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SELF-ALIGNING COAXIAL CONNECTOR

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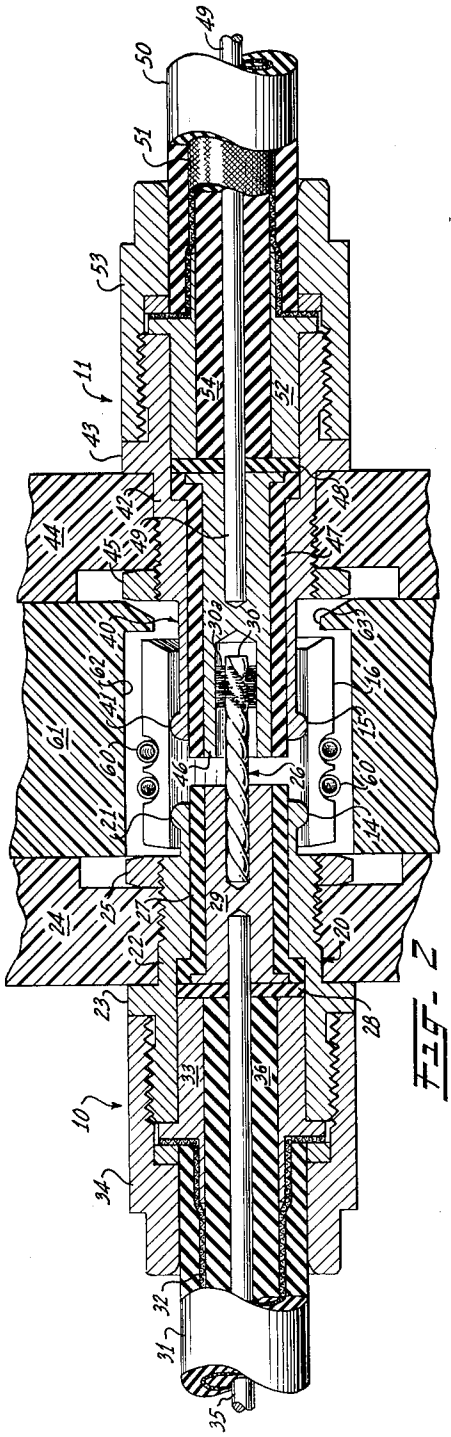


FIG. 2

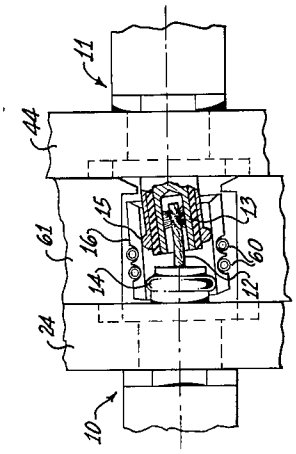


FIG. 3

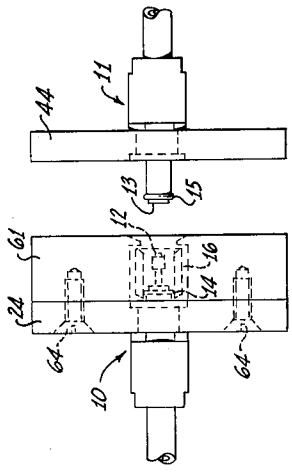


FIG. 1

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SELF-ALIGNING COAXIAL CONNECTOR

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This invention relates to electrical connectors and more specifically involves a coaxial self-aligning connector assembly that may be used under conditions of severe mechanical vibration.

Ordinary coaxial connector terminals must be precisely aligned in order to complete a connection. For this reason the uses for coaxial connectors have been generally limited to situations where the terminals were manually connected, since an operator could then radially move one terminal (usually the plug) until the parts were properly aligned. It would be practically impossible, however, to employ the ordinary coaxial connectors where connections are mechanically operated since a slight axial misalignment of parts would prevent the connection from being completed. Inasmuch as an axial misalignment could be produced merely by mechanical vibrations it should be expected that the range of practical use for coaxial connectors has been extremely limited.

One specific application which is contemplated for this invention is in the field of guided missiles where severe mechanical vibrations are prevalent. Experimentation and tests have shown that a coaxial connector as herein described may be satisfactorily employed under even these most extreme conditions of operation.

