

Description

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention generally relates to electrical spring contact terminals and connector assemblies and more particularly, to an improved spring contact electrical connector assembly including a female receptacle for receiving a mating contact member.

2. Brief Description of the Prior Art

Various spring contact electrical connector assemblies have been provided in the past for making electrical contact between spring contact electrical terminals and other contact members such as terminal pins, circuit board edge contact pads and others. Such known spring contact terminals typically have a spring portion configured to be deflected when mated with the other contact members so that relatively high deflection forces are required to provide necessary contact forces for reliable electrical connection. Some of the resulting disadvantages are that undesirably high insertion forces are required to overcome the required deflection forces and that the insertion forces are relatively large in comparison with the withdrawal force. Another disadvantage is that an undesirably large amount of space typically is required for the various spring configurations. As a consequence of these disadvantages, a desirably small center-to-center terminal spacing cannot be achieved.

SUMMARY OF THE INVENTION

Electrical connectors including mating contact structures which rely on the development of torque to provide normal contact forces between the contacts in mating are known from US-A-4,105,277. The contact structures disclosed in this patent include a rotationally deflectable male contact and a tubular female contact including an angularly offset constriction forming an elliptical throat section. As the male terminal is inserted into the female receptacle, the forward portion of the male terminal is rotated so that it may pass through the constriction, which twisting generates torque in the base support portions of the male terminal. The contact structure described develops only two points of electrical contact between the male and female terminals. The contact structure still does not provide desirably low insertion forces because the ramping surfaces adjacent the constriction section in the female are very short, so that a relatively large amount of insertion force must still be provided to

twist the front end of the male terminal so that it will pass into and through the constriction.

FR-A-2,322,465 discloses a connector assembly in which twistable male contacts are inserted into an untwisted female receptacle.

Among the important objects of the present invention are to provide an improved electrical connector assembly, to provide such an assembly in which effective contact forces can be obtained without unduly large insertion forces; to provide such an assembly in which a low ratio of insertion force to withdrawal force is achieved; and to provide such an assembly overcoming disadvantages by having smaller space requirements than assemblies used for this purpose in the past.

In brief, in accordance with the above and other objects and advantages of the invention, there is provided an electrical contact assembly including a female receptacle 22,72, for receiving a mating contact member 24,74, said mating contact member 24,74, being an axially elongated member formed of a resiliently deflectable electrically conductive material which, in an unmated state, longitudinally extends generally in a single plane including a plurality of parallel beams 34,84, said female receptacle 22,72, being formed of an electrically conductive material and having an elongated tubular body the interior surfaces of which are adapted to slidably engage said mating contact member characterized by said female receptacle including a forward mating end 28,78, an opposed rear end 30,80, and a longitudinally extending rotational skew distributed along its length between said ends, such that the interior surfaces of the receptacle define a generally helical interior for slidably receiving and gradually deflecting said mating contact member, whereby normal contact forces are developed by insertion of the mating contact member into the female receptacle causing gradual resilient deflection of the mating contact member from a planar unmated configuration to a non-planar mated configuration wherein it assumes the generally helical configuration of the interior of the female receptacle.

Some ways of carrying out the present invention will now be described in detail by way of example with reference to drawings which show specific embodiments.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a perspective view of a connector assembly constructed in accordance with the present invention;

FIG. 2 is an end elevational view of a female receptacle of the connector assembly of Fig. 1;

FIG. 3 is an alternative embodiment of a mating male contact member for use with the connector

assembly of Fig. 1;

FIG. 4 is a perspective view of an alternative embodiment of the connector assembly constructed in accordance with the present invention.

FIG. 5 is an end elevational view of a female receptacle of the connector assembly of Fig. 1; and

FIG. 6 is a sectional view taken along the line 6-6 of Fig. 5.

DETAILED DESCRIPTION OF THE SPECIFIC EMBODIMENTS

Referring now to Figs. 1 and 2, the electrical connector assembly, generally designated by the reference numeral 20, includes a female receptacle 22 and a mating contact member 24.

The female receptacle 22 includes an elongated, generally elliptical, tubular body 26 formed of electrically conductive material, having a forward end 28 for receiving the mating contact 24 and an opposite rear end 30 for electrical connection with another contact member (not shown).

The receptacle 22 has a longitudinally extending twist profile or rotational skew distributed along its length between opposite ends 28 and 30. Summation of the distributed rotational skew provides a total diversion angle shown as D in Fig. 2 from an entry axis E-E at the forward end 28 to a fully mated axis F-F at opposite end 30 for the mating contact member 24. The female receptacle 22 may be formed from straight conductive tubing that is cut to the desired length for the body 26, then firmly supported at the rear end 30 and torqued or twisted at the forward end 28 as indicated by an arrow 32 to rotationally deform the tubular body 26 to define the longitudinally extending rotational skew or twist profile for the receptacle 22.

