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Shield Contact System

Abstract

A shield contact system includes a first shield having a first shield body and a protrusion extending from the first shield body, and a second shield having a second shield body and a contact beam extending from the second shield body. The first shield and the second shield are inserted together along an insertion direction from a deflected state to a mated state. The protrusion deflects the contact beam away from the first shield body in the deflected state. The contact beam abuts the first shield body in the mated state.

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Background/Summary

FIELD OF THE INVENTION

[0001] The present invention relates to a contact system and, more particularly, to a contact system connecting a first shield to a second shield.

BACKGROUND

[0002] In a shield contact system, a male shield is inserted into a female shield to form a connection between the shields. The female shield has a contact beam that extends into the space in which the male shield is received. The contact beam contacts an outer surface of the male shield to form the connection and slides along the outer surface of the male shield during insertion of the male shield.

[0003] During insertion of the male shield, it is common for the leading edge of the male shield to contact a contact point of the contact beam of the female shield, shaving off or otherwise damaging the contact point. The contact point of the contact beam also slides along the outer surface of the male shield over a significant portion of the insertion of the male shield, leading to a long wiping distance that increases wear on the contact point. The contact points of current contact systems can thus suffer significant wear during each mating cycle of the male shield and the female shield, which leads to a limited number of mating cycles in the usable life of the shield contact system.

SUMMARY

[0004] A shield contact system includes a first shield having a first shield body and a protrusion extending from the first shield body, and a second shield having a second shield body and a contact beam extending from the second shield body. The first shield and the second shield are inserted together along an insertion direction from a deflected state to a mated state. The protrusion deflects the contact beam away from the first shield body in the deflected state. The contact beam abuts the first shield body in the mated state.

Description

BRIEF DESCRIPTION OF THE DRAWINGS

[0005] The invention will now be described by way of example with reference to the accompanying Figures, of which:

[0006] FIG. **1** is a perspective view of a shield contact system according to an embodiment;

[0007] FIG. **2** is a perspective view of a first shield of the shield contact system;

[0008] FIG. **3** is a perspective view of a second shield of the shield contact system;

[0009] FIG. **4** is a sectional perspective view of the first shield and the second shield in an inserted state of the shield contact system;

[0010] FIG. **5** is a sectional perspective view of the first shield and the second shield in a deflected state of the shield contact system;

[0011] FIG. **6** is a detail sectional end view of a portion of the first shield and the second shield in the deflected state, taken along line **6-6** in FIG. **5**; and

[0012] FIG. **7** is a sectional perspective view of the first shield and the second shield in a mated state of the shield contact system taken along line **7-7** in FIG. **1**.

DETAILED DESCRIPTION OF THE EMBODIMENTS

[0013] Exemplary embodiments of the present disclosure will be described hereinafter in detail with reference to the attached drawings, wherein like reference numerals refer to like elements. The present disclosure may, however, be embodied in many different forms and should not be construed as being limited to the embodiments set forth herein; rather, these embodiments are provided so that the present disclosure will convey the concept of the disclosure to those skilled in the art. In addition, in the following detailed description, for purposes of explanation, numerous specific details are set forth to provide a thorough understanding of the disclosed embodiments. However, it is apparent that one or more embodiments may also be implemented without these specific details.

[0014] Throughout the drawings, only one of a plurality of identical elements may be labeled in a figure for clarity of the drawings, but the detailed description of the element herein applies equally to each of the identically appearing elements in the figure. Throughout the specification, directional descriptors are used such as “circumferential direction,” “insertion direction,” and “radial direction”. These descriptors are merely for clarity of the description and for differentiation of the various directions. These directional descriptors do not imply or require any particular orientation of the disclosed elements.

[0015] A shield contact system **10** according to an embodiment is shown in a mated state M in FIG. **1**. The shield contact system **10** includes a first shield **100** and a second shield **200** that is matable with the first shield **100** along an insertion direction I.

