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Housing assembly having breakaway leg members

Abstract

A housing assembly can include a housing structure and a plurality of leg members. At least one leg member of the plurality of leg members comprises a foot portion and at least one connecting portion. Each leg member can define a first convex portion disposed between the foot portion and the at least one connecting portion and a second convex portion disposed between the first convex portion. A radius of the first convex portion is about two times greater than a radius of the second convex portion.

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Background/Summary

(1) The present disclosure relates to a housing assembly having leg members for protecting an electronic control unit (ECU).

(2) ECUs are control units that can be installed behind the dashboard or in between driver and passenger seats of the vehicle. The ECU typically controls the function of the vehicle such as airbags by controlling a series of actuators based on input from crash sensors.

SUMMARY

(3) A housing assembly can include a housing structure and a plurality of leg members. At least one leg member of the plurality of leg members comprises a foot portion and at least one connecting portion. Each leg member can define a first convex portion disposed between the foot portion and the at least one connecting portion and a second convex portion disposed between the first convex portion. A radius of the first convex portion is about two times greater than a radius of the second convex portion.

(4) In another exemplary arrangement, the housing assembly includes a first concave portion proximal to an interface of the at least one connecting portion and a side surface of the housing structure, wherein a radius ratio of the first convex portion to second convex portion to the concave portion comprises 1:0.5:1.

(5) In another exemplary arrangement, the housing assembly includes a second concave portion, wherein an angle between the first concave portion and the second concave portion comprises about twenty degrees.

(6) In another exemplary arrangement, the radius of the first convex portion comprises about one millimeter.

(7) In another exemplary arrangement, at least one leg member is configured to separate from the housing structure when a predetermined static load force is exerted on the housing assembly.

(8) In another exemplary arrangement, the housing assembly includes an electronic control unit, wherein the housing structure is configured to retain the electronic control unit.

(9) In another exemplary arrangement, the housing assembly includes an electrical connector that is configured to provide an electrical connection to the electronic control unit.

(10) In another exemplary arrangement, the housing assembly includes an overhang that extends outwardly from an upper surface of the housing structure.

(11) In another exemplary arrangement, the overhang is integral with the housing structure.
(12) In another exemplary arrangement, the housing structure comprises die cast metal.
(13) In another exemplary arrangement, the die cast metal comprises aluminum.
(14) A housing assembly can include a housing structure and an electronic control unit disposed within the housing structure. The housing assembly also includes a plurality of leg members. Each leg member of the plurality of leg members comprises a foot portion and a plurality of connecting portions. Each leg member can define a first convex portion disposed between the foot portion and a connecting portion of the plurality of connecting portions and a second convex portion disposed between the first convex portion. A radius of the first convex portion is about two times greater than a radius of the second convex portion.
(15) In another exemplary arrangement, the housing assembly includes a first concave portion proximal to an interface of the connecting portion and a side surface of the housing structure, wherein a radius ratio of the first convex portion to second convex portion to the concave portion comprises 1:0.5:1.
(16) In another exemplary arrangement, the housing assembly includes a second concave portion, wherein an angle between the first concave portion and the second concave portion comprises about twenty degrees.
(17) In another exemplary arrangement, the radius of the first convex portion comprises about one millimeter.
(18) In another exemplary arrangement, at least one leg member is configured to separate from the housing structure when a predetermined static load force is exerted on the housing assembly.
(19) In another exemplary arrangement, the housing assembly includes an electrical connector that is configured to provide an electrical connection to the electronic control unit.
(20) In another exemplary arrangement, the housing assembly includes an overhang that extends outwardly from an upper surface of the housing structure.
(21) In another exemplary arrangement, the overhang is integral with the housing structure.
(22) In another exemplary arrangement, the housing structure comprises die cast metal.
(23) In another exemplary arrangement, the stamped metal comprises of die cast aluminum.
(24) 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

BRIEF DESCRIPTION OF THE DRAWINGS
(1) The drawings described herein are for illustration purposes only and are not intended to limit the scope of the present disclosure in any way.
(2) FIG. **1** is a bottom view of a housing assembly that includes a housing structure retaining an electronic control unit;
(3) FIG. **2** is a plan view of the housing assembly; and
(4) FIG. **3** is a cross-sectional view of a leg member of the housing assembly.
DETAILED DESCRIPTION
(5) The following description is merely exemplary in nature and is not intended to limit the present disclosure, application, or uses.
(6) FIGS. **1** through **3** illustrate an exemplary housing assembly **100** that protects an electronic control unit (ECU) **102** via a housing structure **104**. For example, in one exemplary arrangement, the ECU **102** may comprise an airbag ECU. The ECU **102** can include a circuit board **106** that is retained within the housing structure **104** of the housing assembly **100**. For example, in one exemplary arrangement, the circuit board **106** can be mounted to the housing structure **104** with