The mating contact member 24 includes a pair of parallel, axially elongated, side-by-side beams 34 having spherical or rounded free ends 36 so configured to be smoothly received within the tubular body 26 without scoring or damaging the interior wall surfaces of the female receptacle 22. Opposite ends 38 of the parallel beams are secured to an upper, inclined surface 40 of a support member 42, such as by welding. The elongated parallel beams are formed of flexible conductive material, such as round sectioned copper wire.

When the mating contact member 24 is inserted within the female receptacle 22, the pre-defined longitudinal rotational skew profile of the receptacle 22 causes deflection of the resilient beams 34 to occur progressively. As a result, low insertion forces may be achieved without undue reduction in normal contact forces. A desirable wiping contact is also achieved. A line contact is

obtained along the longitudinal rotational skew profile to provide good mechanical and electrical contact.

The arrangement is such that the resilient beams 34 are resiliently deformed below their elastic limit so that when the contact member 24 is removed or demated from the receptacle 22 the beams reversely resiliently deflect to resume their original parallel longitudinally extending profile. Thereby, a low ratio of insertion to withdrawal force is provided by the contact assembly 20.

Referring now to Fig. 3, there is shown an alternative embodiment of a mating contact member 44 that can be used with the female receptacle 22 of Fig. 1 instead of the contact member 24. The contact member 44 includes a single integral member 46 defining a pair of elongated, generally parallel beams 48 with a bent, rounded free end 50. Opposite ends 52 of the resilient parallel beams 48 are secured to a support member 54. Support member 54 is formed of a tubular body 56 with a forward open end 58 for receiving the beam ends 52 and an opposite rear end 60 for engagement with another contact member (not shown). The beam ends 52 may be secured to the body 56 by welding or by crimping. The rear end 60 can be formed by compressing the tubular body 56 on all of its sides to provide the flattened rear end, as shown.

In accordance with this embodiment, when mating contact member 44 is inserted into female receptacle 22, the contact member 44 is gradually resiliently deflected from a generally planar unmated state to a non-planar generally helical mated configuration wherein mating contact 44 assumes the helical configuration defined by the interior of the female receptacle 22. In the process, this mating deformation causes four independent points of electrical contact to be developed between the male and female contact members, acting on opposite sides of a male terminal 44 adjacent free end 50 and adjacent open end 58 of support member 54. An advantageous wiping action occurs between the contact points disposed on opposite sides of parallel beams 48 adjacent free end 50 and the interior surfaces of the female receptacle 22. More particularly, as mating contact 44 is inserted into receptacle 22, debris, dust and other contaminants are ploughed up the surfaces of beams 48 away from the front end toward the center portion of the beams. The contact points located on beams 48 adjacent free end 50 are wiped clean during insertion to provide reliable electrical contact with the rearward interior surfaces of female receptacle 22.

Although contact 44 is shown comprising a bent wire loop for forming parallel beams 48, other equivalent structures may be used. More particu-

larily, mating contact 44 may comprise a stamped rectangular blade formed from conductive resilient sheet metal stock including an elongate central slot aperture therein to define parallel beams 48. In either case, the male contact 44 of this embodiment is gradually resiliently deflected during mating to assume the non-planar helical configuration of the interior of the torque tube female receptacle 22.

The connector assembly 70 shown in Figs. 4 to 6 includes a female receptacle 72 and a mating contact member 74.

The female receptacle 72 includes an elongated, generally rectangular tubular body 76 formed of electrically conductive material, having a forward end 78 for receiving the mating contact 74 and an opposite cylindrical rear end 80 for electrical connection with another contact member (not shown). As with the before-described embodiments of the present invention, the female receptacle 72 has a longitudinally extending twist profile distributed along its length between the forward end 78 and an opposite end 82 of the tubular body 76. As illustrated in Fig. 5, summation of the distributed rotational skew provides a total diversion angle shown as G in Fig. 5 from the entry axis H-H at the forward end 78 to a fully mated axis I-I at the opposite end 82 for the mating contact member 74. The longitudinally extending rotational skew for the receptacle 72 may be formed by firmly supporting the rear mating end portion 80 and twisting the forward end 78 as indicated by an arrow 83 to rotationally deform an originally straight tubular body 76.

As illustrated in Fig. 6, the forward end 78 includes an inclined or tapered lead-in 78A to ensure that the mating contact member 74 is guided accurately into the receptacle body 76. The before-described embodiments likewise, advantageously include such a tapered lead-in at the forward end 28 of the female receptacle 22.

