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Bruce

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(54) **CLIP RING FOR AN ELECTRICAL CONNECTOR**

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(63) Continuation of application No. 09/458,082, filed on Dec. 10, 1999, now Pat. No. 6,332,815.

(51) **Int. Cl.**[7] **H01R 13/648**
(52) **U.S. Cl.** **439/609**; 439/862; 439/578
(58) **Field of Search** 439/609, 578, 439/862, 860, 868, 883

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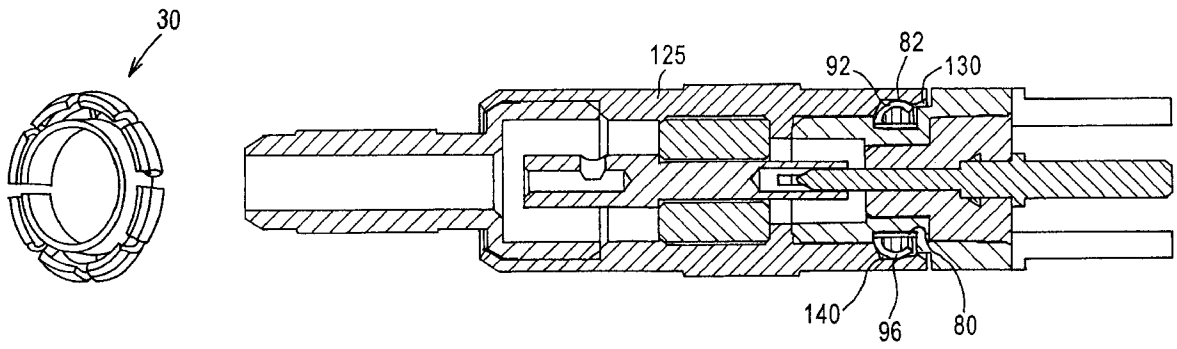
(57) **ABSTRACT**

The present invention is directed to an integrally formed clip ring made out of a conductive resilient material such as beryllium copper. The clip ring is used for retaining a male member and a female member of an electrical connector and for forming a ground circuit between the male member and the female member of the electrical connector. The clip ring of the present invention fully engages the outside diameter of the male retaining groove and the inside diameter of the female retaining groove simultaneously. Advantageously, this eliminates the potential for discontinuities in a ground circuit in a vibrational environment. The clip ring includes an annular-shaped body having an inner wall and an outer wall where the outer wall has a plurality of circumferentially spaced slots. The outer wall has a first end circumferentially spaced from a second end wherein when the clip ring is compressed a first end and a second end are brought into contact with each other. In this manner, a complete 360° contact is maintained when the male member and the female member are fully engaged.