one or more fasteners.
(7) The housing assembly **100** can also include an electrical connector **108** and an overhang **110**. The electrical connector **108** can receive electrical interfaces and provide an electrical connection between various vehicle components and the ECU **102**. The overhang **110** can comprise metal, such as aluminum, that extends outwardly from an upper surface **112** of the housing structure **104**. The overhang **110** can mitigate exposure of the electrical connector **108** to moisture and/or other foreign particles. In some exemplary implementations, the overhang **110** can be integral with the housing structure **104**.
(8) The housing structure **104** serves to mitigate intrusion of moisture and/or foreign particles into the housing assembly **100**. The housing structure **104** can comprise diecast metal, such as aluminum, and serves to encapsulate the ECU **102** when positioned within the vehicle.
(9) As shown, the housing structure **104** includes one or more leg members **114**. In an exemplary implementation, the housing structure **104** includes leg members **114-1**, **114-2**, **114-3**. As discussed herein, the leg members **114** comprise a geometric configuration that allows the leg members **114** to separate from the housing structure **104** when subjected to a predetermined static load force such that the housing structure **104** and/or ECU **102** remain undamaged due to the static load force. The predetermined static force can be determined via empirical analysis to determine a static force threshold that may cause damage to the housing structure **104** and/or ECU **102** in an event the leg members **114-1**, **114-2**, **114-3** do not break.
(10) As shown in FIGS. **1** through **3**, the leg members **114** can each comprise a foot portion **118** and connecting portions **122-1**, **122-2**. Each foot portion **118** defines a bore **126** that can receive a fastener for attaching the housing structure **104** within the vehicle. In some implementations, the foot portion **118** may define a fastener or other structure that engages with a corresponding structure. The foot portion **118** can interface with a surface of the vehicle and the connecting portions **122** can interface with a side surface **128** of the housing structure **104**. In an exemplary implementation, the leg members **114** are integral with the housing structure **104**. For example, the housing structure **104** and the leg members **114** can be constructed through suitable metal casting and/or stamping processes.
(11) With reference to FIG. **3**, each leg member **114** can define a first convex portion **202**, a second convex portion **206**, a first concave portion **210**, and a second concave portion **214**. The first convex portion **202** is positioned between the foot portion **118** and the connecting portion **122**, and the second convex portion **206** is positioned between the first convex portion **202** and a first concave portion **210**. The concave portions **210**, **214** are positioned proximal to an interface **218** of the housing structure **104** and the connecting portion **122** and distal to the foot portion **118**. The convex portions **202**, **206** and the concave portions **210**, **214** can allow the leg member **114** to separate, or break away, from the housing structure **104** when a predetermined static load force is exerted.
(12) In an exemplary implementation, a radius of the first convex portion **202** is about two (2) times greater than a radius of the second convex portion **206**. In other words, the radius of the second convex portion **206** is about one-half (**0.5**) the radius of the first convex portion **202**. A radius of the concave portions **210**, **214** can about equal the radius of the first convex portion **212**. The geometric parameters of the leg member **114** can comprise a ratio of about 1:0.5:1, i.e., a radius ratio, which represents the ratio of the radius of the convex portion **202** to the radius of the convex portion **206** to the radius of the convex portion **212**.
(13) In an exemplary implementation, the radius of the convex portion **202** comprises about one millimeter (1 mm). In this exemplary implementation, the radius of the convex portion **206** comprises about one-half millimeters (0.5 mm), and the radius of the concave portions **210**, **214** comprise about one millimeter (1 mm). Referring to FIG. **3**, an angle **218** between the concave portions **210**, **214** comprises about twenty degrees (20°).
(14) Throughout the present disclosure, the numerical values represent approximate measures or