In brief, this invention in electrical connector assemblies comprises a mating pair of plug and jack terminals for completing a coaxial connection. Both terminals have outer rim surfaces that are embraced by an expansible contactor sleeve to provide an exterior connection. Since the sleeve may be pivoted about the terminals, the connector assembly will correct itself for misalignments of comparatively large magnitude. In addition, an interior terminal connection is completed between a conductive brush member and a conductive receptacle, which are respectively mounted centrally of said plug and jack terminals. The brush member is comprised of a plurality of twisted core wires having radially projecting ends that engage the receptacle when the terminals are mated. The internal connection formed thereby will possess the advantages of providing multiple contacts, high local pressures and low overall forces, while also producing terminal flexibility that will compensate for misalignments between those parts. The individual attributes of the interior and exterior terminal connections cooperate in a unique manner providing a self-aligning coaxial connector that may be constructed to possess superior operational characteristics under extreme conditions of mechanical vibration.

A primary object of this invention, then, is to provide a self-aligning coaxial connector assembly.

Another object is to provide a coaxial connector assembly that will withstand severe vibrational strains without being adversely affected and while maintaining electrical conductivity.

Other objects of this invention will become apparent in view of the following description.

In the drawings forming a part of this application, and in which like reference numerals are used to indicate like parts throughout the same,

FIG. 1 is a side view of one embodiment of this invention in electrical connectors, showing the plug and jack terminals in a spaced relationship and with interior connections of the plug terminal illustrated by broken lines;

FIG. 2 is an enlarged detail view, mostly in section, of the embodiment of FIG. 1 with the plug and jack terminals assembled; and

FIG. 3 is a side view, partly in section, of the embodiment of FIGS. 1 and 2, illustrating connector relationships which may result from terminal misalignment.

As particularly shown in the drawings, this novel connector assembly is generally comprised of a terminal plug **10** and a terminal jack **11**, so designated because of the internal connection formed between terminal contacts **12** and **13**. The outer coaxial contacts **14** and **15** are received within an expansible, electrically conductive sleeve **16**, thereby forming an electrical coaxial connection.

The terminal plug **10** includes an outer conductive sleeve **20** that terminates in a rounded contact rim **21**, forming the outer coaxial contact **14**. Sleeve **20** has a hub portion **22** with a collar **23** and a threaded section spaced therefrom. This construction enables the sleeve to be clamped to a base plate **24**, with a nut member **25**, as shown.

Plug **10** also comprises a conductive brush contact **26** mounted from within sleeve **20** and insulated therefrom by a spacer sleeve **27** and a washer member **28**. Brush contact **26**, which forms the inner coaxial contact **12**, comprises an adapter **29** and twisted, resilient core wires **30** having radially projecting wire members **30***a*. Each wire **30***a* forms a point contact with the receptacle of terminal jack **11**.

The terminal plug may be connected to a coaxial conductor **31** in the conventional manner shown. The outer conductor member **32** is clamped between a ferrule **33** and a fastening sleeve **34**, which in turn is threaded to sleeve **20**. The inner conductor member **35** projects axially through an insulation core **36** and may be soldered to the brush adapter **29**.

Jack terminal **11** comprises an outer conductive sleeve **40** that has a rounded contact rim **41**, forming the outer coaxial contact **15**, and includes a hub portion **42** with a collar **43** and a threaded portion spaced therefrom. Sleeve **40** may then be clamped to a base plate **44** by means of a nut member **45**.

A conductive receptacle **46** is mounted from within sleeve **40** and is insulated therefrom by a non-conductive spacer sleeve **47** and washer member **48**. Receptacle **46** is adapted for receiving the brush contact of terminal plug **10**, and is also adapted for being soldered to the central conductor member **49** of a second coaxial conductor **50**. The connection of conductor **50** to the jack terminal is in all other respects similar to that used for joining conductor **31** to the terminal plug. The outer conductor **51** is clamped between a ferrule **52** and a fastening sleeve **53** that is also threaded to sleeve **40**, an insulating core **54** separating conductor members **49** and **51**.