The mating contact member 74 includes a plurality of four parallel, axially elongated beams 84 configured for mating with the rectangular tubular body 76. Each of the elongated beams 84 has a spherical or rounded free end 86 and an opposite end 88 (shown in dotted line) secured within a forward open end 80 of the support member 82. A similar tubular body as used for the receptacle 72 (except without the rotational skew) may be utilized for the support member 82. The beam ends 88 may be secured within the support member 82 by welding or crimping. Support member 82 includes an enlarged, cylindrical rear end 84 for mating engagement with another contact member (not shown).

Claims

1. An electrical contact assembly including a female receptacle (22,72), for receiving a mating contact member (24,74), said mating contact member (24,74), being an axially elongated member formed of a resiliently deflectable electrically conductive material which, in an unmated state, longitudinally extends generally in a single plane including a plurality of parallel beams (34,84), said female receptacle (22,72), being formed of an electrically conductive material and having an elongated tubular body the interior surfaces of which are adapted to slidably engage said mating contact member characterized by said female receptacle including a forward mating end (28,78), an opposed rear end (30,80), and a longitudinally extending rotational skew distributed along its length between said ends, such that the interior surfaces of the receptacle define a generally helical interior for slidably receiving and gradually deflecting said mating contact member, whereby normal contact forces are developed by insertion of the mating contact member into the female receptacle causing gradual resilient deflection of the mating contact member from a planar unmated configuration to a non-planar mated configuration wherein it assumes the generally helical configuration of the interior of the female receptacle.
2. An electrical contact assembly as claimed in claim 1 wherein four independent points of electrical contact are developed between the mating contact member and the female receptacle as the contacts are moved to a fully mated condition.
3. An electrical contact assembly as claimed in claim 1 or claim 2, in which the female receptacle has an elliptical body.

Patentansprüche

1. Elektrische Kontakteinheit mit einer Aufnahme (22,72) zur Aufnahme eines Verbindungskontaktglieds (24,74), wobei das Verbindungskontaktglied (24,74) ein axial langgestrecktes Glied aus einem elastisch verbiegbaren elektrisch leitenden Material ist, das in einem unverbundenen Zustand in Längsrichtung im allgemeinen in einer einzigen Ebene mit einer Mehrzahl paralleler Stäbe (34,84) verläuft, und die Aufnahme (22,72) aus einem elektrisch leitenden Material gebildet ist und einen langgestreckten Rohrkörper besitzt, dessen innere Oberflächen mit dem Verbindungskontaktglied gleitbar in Eingriff bringbar sind, dadurch ge-



larly, mating contact 44 may comprise a stamped rectangular blade formed from conductive resilient sheet metal stock including an elongate central slot aperture therein to define parallel beams 48. In either case, the male contact 44 of this embodiment is gradually resiliently deflected during mating to assume the non-planar helical configuration of the interior of the torque tube female receptacle 22.

The connector assembly 70 shown in Figs. 4 to 6 includes a female receptacle 72 and a mating contact member 74.

The female receptacle 72 includes an elongated, generally rectangular tubular body 76 formed of electrically conductive material, having a forward end 78 for receiving the mating contact 74 and an opposite cylindrical rear end 80 for electrical connection with another contact member (not shown). As with the before-described embodiments of the present invention, the female receptacle 72 has a longitudinally extending twist profile distributed along its length between the forward end 78 and an opposite end 82 of the tubular body 76. As illustrated in Fig. 5, summation of the distributed rotational skew provides a total diversion angle shown as G in Fig. 5 from the entry axis H-H at the forward end 28 to a fully mated axis I-I at the opposite end 82 for the mating contact member 74. The longitudinally extending rotational skew for the receptacle 72 may be formed by firmly supporting the rear mating end portion 80 and twisting the forward end 78 as indicated by an arrow 83 to rotationally deform an originally straight tubular body 76.

As illustrated in Fig. 6, the forward end 78 includes an inclined or tapered lead-in 78A to ensure that the mating contact member 74 is guided accurately into the receptacle body 76. The before-described embodiments likewise, advantageously include such a tapered lead-in at the forward end 28 of the female receptacle 22.

The mating contact member 74 includes a plurality of four parallel, axially elongated beams 84 configured for mating with the rectangular tubular body 76. Each of the elongated beams 84 has a spherical or rounded free end 86 and an opposite end 88 (shown in dotted line) secured within a forward open end 80 of the support member 82. A similar tubular body as used for the receptacle 72 (except without the rotational skew) may be utilized for the support member 82. The beam ends 88 may be secured within the support member 82 by welding or crimping. Support member 82 includes an enlarged, cylindrical rear end 84 for mating engagement with another contact member (not shown).