24 Claims, 2 Drawing Sheets



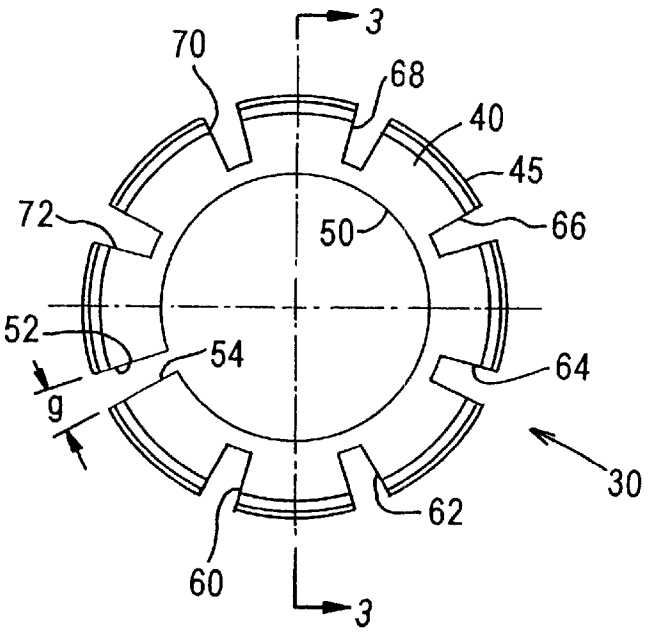


FIG. 2

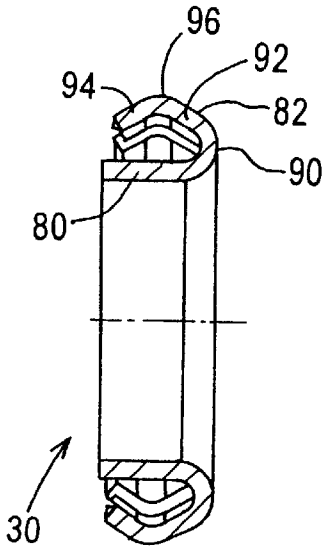


FIG. 3

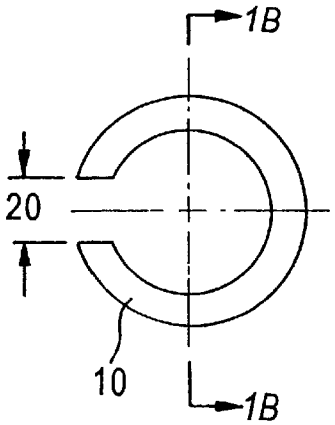


FIG. 1A
(PRIOR ART)