The expansible electrically conductive sleeve **16** embraces contact rims **21** and **41** with a resilient biasing force provided by a pair of garter springs **60**. Sleeve **16** is longitudinally segmented and circumferentially grooved for receiving these garter springs. It will be further observed from FIGS. 2 and 3 that when terminals **10** and **11** are mated, garter spring **60** will apply a biasing force intermediate the respective points of contact between sleeve **16** and the contact rims **21** and **41**. This facet of the construction is an important factor in deriving the optimum benefits under conditions of severe mechanical vibrations.

A housing plate **61** is employed for mounting the expansible sleeve **16** to the plug terminal **10**. A cavity or slot **62** is formed in plate **61** with a lipped opening **63** on the side remote from plug **10**. The peripheral surface that defines the opening **63** confines the sleeve **16** within cavity **62**, although allowing limited longitudinal move-

ment of the sleeve and the insertion of sleeve 40 therethrough. The lipped opening is preferably recessed by counterboring to guide the jack sleeve 40 into the opening, thereby facilitating the connector's operation. Also, the cavity is formed sufficiently larger than the diameter of sleeve 16 to allow said sleeve to be freely pivoted about the contact rim 21 with limited universal movement. Housing plate 61 may be attached to the base plate 24 by conventional means such as the threaded screw connections generally indicated by reference 64.

With an electrical connector of the kind described and illustrated, it will be apparent, particularly in view of FIG. 3, that a connection can be formed even though the terminal contacts of connectors 10 and 11 may be out of alignment. Since the expansible sleeve 16 can swivel upon the contact rim 21, the sleeve can assume a position satisfactory for receiving contact rim 41. Also, inasmuch as the brush contact 26 is flexible, being comprised of resilient wire members, this contact may adapt itself to an axial misalignment of receptacle 46.

In view of the above description, and although only a preferred embodiment of the invention has been illustrated and described, it is to be realized that certain changes in the shape, size and arrangement of parts may be resorted to without departing from the spirit of the invention or the scope of the attached claims, and each of such changes is contemplated.

Having thus described my invention, what I claim and desire to secure by Letters Patent is:

1. A vibration resistant, self-aligning, coaxial connector assembly, comprising: a terminal jack formed with an outer conductive sleeve terminating in a rounded contact rim, said jack having a conductive receptacle mounted within said sleeve and insulated therefrom; a terminal plug formed with an outer conductive sleeve terminating in a rounded contact rim, said plug having a coaxial contact mounted from within said sleeve and insulated therefrom, said coaxial contact being supported at the end of a resilient stem extending outwardly beyond said plug contact rim and adapted for being received by said receptacle; an expansible electrically conductive sleeve adapted for embracing said rounded contact rims; and means for holding one end of said expansible sleeve into embracement with said plug contact rim, the opposite end projecting angularly beyond the coaxial contact of said plug.

2. A vibration resistant, self-aligning, coaxial connector assembly, comprising: a terminal jack formed with an outer conductive sleeve terminating in a rounded contact rim, said jack having a conductive receptacle mounted within said sleeve and insulated therefrom; a terminal plug formed with an outer conductive sleeve terminating in a rounded contact rim, said plug having a conductive brush resiliently mounted from within said sleeve and insulated therefrom, said brush comprising twisted core wires having radially outward projecting wires and adapted for being received by said receptacle; an expansible electrically conductive sleeve adapted for embracing said rounded contact rims; and means for holding one end of said expansible sleeve into embracement with said plug contact rim, the opposite end projecting angularly beyond the brush of said plug; whereby said brush wires will flex to assist mating of said terminals.

3. A vibration resistant, self-aligning, coaxial connector assembly, comprising: a terminal jack formed with an outer conductive sleeve terminating in a rounded contact rim, said jack having a conductive receptacle mounted within said sleeve and insulated therefrom; a terminal plug formed with an outer conductive sleeve terminating in a rounded contact rim, said plug having a conductive coaxial contact mounted from within said sleeve and insulated therefrom, said coaxial contact being supported at the end of a resilient stem extending outwardly beyond said plug contact rim and adapted for being received by said receptacle; an expansible electrically conductive sleeve adapted for embracing said rounded contact rims, said expansible sleeve being longitudinally slidable on said contact rims and biased into contraction; and stop means fixed relative to said terminal plug and engageable with said expansible sleeve for limiting the free longitudinal movement thereof, said stop means holding one end of said expansible sleeve into embracement with said plug contact rim, the opposite end projecting angularly beyond the coaxial contact of said plug.