[0016] The first shield **100**, as shown in FIG. **2**, has a first shield body **110**, a plurality of protrusions **120** extending from the first shield body **110**, and a plurality of ribs **130** extending from the first shield body **110**.

[0017] As shown in FIG. **2**, the first shield body **110** has a first exterior surface **111** and a first interior surface **112** opposite the first exterior surface **111** in a radial direction R perpendicular to the insertion direction I. The first shield body **110** defines a first receiving space **113** extending along the insertion direction I and has a first leading edge **114** at one end in the insertion direction I. The first shield body **110** defines the first receiving space **113** with a rounded-rectangular cross-sectional shape in the shown embodiment. In other embodiments, the first shield body **110** could define the first receiving space **113** as a circular cross-sectional shape, or any other cross-sectional shape used in shield contacts.

[0018] The protrusions **120** each extend from the first exterior surface **111** of the first shield body **110** in the radial direction R, as shown in FIG. **2**. The protrusions **120** each have a protrusion length **122** along the insertion direction I and a protrusion width **124** in a circumferential direction C of the first shield **100** around the insertion direction I. The protrusions **120** are each positioned adjacent to the first leading edge **114** but spaced apart from the first leading edge **114** along the insertion direction I.

[0019] The protrusions **120** are distributed in the circumferential direction C around the first shield body **110**. In the shown embodiment, four protrusions **120** are distributed around the first shield body **110**. This embodiment is merely exemplary and, in other embodiments, less than four or more than four protrusions **120** may be distributed around the first shield body **110** and may be arranged differently than in the positions shown in FIG. **2**.

[0020] The ribs **130** each extend from the first exterior surface **111** of the first shield body **110** in the radial direction R, as shown in FIG. **2**. The ribs **130** each have a rib length **132** along the insertion direction I. The rib length **132** is longer than the protrusion length **122** in the shown embodiment. The ribs **130** are each positioned adjacent to the first leading edge **114** but spaced apart from the first leading edge **114** along the insertion direction I. In the shown embodiment, the ribs **130** are each spaced the same distance from the first leading edge **114** along the insertion direction I as the protrusions **120**.

[0021] The ribs **130** are distributed in the circumferential direction C around the first shield body **110**. In the shown embodiment, six ribs **130** are distributed around the first shield body **110**. This embodiment is merely exemplary and, in other embodiments, less than six or more than six ribs **130** may be distributed around the first shield body **110** and may be arranged differently than in the positions shown in FIG. **2**.

[0022] The first shield **100** is formed of a conductive material, such as aluminum. In the shown embodiment, the first shield **100** is monolithically formed in a single piece from the conductive material with the first shield body **110**, the protrusions **120**, and the ribs **130**; in this embodiment, the protrusions **120** and the ribs **130** may be embossed on the first shield body **110** and the first shield body **110** is formed in a sheet and bent into the shape shown in FIG. **2**. In other embodiments, the first shield body **110** may be formed separately and attached together with the protrusions **120** and the ribs **130**.

[0023] The second shield **200**, as shown in FIG. **3**, has a second shield body **210** and a plurality of contact beams **220** extending from the second shield body **210**.

[0024] As shown in FIG. **3**, the second shield body **210** has a second exterior surface **211** and a second interior surface **212** opposite the second exterior surface **211** in the radial direction R. The second shield body **210** defines a second receiving space **213** extending along the insertion direction I and has a plurality of beam openings **214** extending through the second shield body **210** in the radial direction R and communicating with the second receiving space **213**. The second shield body **210** has a second leading edge **216** at one end in the insertion direction I. The second shield body **210** defines the second receiving space **213** with a shape corresponding to the shape of the first receiving space **113** of the first shield body **110**. In the shown embodiment, the second shield body **210** defines the second receiving space **213** with a rounded-rectangular cross-sectional shape in the shown embodiment. In other embodiments, the second shield body **210** could define the second receiving space **213** as a circular cross-sectional shape, or any other cross-sectional shape corresponding to the first receiving space **113** and used in shield contacts.