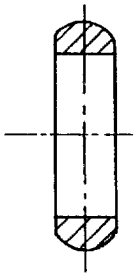


FIG. 1B

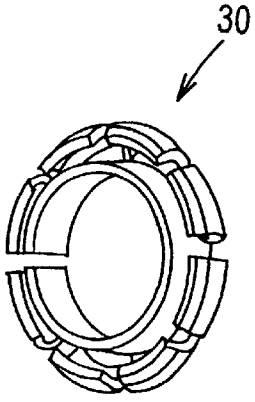


FIG. 4

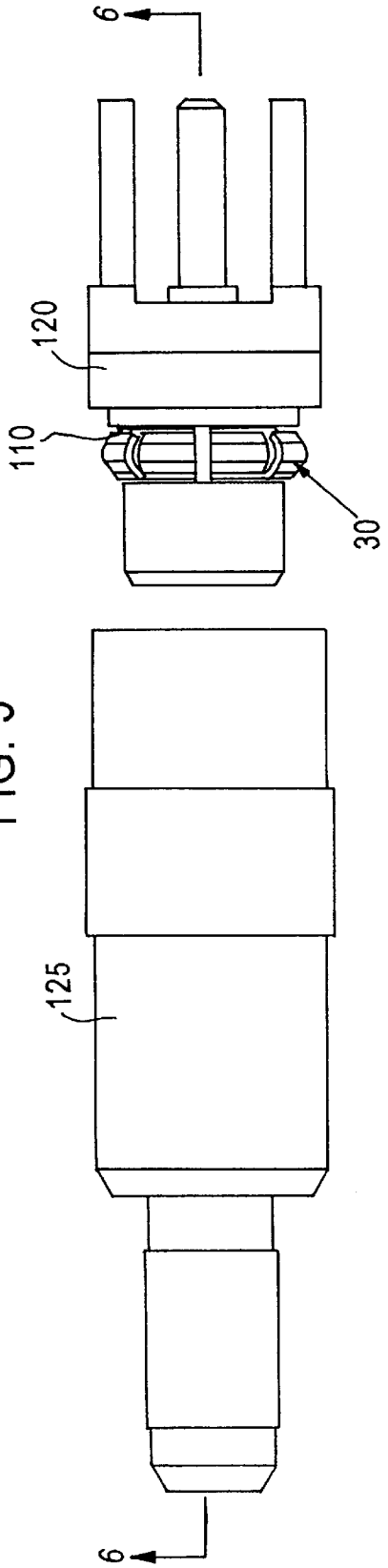


FIG. 5

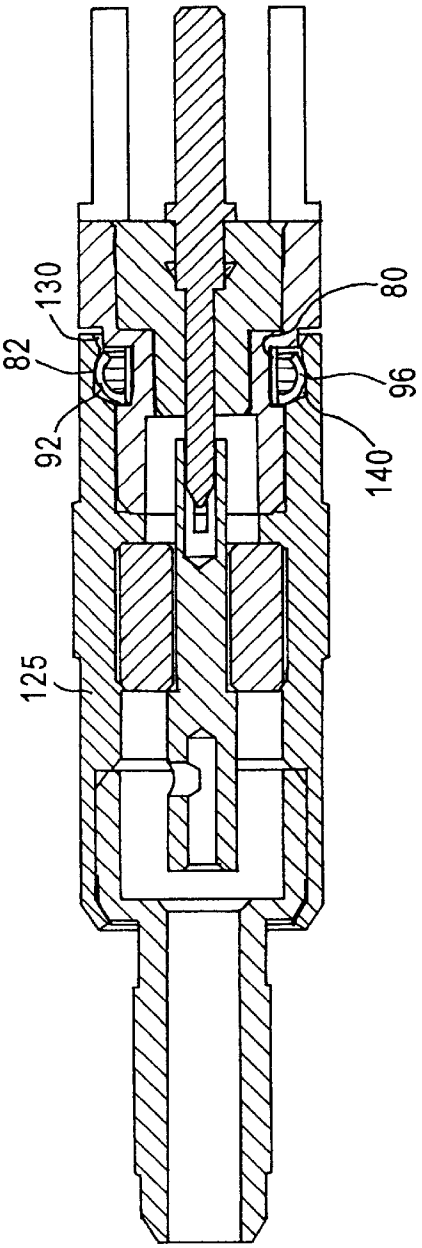


FIG. 6

CLIP RING FOR AN ELECTRICAL CONNECTOR

This application is a Continuation of application Ser. No. 09/458,082 filed Dec. 10, 1999, U.S. Pat. No. 6,332,815.

FIELD OF THE INVENTION

The present invention relates generally to clip rings, and more particularly to clip rings for electrical connectors.

BACKGROUND OF THE INVENTION

Depicted in FIGS. **1**A and **1**B is a simple "C" ring that fits in a groove on a male member of a mated pair of electrical connectors. When the male member and the female member are being engaged, this "C" ring is compelled to close into the groove on the male member so that the inside diameter of the female member may pass around it. Once the male member and the female member are fully engaged there is a concentric undercut groove in the female member that the "C" ring on the male member engages by springing back and partially engaging the outside diameter of the retaining groove of the male member and the inside diameter of the retaining groove of the female member.

The problem with the "C" ring depicted in FIGS. **1**A and **1**B is that the "C" ring can only touch a portion of the inside diameter of the female connector and a portion of the male connector simultaneously. The "C" ring can rattle in a vibrational environment causing a discontinuity in the circuit. In addition, the insertion withdrawal forces cannot be accurately tuned to the needs of the user. Accordingly, a need exists for a clip ring in which the insertion forces can be accurately predicted, and in which a complete electrical circuit is completed when the male member and the female member are fully engaged.

SUMMARY OF THE INVENTION

It, therefore, an object of the present invention to provide a clip ring in which the insertion withdrawal forces can be kept within a narrow band.

Another object of the present invention is to provide a clip ring which provides an excellent grounding path completing a ground circuit between a male and female connector when the male member and the female member are fully engaged.

It is yet another object of the present invention to provide a retaining clip in which the outside diameter and inside diameter of the clip extend for a fully 360° contact with both the female member and the male member when the male member and the female member are fully engaged.

It is yet another object of the present invention to provide a clip ring in which the withdrawal and insertion forces can be tuned to a great degree by varying the material thickness and beam length of the fingers of the clip ring.

The present invention is directed to an integrally formed clip ring made out of a conductive resilient material such as beryllium copper. The clip ring is used for retaining a male member and a female member of an electrical connector and for forming a ground circuit between the male member and the female member of the electrical connector. The clip ring of the present invention fully engages the outside diameter of the male retaining groove and the inside diameter of the female retaining groove simultaneously. Advantageously, this eliminates the potential for discontinuities in a ground circuit in a vibrational environment. The clip ring includes an annular-shaped body having an inner wall and an outer wall where the outer wall has a plurality of circumferentially spaced slots. The outer wall has a first end circumferentially spaced from a second end wherein when the clip ring is compressed a first end and a second end are brought into contact with each other. In this manner, a complete 360° contact is maintained when the male member and the female member are fully engaged.

