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Robustly Manufacturable, Modular Structure to House, Maintain, and Protect Battery Cells and Cell Modules for Electric Vehicles

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[0001] Electric vehicles utilize a different type of battery than their gas-powered counterparts. Electric vehicles may use a bigger battery than gas-powered cars, which may lead to differing interior configurations with respect to battery placement and battery housing. Furthermore, with larger batteries, securing the battery to prevent durability fatigue and wear from constant vibrations becomes more difficult and more costly.

[0002] To accommodate the larger batteries, different approaches have been taken with different shortcomings. A stamped steel enclosure with a sheet molding compound cover may be used, providing a heavier solution than an all-aluminum enclosure. Alternatively, aluminum extrusions that are joined together may be used with the drawback of a more expensive and inefficient production process.

[0003] Disclosed is a modular battery housing for electric vehicles that utilizes standard automotive techniques to provide an efficiently produced battery housing at both high volume and scale. The battery housing may allow for production to exceed 30,000 units per year.

[0004] Embodiments of the disclosure include a battery housing with a tall, strong energy-absorbing frame around the perimeter, joined to a thick bottom sheet that serves as a bottom plate to form a protective exoskeleton. The frame may be roll-formed or stamped. Large stampings to seal corners may be used to streamline sealing the joints and eliminate the need for sealing joints bridging the structural joints between components. A single or multi-piece tub may be dropped into the exoskeleton and mate with the bottom plate through adhesive bonding and welding, providing a unique floor structure that exhibits constrained layer damping. The tub may contain the battery with internal crossmembers and/or longitudinal rails to strengthen the overall system. Because the frame meets the high-strength requirements, a lower strength material may be used for the tub, if desired. The internal crossembers and/or longitudinal rails of the tub may be positioned to reduce vibration-induced fatigue within the sealed exoskeleton. Standard automotive body-in-white joining techniques may be used to facilitate more efficient throughput of the battery housing.

[0005] The tub may be one or more than one piece to allow for straight walls on the side of the battery housing, and serve the purpose of sealing the lower half of the enclosure. The housing may have a flat cover that closes out the sides and mates on a planar surface or generally planar surface around the perimeter of the housing atop the tub. The configuration of the tub serving as a sealing function eliminates the need to seal the corners. The tub and exoskeleton may be assembled separately and later married together, allowing for two-sided access to joining. The tub, adhesive and bottom plate configuration results in improved damping due to the constrained layer of viscoelastic adhesive, which mitigates vibration-induced damage and acousting ringing noise. Furthermore, the process of creating said constrained-layer is efficient and streamlines the manufacturing process to standard methods in the automotive industry.

[0006] A cooling system may be incorporated within the battery housing. The tub geometry may accommodate for such incorporation of a cooling system. The cooling may be by an additional cold plate assembly (brazed or other pressure-proof method). Alternatively, the cooling may be integrated directly onto the tub by brazing or a continuous joining method, such as laser welding or laser brazing. The cooling may be within the constrained layer of the floor structure, or above in the cell cavity of the tub.

[0007] The battery housing may have one or more attachment mechanisms to secure the housing to the frame of the car. Embodiments include the use of brackets to mate the battery housing to the side frame rails. For example, the bottom plate of the battery housing may have brackets or flanges that can be joined to the frame through welds or bolts or using other means that avoid distortion of the flange. Other embodiments may use different attachment mechanisms to mate the battery housing to the frame of the vehicle. The battery housing may be sized appropriately to fit under passenger compartments of vehicles, and accommodate boxy batteries.

[0008] The battery housing described herein may allow for heat treating to high-strength at a coil level rather than post-forming or post-assembly. Moreover, the roll-forming allows for a section which can crush well to absorb side impacts and pole energy, without the need for sealed corners on the exterior, due to the interior sealed tub. The battery housing provides both resistance to vibration-induced fatigue as well as suitable protection to the battery in the event of vehicle collisions.

[0009] Different arrangements of the components described above, as well as components not shown or described, are possible.