[0025] The contact beams **220** are each positioned in one of the beam openings **214**, as shown in FIG. **3**. The contact beams **220**, in the shown embodiment, are each cantilevered from the second shield body **210** and extend from a fixed end **222** to a cantilevered end **224** along the insertion direction I. In the shown embodiment, the cantilevered end **224** is positioned further from the second leading edge **216** of the second shield body **210** than the fixed end **222** along the insertion direction I. In another embodiment, the contact beam **220** may extend in the reverse direction with the cantilevered end **224** positioned closed to the second leading edge **216** than the fixed end **222** along the insertion direction I. In other embodiments, the contact beams **220** may be connected at both ends but otherwise function as described herein.

[0026] Each of the contact beams **220**, as shown in FIGS. **3** and **4**, has a beam body **230** and a pair of contact points **240**. The beam body **230** has a first beam section **232** and a second beam section **234** connected to the first beam section **232** at an intersection **236**, shown in detail in FIG. **4**. The second beam section **234** is bent at an angle **238** with respect to the first beam section **232**. The angle **238** is greater than 90° and less than 180°.

[0027] The contact points **240** are positioned at the intersection **236** of the first beam section **232** and the second beam section **234** and protrude, as shown in FIG. **4**, from the beam body **230** in the radial direction R toward the second receiving space **213**. The contact points **240** are spaced apart from the cantilevered end **224** along the insertion direction I. The contact points **240** on each contact beam **220** include a pair of contact points **240** that have a same position along the insertion direction I and are spaced apart from one another in the circumferential direction C of the second shield **200**.

[0028] The contact beams **220**, as shown in FIG. **3**, are distributed in the circumferential direction C around the second shield body **210**. In the shown embodiment, four contact beams **220** are distributed around the second shield body **210**. This embodiment is merely exemplary; the number of contact beams **220** of the second shield **200** and the location of the contact beams **220** on the second shield **220** in the circumferential direction C corresponds to the number of protrusions **120** of the first shield **100** and the locations of the protrusions **120** on the first shield **100** in the circumferential direction C.

[0029] The second shield **200** is formed of a conductive material, such as aluminum. In the shown embodiment, the second shield **200** is monolithically formed in a single piece from the conductive material with the second shield body **210** and the contact beams **220**. The second shield body **210** may be formed in a sheet, with the contact beams **220** punched and embossed, and then bent into the shape shown in FIG. **3**. In other embodiments, the second shield body **210** may be formed separately and attached together with the contact beams **220**.

[0030] The mating of the first shield **100** and the second shield **200** to form the connection of the shield contact system **10** will now be described in greater detail primarily with respect to FIGS. **4-7**.