Claims

1. An electrical contact assembly including a female receptacle (22,72), for receiving a mating contact member (24,74), said mating contact member (24,74), being an axially elongated member formed of a resiliently deflectable electrically conductive material which, in an unmated state, longitudinally extends generally in a single plane including a plurality of parallel beams (34,84), said female receptacle (22,72), being formed of an electrically conductive material and having an elongated tubular body the interior surfaces of which are adapted to slidably engage said mating contact member characterized by said female receptacle including a forward mating end (28,78), an opposed rear end (30,80), and a longitudinally extending rotational skew distributed along its length between said ends, such that the interior surfaces of the receptacle define a generally helical interior for slidably receiving and gradually deflecting said mating contact member, whereby normal contact forces are developed by insertion of the mating contact member into the female receptacle causing gradual resilient deflection of the mating contact member from a planar unmated configuration to a non-planar mated configuration wherein it assumes the generally helical configuration of the interior of the female receptacle.
2. An electrical contact assembly as claimed in claim 1 wherein four independent points of electrical contact are developed between the mating contact member and the female receptacle as the contacts are moved to a fully mated condition.
3. An electrical contact assembly as claimed in claim 1 or claim 2, in which the female receptacle has an elliptical body.

Patentansprüche

1. Elektrische Kontakteinheit mit einer Aufnahme (22,72) zur Aufnahme eines Verbindungskontaktglieds (24,74), wobei das Verbindungskontaktglied (24,74) ein axial langgestrecktes Glied aus einem elastisch verbiegbaren elektrisch leitenden Material ist, das in einem unverbundenen Zustand in Längsrichtung im allgemeinen in einer einzigen Ebene mit einer Mehrzahl paralleler Stäbe (34,84) verläuft, und die Aufnahme (22,72) aus einem elektrisch leitenden Material gebildet ist und einen langgestreckten Rohrkörper besitzt, dessen innere Oberflächen mit dem Verbindungskontaktglied gleitbar in Eingriff bringbar sind, dadurch ge-



kennzeichnet, daß die Aufnahme ein vorderes Verbindungsende (28,78), ein gegenüberliegendes hinteres Ende (30,80) und eine in Längsrichtung verlaufende, auf ihrer Länge zwischen den Enden verteilte Rotationsschrägstellung aufweist, derart, daß die inneren Oberflächen der Aufnahme einen im allgemeinen schraubenlinienförmigen Innenraum für eine gleitbare Aufnahme und ein allmähliches Verbiegen des Verbindungskontaktglieds bilden, wodurch normale Kontaktkräfte durch Einsetzen des Verbindungskontaktglieds in die Aufnahme entwickelt werden, die ein allmähliches elastisches Verbiegen des Verbindungskontaktglieds aus einer ebenen unverbundenen Gestalt in eine nicht-ebene Verbindungsgestalt herbeiführen, wobei es die im allgemeinen schraubenlinienförmige Gestalt des Innenraums der Aufnahme annimmt.

2. Elektrische Kontakteinheit nach Anspruch 1, bei der vier unabhängige Punkte elektrischen Kontakts zwischen dem Verbindungskontaktglied und der Aufnahme bei der Bewegung der Kontakte in einen Vollverbundungszustand aufgebaut werden.
3. Elektrische Kontakteinheit nach Anspruch 1 oder Anspruch 2, bei der die Aufnahme einen elliptischen Körper besitzt.

Revendications

1. Connecteur électrique comprenant un boîtier femelle (22,72) destiné à recevoir un élément d'accouplement (24,74), ledit élément d'accouplement (24,74) étant formé d'un élément allongé axialement en un matériau électriquement conducteur et déformable élastiquement, qui, dans un état non connecté, s'étend longitudinalement dans un simple plan, comportant une pluralité d'éléments parallèles (34,84), ledit boîtier femelle (22,72) étant formé d'un matériau conducteur électriquement et possédant un corps tubulaire allongé, dont les surfaces intérieures sont adaptées à un coulisement de l'élément connecteur, caractérisé en ce que ledit boîtier femelle comporte une extrémité d'accouplement avant (28,78) et une extrémité arrière opposée (30,80), qui s'étend longitudinalement de biais en hélice sur toute sa longueur entre lesdites extrémités, telles que les surfaces intérieures du boîtier constituent un intérieur de forme générale en hélice, pour recevoir, à coulisement, et déformer graduellement ledit élément connecteur, de façon à développer des forces de contact normales par l'insertion de l'élément connecteur dans le boî-

tier femelle, provoquant une déformation élastique graduelle de l'élément connecteur, d'une forme de plan en configuration non connecté; à une forme non plane en configuration connectée, dans laquelle il épouse la configuration en hélice de l'intérieur du boîtier femelle.

2. Connecteur électrique suivant la revendication 1 caractérisé en ce que quatre points de contact électrique indépendants sont réalisés entre l'élément connecteur et le boîtier femelle, lorsque les contacts sont déplacés vers un état totalement connecté.
3. Connecteur électrique suivant l'une des revendications 1 ou 2 caractérisé en ce que le boîtier femelle possède un corps elliptique.