4. A vibration resistant, self-aligning, coaxial connector assembly, comprising: a terminal jack formed with an outer conductive sleeve terminating in a rounded contact rim, said jack having a conductive receptacle mounted within said sleeve and insulated therefrom; a terminal plug formed with an outer conductive sleeve terminating in a rounded contact rim, said plug having a conductive coaxial contact mounted from within said sleeve and insulated therefrom, said coaxial contact being supported at the end of a resilient stem extending outwardly beyond said plug contact rim and adapted for being received by said receptacle; an expansible electrically conductive sleeve adapted for embracing said rounded contact rims, said expansible sleeve comprising at least two longitudinal segments and being longitudinally slidable on said contact rims, spring means for biasing said segments into contraction upon said contact rims; and stop means fixed relative to said terminal plug and engageable with said expansible sleeve for limiting the free longitudinal movement thereof, said stop means holding one end of said expansible sleeve into embracement with said plug contact rim, the opposite end projecting angularly beyond the coaxial contact of said plug.

5. A vibration resistant, self-aligning, coaxial connector assembly, compirsing: a terminal jack formed with an outer conductive sleeve terminating in a rounded contact rim, said jack having a conductive receptacle mounted within said sleeve and insulated therefrom; a terminal plug formed with an outer conductive sleeve terminating in a rounded contact rim, said plug having a conductive brush resiliently mounted from within said sleeve and insulated therefrom, said brush comprising twisted core wires having radially outward projecting wires and adapted for being received by said receptacle; and an expansible electrically conductive sleeve adapted for embracing said rounded contact rims; whereby said brush wires will flex to assist mating of said terminals; an expansible electrically conductive sleeve adapted for embracing said rounded contact rims, said expansible sleeve comprising at least two longitudinal segments and being longitudinally slidable on said contact rims, spring means for biasing said segments into contraction upon said contact rims; and stop means fixed relative to said terminal plug and engageable with said expansible sleeve for limiting the free longitudinal movement thereof, said stop means holding one end of said expansible sleeve into embracement with said plug contact rim, the opposite end projecting angularly beyond the brush of said plug.

6. A vibration resistant, self-aligning, coaxial connector assembly, comprising: a terminal jack formed with an outer conductive sleeve terminating in a rounded contact rim, said jack having a conductive receptacle mounted within said sleeve and insulated therefrom; a terminal plug formed with an outer conductive sleeve terminating in a rounded contact rim, said plug having a conductive coaxial contact mounted from within said sleeve and insulated therefrom, said coaxial contact being supported at the end of a laterally resilient stem extending outwardly beyond said plug contact rim and adapted for being received by said receptacle; an expansible electrically conductive sleeve adapted for embracing said rounded contact rims, said expansible sleeve comprising at least two longitudinal segments and being longitudinally slidable on said contact rims, spring means for biasing said segments into contraction upon said contact rims,

said spring means comprising at least one coil garter spring disposed axially of said expansible sleeve at a position intermediate the respective points of contact between said sleeve and said contact rims, and means for holding one end of said expansible sleeve into embracement with said plug contact rim, the opposite end projecting angularly beyond the coaxial contact of said plug.

7. A vibration resistant, self-aligning, coaxial connector assembly, comprising: a terminal jack formed with an outer conductive sleeve terminating in a rounded contact rim, said jack having a conductive receptacle mounted within said sleeve and insulated therefrom; a terminal plug formed with an outer conductive sleeve terminating in a rounded contact rim, said plug having a conductive coaxial contact mounted from within said sleeve and insulated therefrom, said coaxial contact being supported at the end of a laterally resilient stem extending outwardly beyond said plug contact rim and adapted for being received by said receptacle; an expansible electrically conductive sleeve adapted for embracing said rounded contact rims, said expansible sleeve comprising at least two longitudinal segments and being longitudinally slidable on said contact rims, spring means for biasing said segments into contraction upon said contact rims, said spring means comprising a pair of coil garter springs disposed axially of said expansible sleeve at positions intermediate the respective points of contact between said sleeve and said contact rims; and stop means fixed relative to said terminal plug for limiting the free longitudinal movement of said expansible sleeve such that said spring means will apply a biasing force intermediate said contact rims for all longitudinal positions of said sleeve relative to said terminal jack and plug, said stop means holding one end of said expansible sleeve into embracement with said plug contact rim, the opposite end projecting angularly beyond the coaxial contact of said plug.