[0031] The first shield **100** and the second shield **200** are inserted together along the insertion direction I. As shown in FIG. **4**, the first leading edge **114** of the first shield body **110** is positioned within the second leading edge **216** of the second shield body **210** and the first shield **100** is inserted into the second receiving space **213**. The first shield **100** is inserted into the second shield **200** in an intermediate position, referred to herein as an inserted state S, which is between a separated state of the shields **100**, **200** and the mated state M of the shields **100**, **200**.
[0032] In the inserted state S shown in FIG. **4**, the ribs **130** abut the second interior surface **212** of the second shield body **210**. Due to their position spaced apart from the first leading edge **114**, the ribs **130** allow for a greater tolerance in inserting the first leading edge **114** within the second leading edge **216** and, as the first shield **100** is further inserted along the insertion direction I, engage the second interior surface **212** to center and more precisely position the first shield **100** in the second receiving space **213**. The ribs **130** remain in abutment with the second interior surface **212** to provide this centering during insertion along the insertion direction I to the mated state M shown in FIGS. **1** and **7**.
[0033] Each of the protrusions **120** is aligned with one of the contact beams **220** during insertion of the first shield **100** along the insertion direction I. In the inserted state S shown in FIG. **4**, the protrusions **120** initially contact the contact beams **220** at the fixed ends **222** but have not yet deflected the contact beams **220**.
[0034] The first shield **100** is moved further along the insertion direction I in the second shield **200** to a deflected state D shown in FIG. **5**. As each of the protrusions **120** moves along one of the contact beams **220** in the insertion direction I, the protrusion **120** deflects the contact beam **220** away from the first shield body **110** and away from the second receiving space **213** in the radial direction R. The protrusion **120** deflects the contact beam **220** away from the first shield body **110** such that the contact points **240** of the contact beam **220** do not contact the first shield body **110** prior to the deflected state D or in the deflected state D. Due to the deflection of the beams **220** imparted by movement of the protrusions **120**, the first leading edge **114** of the first shield body **110** also does not contact the contact points **240** on the contact beams **220**. The ribs **130** remain in abutment with the second interior surface **212** of the second shield body **210** in the deflected state D.
[0035] FIG. **6** shows in greater detail that, when the protrusion **120** deflects the contact beam **220** in the deflected state D, the contact points **240** are deflected away from the first shield body **110** and do not contact the first exterior surface **111** of the first shield body **110**. As the first shield **100** is inserted further into the second receiving space **213** of the second shield **200** along the insertion direction I from the deflected state D to the mated state M, the protrusion **120** passes between the contact points **240**. As shown in FIG. **6**, a distance **242** between the contact points **240** in the circumferential direction C is greater than the protrusion width **124**, allowing the protrusion **120** to pass through while the contact beam **220** is deflected without abutting the contact points **240**.
[0036] The first shield **100** is further inserted together with the second shield **200** along the insertion direction I from the deflected state D shown in FIG. **5** to the mated state M shown in FIGS. **1** and **7**. When an end of the protrusion **120** further from the first leading edge **114** reaches the second beam section **234** of the contact beam **220**, the contact beam **220** elastically returns from the deflected position and the contact points **240** abut the first exterior surface **111** of the first shield body **110**. The contact beam **220** thus abuts the first shield body **110** in the mated state M, as shown in FIG. **7**. The first shield **100** may be further inserted a short distance along the insertion direction I with the contact points **240** sliding along the first exterior surface **111** by a correspondingly short wiping distance **250**. The wiping distance **250** is less than a distance **260** between the contact points **240** and the first leading edge **114** along the insertion direction I. The ribs **130** remain in abutment with the second interior surface **212** of the second shield body **210** in the mated state D.
[0037] The shield contact system **10** described above and shown in the drawings is one possible embodiment that incorporates the features of the invention. In another embodiment, for example,

the second shield **200** can be received within the first shield **100**. In this embodiment, the protrusion **120** is positioned on the first interior surface **112** and extends into the first receiving space **113**; this embodiment has the same function as described above, but the contact beams **220** deflect away from and then contact the first interior surface **112** of the first shield **100** in the mated state M.

[0038] In the mated state M, the first shield **100** and the second shield **200** are electrically connected. The shield contact system **10** may be part of an electrical connector system that electrically connects electrical components. In this application, the first shield **100** is positioned around a first dielectric having a first contact and the second shield **200** is positioned around a second dielectric having a second contact. The first shield **100** and the second shield **200** move into the mated state M described above to provide electromagnetic shielding for the mating between the first contact and the second contact.

[0039] In the shield contact system **10** according to the embodiments described above, the protrusion **120** deflects the contact beam **220** away from the first shield body **110** during insertion, which prevents the first leading edge **114** from contacting or shearing the contact points **240** of the contact beam **220**. The contact beam **220** remains deflected during insertion, and the contact points **240** remain separated from the first shield body **110**, until an end of the protrusion **120** further from the first leading edge **114** reaches the second beam section **234**. Thus, the contact points **240** of the contact beam **220** only have a short wiping distance **250** along the first exterior surface **111** of the first shield body **110** to the mated state M. Further, the use of multiple contact points **240** on each contact beam **220** create a redundancy in the contact in case one of the points **240** wears faster due to variations of the first shield **100** and second shield **200** within the manufacturing tolerance. The shield contact system **10** of the present invention limits damage to the contact points **240** and decreases the wiping distance **250**, minimizing wear and allowing the shield contact system **10** to be used over a greater number of mating cycles.