These and other objects of the present invention are achieved by a resilient clip ring which includes an annular-shaped body having an inner wall and an outer wall. The outer wall has a plurality of circumferentially spaced slots.

The foregoing and other objects of the present invention are achieved by a resilient clip ring which includes an annular-shaped body having an inner wall and an outer wall. The outer wall has a plurality of circumferentially spaced slots. The body has a first end circumferentially spaced from a second end. The first end and the second edge are brought into contact when the clip ring is inserted into a groove.

Still other objects and advantages of the present invention will become readily apparent to those skilled in the art from the following detailed description, wherein the preferred embodiments of the invention are shown and described, simply by way of illustration of the best mode contemplated of carrying out the invention. As will be realized, the invention is capable of other and different embodiments, and its several details are capable of modifications in various obvious respects, all without departing from the invention. Accordingly, the drawings and description thereof are to be regarded as illustrative in nature, and not as restrictive.

BRIEF DESCRIPTION OF THE DRAWINGS

The present invention is illustrated by way of example, and not by limitation, in the figures of the accompanying drawings, wherein elements having the same reference numeral designations represent like elements throughout and wherein:

FIG. **1**A is a top view of a prior art clip ring;

FIG. **1**B is cross-sectional view taken along lines **1**B—**1**B of FIG. **1**A depicting a cross-sectional view of the clip ring;

FIG. **2** is a top plan view of a clip ring according to the present invention;

FIG. **3** is a cross-sectional view taken along lines **3**—**3** in FIG. **2**; and

FIG. **4** is a bottom perspective view of the clip ring according to the present invention;

FIG. **5** is a side elevational view of an exemplary electrical connector in an uncoupled condition which is usable with the inventive clip ring of the present invention; and

FIG. **6** is a cross-sectional view taken along lines **6**—**6** in FIG. **5** within the electrical connector in a coupled condition.

BEST MODE FOR CARRYING OUT THE INVENTION

Referring first to FIG. **2**, a bottom plan view of a clip ring **30** according to the present invention is depicted. The clip ring **30** includes an annular body **40** having an outer surface **45** and an inner surface **50**. A first edge **52** and a second edge **54** are circumferentially spaced from each other and form a gap g. As depicted in FIG. **2**, seven slots extend from outer wall **45** and are equally circumferentially spaced. The seven slots **60**–**72** and the gap g essentially form eight weak areas in the body **40** thereby providing flexibility to the clip ring **30**. The slots **60**–**72** and the gap g are equally circumferentially spaced. Slots **60**, **62**, **64**, **66**, **68**, **70**, **72** extend inwardly from the outer wall **45** and terminate before inner wall **50**.

As depicted in FIG. **3**, clip ring **30** has an inner section **80** and outer fingers **82** formed between each of the inwardly extending slots. Although seven slots are depicted, any number of slots can be used. As should be understood, the more slots that are used the lower the insertion forces would be for any given material thickness and the fewer slots that are used for any given material thickness will increase insertion withdrawal forces. Each of the fingers **82** has a first rounded section **90** which connects the finger **82** to the inner wall **80**, a front ramp section **92** and a rear ramp section **94**.

As depicted in FIG. **4**, the rear ramp section **94** is spaced from the inner wall **80**. Referring back to FIG. **3**, front ramp section **92** and rear ramp section **94** meet at a knuckle portion **96**.

As depicted in FIG. **5**, the clip ring **30** is positioned in a groove **110** in a male connector **120** for mating with a female connector **125**. The components of the male connector **120** and the female connector **125** are not described herein as they form no part of the present invention. It should be appreciated that the clip ring **30** according to the present invention is usable on any type of male/female connector which are mated in a push/pull manner. In operation, when one connector is being inserted into the other, front ramp section **92** will make contact with a lead in ramp **130** on the female connector **125**, the outer diameter of the female connector **125**, thereby causing the outer section **82** to flex radially inwardly. That is, rear section **94** will be brought nearer to inner wall **80**. The knuckle portion **96** will be brought into contact with the inner diameter **140** of the female connector **125**. Upon full insertion into the groove, the portion **82** will flex radially outwardly and be in full engagement with the inner diameter **140**. Most preferably, the inner diameter **140** will have a curved shape as depicted in FIG. **6**. The shape of the curved surface should be such that rear ramp section **94** is in contact with the curved surface when the clip ring **30** is fully inserted into the female connector **125**. The shape of the curved surface will help retain the clip ring **30** in the curved surface.