8. A vibration resistant, self-aligning, coaxial connector assembly, comprising: a terminal jack formed with an outer conductive sleeve terminating in a rounded contact rim, said jack having a conductive receptacle mounted within said sleeve and insulated therefrom by a spacer sleeve and a washer member, said outer conductive sleeve having a hub portion provided with a collar and a threaded section spaced therefrom, a nut member adapted to be threaded upon said hub for fastening said jack to a base plate, said plate being clamped between said collar and said nut member; a terminal plug formed with an outer conductive sleeve terminating in a rounded contact rim, said plug having a conductive coaxial contact mounted from within said sleeve and insulated therefrom by a spacer sleeve and a washer member, said coaxial contact being supported at the end of a laterally resilient stem extending outwardly beyond said plug contact rim and adapted for being received by said receptacle, said outer conductive sleeve having a hub portion provided with a collar and a threaded section spaced therefrom, a second nut member adapted to be threaded upon said hub for fastening said plug to a second base plate, said second plate being clamped between said collar and said nut member; an expansible electrically conductive sleeve adapted for embracing said rounded contact rims, said expansible sleeve being longitudinally slidable on said contact rims and biased into contraction; and stop means fixed relative to said terminal plug for limiting the free longitudinal movement of said expansible sleeve, said stop means holding one end of said expansible sleeve into embracement with said plug contact rim, the opposite end projecting angularly beyond the coaxial contact of said plug.

9. A vibration resistant, self-aligning, coaxial connector assembly, comprising: a terminal jack formed with an outer conductive sleeve terminating in a rounded contact rim, said jack having a conductive receptacle mounted within said sleeve and insulated therefrom by a spacer sleeve and a washer member, said outer conductive sleeve having a hub portion provided with a collar and a threaded section spaced therefrom, a nut member adapted to be threaded upon said hub for fastening said jack to a base plate, said plate being clamped between said collar and said nut member; a terminal plug formed with an outer conductive sleeve terminating in a rounded contact rim, said plug having a conductive brush resiliently mounted from within said sleeve and insulated therefrom by a spacer sleeve and a washer member, said outer conductive sleeve having a hub portion provided with a collar and a threaded section spaced therefrom, a second nut member adapted to be threaded upon said hub for fastening said plug to a second base plate, said second plate being clamped between said collar and said nut member; an expansible electrically conductive sleeve adapted for embracing said rounded contact rims, said expansible sleeve being longitudinally slidable on said contact rims and biased into contraction; and a housing plate having a cavity therein for receiving and retaining said expansible sleeve, said housing plate being secured to said second base plate for holding one end of said expansible sleeve into embracement with said plug contact rim, the opposite end projecting angularly beyond the brush of said plug.

10. A vibration resistant, self-aligning, coaxial connector assembly, comprising: a terminal jack formed with an outer conductive sleeve terminating in a rounded contact rim, said jack having a conductive receptacle mounted within said sleeve and insulated therefrom by a spacer sleeve and a washer member, said outer conductive sleeve having a hub portion provided with a collar and a threaded section spaced therefrom, a nut member adapted to be threaded upon said hub for fastening said jack to a base plate, said plate being clamped between said collar and said nut member; a terminal plug formed with an outer conductive sleeve terminating in a rounded contact rim, said plug having a conductive brush mounted from within said sleeve and insulated therefrom by a spacer sleeve and a washer member, said brush comprising twisted core wires having radially projecting wires and adapted for being received by said receptacle; and an expansible electrically conductive sleeve adapted for embracing said rounded contact rims; whereby said brush wires will flex to assist mating of said terminals, said outer conductive sleeve having a hub portion provided with a collar and a threaded section spaced therefrom, a second nut member adapted to be threaded upon said hub for fastening said plug to a second base plate, said second plate being clamped between said collar and said nut member; an expansible electrically conductive sleeve adapted for embracing said rounded contact rims, said expansible sleeve being longitudinally slidable on said contact rims and biased into contraction; and a housing plate having a cavity therein for receiving and retaining said expansible sleeve.

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