threaded sleeves that extend through a hole formed in the bus bar, and wherein the panel is shorter than the walls by a distance that is about the height of the bus bar, and wherein the bus bar includes a front and rear surface which contact with the front and rear walls, respectively.

3. A ballistic resistant case according to any of the preceding claims, wherein the bus bar is made primarily from aluminum and electrically couples all of the cell pack terminals of one polarity together, wherein the bus bar has sufficient cross-sectional area around the hole containing the threaded sleeve to conduct at least 80 amps along its length, with the corresponding heat being dissipated through contact to the cover.

4. A ballistic resistant case according to any of the preceding claims, wherein the connector includes: a stud having an upper threaded portion and a lower portion fixedly mounted at a central point along the top of the panel; and an insulating bushing disposed within the bus bar hole to prevent shorting between the bus bar and any portion of the connector.

5. A ballistic resistant case according to any of the preceding claims, wherein the metal case is made from one of iron/carbon steel and high temperature steel, wherein all surfaces of the case are galvanized for rust prevention.

6. A ballistic resistant case according to any of the preceding claims, wherein the metal case is made from one of iron/carbon steel and high temperature steel, wherein all surfaces of the case are provided with a highly-crosslinked non-porous coating that protects the metal from biological, radioactive and chemical contamination and withstands chemical cleaning and decontamination without corroding.
7. A ballistic resistant case according to any of the claims 1- 4 and 6, wherein the highly-crosslinked non-porous coating comprises one of urethane, polyurethane, aliphatic polyurethane, epoxy, epoxy polyamide, epoxy polyamide enamel and combinations thereof.
8. A ballistic resistant case according to any of the preceding claims, wherein all of the surfaces facing the cell pack receiving bays are lined with an electrically insulating material which serves to prevent any of the cell pack leads, connectors or control electronics from shorting to the metal case.
9. A ballistic resistant case according to any of the preceding claims, wherein the electrically insulating material comprises a thermoplastic film adhered to the surfaces, and wherein the metal case is made from high temperature steel which withstands temperatures up to about 500 degrees C (930 degrees F) containing a majority of nickel, iron, cobalt and combinations thereof.
10. A ballistic resistant case according to any of the preceding claims, wherein the thermoplastic film is one of polyester, nylon and polycarbonate, preferably polyester having a thickness between 0.2 and 2.0 mm thick, preferably 0.5 mm thick.
11. A ballistic resistant case according to any of the preceding claims, wherein the cover is sealed to the top end of the walls with glue to provide a waterproof case that protects the cell packs from moisture intrusion, wherein the case includes a pressure relief vent, and wherein side portions of the cover parallel to the bus bar are adapted to pivot upwardly breaking the glue seal to provide over-pressure protection venting following ballistic impact.
12. A ballistic resistant case according to any of the preceding claims, wherein the pressure relief vent includes a vent hole formed in the case with a label adhered over the

vent; wherein the adhered label can withstand up to 10 times variation in atmospheric pressure as encountered during altitude changes up to 15,000 meters (50,000 feet) and will rupture at greater than 10 times atmospheric pressure; and wherein a pressure sensor monitors internal pressure and is coupled to software to open circuit breakers and disconnect the bus bars at greater than 10 times atmospheric pressure.

13. A ballistic resistant case according to any of the preceding claims, wherein the cell pack includes individual cells arranged within end frames, and wherein the case further including a thermally conductive filler material occupying the interstices between the individual cells and between the cell pack and the thermoplastic film lining, wherein the thermally conductive filler material decreases the thermal impedance from the cell pack to the outside surface of the metal case to reduce cell pack temperature and increase battery life.

14. A ballistic resistant case according to any of the preceding claims, further including: tabs extending outwardly from the end frames to space the cell packs from the case; and a silicon-based shock absorbing material selectively disposed between the end frames and the metal case to stabilize the cell packs.

15. A ballistic resistant case according to any of the preceding claims, wherein the thermally conductive filler is granular with a particle size between 2-200 microns, wherein the filler is Alumina Trihydrate which endothermically decomposes at 220 degrees C (430 degrees F) to release 35% of its weight as water vapor; wherein excessive water vapor pressure will breach the pressure relief vent.

16. A ballistic resistant case according to any of the preceding claims, wherein the case is made from high temperature steel of a sufficient thickness to absorb ballistic incursion and remain intact while damaged cells burn out and ignite neighboring cells in a domino effect and simultaneously prevent the cells or other internal battery components from ejecting as secondary projectiles.