As should be appreciated, the clip ring **30** of the present invention will fully engage the outside diameter of the male retaining groove and the inside diameter of the female retaining groove simultaneously. Further, upon insertion of the clip ring into the groove, the gap will be closed and surfaces **52** and **54** will be brought into contact with each other. This eliminates the potential for discontinuities in the ground circuit in a vibrational environment. In addition, the insertion and withdrawal forces can be tuned to a greater degree by varying the material thickness and the beam length of the fingers **82**.

It will be readily seen by one of ordinary skill in the art that the present invention fulfills all of the objects set forth above. After reading the foregoing specification, one of ordinary skill will be able to affect various changes, substitutions of equivalents and various other aspects of the invention as broadly disclosed herein. It is therefore intended that the protection granted hereon be limited only by the definition contained in the appended claims and equivalents thereof.

What is claimed is:

1. A resilient electrically conductive clip ring, comprising:

an annular-shaped body having an inner wall and an outer wall;

said outer wall having a plurality of circumferentially spaced slots extending substantially through the whole entirety of said outer wall, thereby rendering said outer wall operatively elastically flexible radially inwardly toward said inner wall;

said body extending circumferentially for less than 360°, and having first and second ends circumferentially spaced from each other and adapted to be brought into contact;

wherein said outer wall has a first section extending obliquely and away from an edge of said inner wall, and a second section extending obliquely from an edge of the first section and towards said inner wall.

2. The resilient clip ring of claim **1**, wherein said body extends circumferentially for a fill 360° when said first and second ends are brought into contact.

3. The resilient clip ring of claim **1**, wherein said outer wall has a plurality of radially outwardly extending fingers.

4. The resilient clip ring of claim **1**, wherein said first section is a ramp extending radially away from said inner wall.

5. The resilient clip ring of claim **1**, wherein said second section is a ramp extending radially toward said inner wall.

6. The resilient clip ring of claim **1**, wherein said body is made of beryllium copper.

7. The resilient clip ring of claim **1**, wherein said clip ring is integrally formed.

8. A resilient electrically conductive clip ring for connecting a male connector with a mating female connector, said clip ring comprising:

an annular-shaped body having an inner wall and an outer wall;

said inner wall forming an electrical contact with an outside diameter of said male connector when said clip ring is positioned on said male connector;

said outer wall having a convex shape including a first section extending from an edge of said inner wall, a knuckle portion extending from an edge of said first section, and a second section extending from an edge of said knuckle portion,

said outer wall being operatively elastically flexible radially inwardly toward said inner wall and said knuckle portion forming an electrical contact with an inner diameter of said female connector when said clip ring is introduced into said female connector; and

said body extending circumferentially for less than 360°, and having first and second ends circumferentially spaced from each other and adapted to be brought into non-overlapping contact.

9. The resilient clip ring of claim **8**, wherein said body extends circumferentially for a full 360° when said first and second ends are brought into contact.

10. The resilient clip ring of claim **8**, wherein said body is made of beryllium copper.

11. The resilient clip ring of claim **8**, wherein said clip ring is integrally formed.

12. The resilient clip ring of claim **8**, wherein said first section is angled to form a lead in section when said clip ring is introduced into said female connector.

13. The resilient clip ring of claim **12**, wherein said lead in section is a ramp.

14. The resilient clip ring of claim **8**, wherein said second section is angled to form a lead out section when said clip ring is withdrawn from said female connector.

15. The resilient clip ring of claim **14**, wherein said lead out section is a ramp.

16. The resilient clip ring of claim **8**, wherein said outer wall has a plurality of circumferentially spaced slots and a plurality of radially outwardly extending fingers formed therebetween.

17. The resilient clip ring of claim **16**, wherein said slots extend substantially through the whole entirety of said outer wall.

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