limits to ranges to encompass minor deviations from the given values and embodiments having about the value mentioned as well as those having exactly the value mentioned. The numerical values of parameters in this specification, including the appended claims, are to be understood as being modified in all instances by the term “about” whether or not “about” actually appears before the numerical value. “About” indicates that the stated numerical value allows some slight imprecision (with some approach to exactness in the value; approximately or reasonably close to the value; nearly). If the imprecision provided by “about” is not otherwise understood in the art with this ordinary meaning, then “about” as used herein indicates at least variations that may arise from ordinary methods of measuring and using such parameters. For example, “about” may comprise a variation of less than or equal to 5%, optionally less than or equal to 4%, optionally less than or equal to 3%, optionally less than or equal to 2%, optionally less than or equal to 1%, optionally less than or equal to 0.5%, and in certain aspects, optionally less than or equal to 0.1%.
(15) It is to be understood that the above description is intended to be illustrative and not restrictive. Many implementations and applications other than the examples provided would be apparent to those of skill in the art upon reading the above description. The scope of the invention should be determined, not with reference to the above description, but should instead be determined with reference to the appended claims, along with the full scope of equivalents to which such claims are entitled. It is anticipated and intended that future developments may occur in the arts discussed herein, and that the disclosed systems and methods will be incorporated into such future implementations. In sum, it should be understood that the invention is capable of modification and variation and is limited only by the following claims.
(16) All terms used in the claims are intended to be given their plain and ordinary meanings as understood by those skilled in the art unless an explicit indication to the contrary in made herein. In particular, use of the singular articles such as “a,” “the,” “said,” etc. should be read to recite one or more of the indicated elements unless a claim recites an explicit limitation to the contrary.

Claims

1. A housing assembly comprising: a housing structure; a plurality of leg members, wherein at least one leg member of the plurality of leg members comprises a foot portion and at least one connecting portion, wherein the at least one leg member defines, extending from a bottom surface thereof, a first convex portion disposed between the foot portion and the at least one connecting portion that interfaces with a side of the housing structure and a second convex portion disposed between the first convex portion and the connecting portion, wherein a radius of the first convex portion is about two times greater than a radius of the second convex portion.
2. The housing assembly as recited in claim 1, further comprising a first concave portion proximal to an interface of the at least one connecting portion and a side surface of the housing structure, wherein a radius ratio of the first convex portion to second convex portion to the concave portion comprises 1:0.5:1.
3. The housing assembly as recited in claim 2, further comprising a second concave portion, wherein an angle between the first concave portion and the second concave portion comprises about twenty degrees.
4. The housing assembly as recited in claim 1, wherein the radius of the first convex portion comprises about one millimeter.
5. The housing assembly as recited in claim 1, wherein the at least one leg member is configured to separate from the housing structure when a predetermined static load force is exerted on the housing assembly.
6. The housing assembly as recited in claim 1, further comprising an electronic control unit, wherein the housing structure is configured to retain the electronic control unit.
7. The housing assembly as recited in claim 6, further comprising an electrical connector that is

configured to provide an electrical connection to the electronic control unit.
8. The housing assembly as recited in claim 7, further comprising an overhang that extends outwardly from an upper surface of the housing structure.
9. The housing assembly as recited in claim 8, wherein the overhang is integral with the housing structure.
10. The housing assembly as recited in claim 1, wherein the housing structure comprises die cast metal.
11. The housing assembly as recited in claim 10, wherein the die cast metal comprises aluminum.
12. A housing assembly comprising: a housing structure; an electronic control unit disposed within the housing structure; a plurality of leg members, wherein each leg member of the plurality of leg members comprises a foot portion and a plurality of connecting portions that interface with a side surface of the housing structure, wherein the connecting portions are separated from one another to define a gap therebetween, wherein each leg member defines a first convex portion disposed between the foot portion and a connecting portion of the plurality of connecting portions and a second convex portion disposed between the first convex portion and the connecting portions, wherein a radius of the first convex portion is about two times greater than a radius of the second convex portion.
13. The housing assembly as recited in claim 12, further comprising a first concave portion proximal to an interface of the connecting portion and a side surface of the housing structure, wherein a radius ratio of the first convex portion to second convex portion to the concave portion comprises 1:0.5:1.
14. The housing assembly as recited in claim 13, further comprising a second concave portion, wherein an angle between the first concave portion and the second concave portion comprises about twenty degrees.
15. The housing assembly as recited in claim 12, wherein the radius of the first convex portion comprises about one millimeter.
16. The housing assembly as recited in claim 12, wherein at least one leg member is configured to separate from the housing structure when a predetermined static load force is exerted on the housing assembly.
17. The housing assembly as recited in claim 16, further comprising an electrical connector that is configured to provide an electrical connection to the electronic control unit.
18. The housing assembly as recited in claim 17, further comprising an overhang that extends outwardly from an upper surface of the housing structure.
19. The housing assembly as recited in claim 18, wherein the overhang is integral with the housing structure.
20. The housing assembly as recited in claim 12, wherein the housing structure comprises diecast metal.