Claims

1. A shield contact system, comprising: a first shield having a first shield body and a protrusion extending from the first shield body; and a second shield having a second shield body and a contact beam extending from the second shield body, the first shield and the second shield are inserted together along an insertion direction from a deflected state to a mated state, the protrusion deflects the contact beam away from the first shield body in the deflected state, the contact beam abuts the first shield body in the mated state.

2. The shield contact system of claim 1, wherein the protrusion extends from a first exterior surface of the first shield body and the contact beam abuts the first exterior surface in the mated state.

3. The shield contact system of claim 2, wherein the first shield body is inserted into a second receiving space defined by the second shield body.

4. The shield contact system of claim 1, wherein the contact beam has a beam body and a contact point protruding from the beam body, the contact point abuts the first shield body in the mated state.

5. The shield contact system of claim 4, wherein the contact point is one of a pair of contact points of the contact beam, the contact points have a same position along the insertion direction and are spaced apart from one another in a circumferential direction of the second shield.

6. The shield contact system of claim 5, wherein the protrusion passes between the contact points along the insertion direction from the deflected state to the mated state.

7. The shield contact system of claim 4, wherein the contact point is not in contact with the first shield body in the deflected state.

8. The shield contact system of claim 4, wherein the contact beam is cantilevered from the second shield body and extends from a fixed end to a cantilevered end.

9. The shield contact system of claim 8, wherein the cantilevered end is positioned further from a second leading edge of the second shield body than the fixed end along the insertion direction.
10. The shield contact system of claim 8, wherein the beam body has a first beam section and a second beam section bent at an angle with respect to the first beam section.
11. The shield contact system of claim 10, wherein the contact point is positioned at an intersection of the first beam section and the second beam section, the contact point is spaced apart from the cantilevered end along the insertion direction.
12. The shield contact system of claim 1, wherein the protrusion is one of a plurality of protrusions of the first shield and the contact beam is one of a plurality of contact beams of the second shield, each of the protrusions is aligned with one of the contact beams during insertion along the insertion direction.
13. The shield contact system of claim 12, wherein the protrusions are distributed in a circumferential direction around the first shield body and the contact beams are distributed in the circumferential direction around the second shield body.
14. The shield contact system of claim 1, wherein the first shield has a rib extending from the first shield body, the rib abuts the second shield body in the deflected state and in the mated state.
15. The shield contact system of claim 14, wherein the rib has a rib length that is longer than a protrusion length of the protrusion along the insertion direction.
16. A process of connecting a shield contact system, comprising: providing a first shield having a first shield body and a protrusion extending from the first shield body; providing a second shield having a second shield body and a contact beam extending from the second shield body; and inserting the first shield and the second shield together along an insertion direction to a mated state, the contact beam abuts the first shield body in the mated state, the protrusion deflects the contact beam away from the first shield body during insertion in a deflected state prior to reaching the mated state.
17. The process of claim 16, wherein the contact beam has a beam body and a contact point protruding from the beam body, the contact point abuts the first shield body in the mated state.
18. The process of claim 17, wherein the protrusion deflects the contact beam away from the first shield body during insertion before a first leading edge of the first shield body contacts the contact point.
19. The process of claim 18, wherein, during insertion, the contact point slides along the first shield body by a wiping distance to the mated state that is less than a distance between the contact point and a first leading edge of first shield body in the mated state.
20. The process of claim 17, wherein the contact point is one of a pair of contact points of the contact beam, the protrusion passes between the contact points during insertion.