United States Patent

Christman

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[54] BALL AND SOCKET ELECTRICAL CONNECTOR MEANS

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[52] **U.S. Cl.** .....**339/211**, 339/256 R

[51] **Int. Cl.**.....**H01r 11/22**

[58] **Field of Search**.....339/211, 256, 258, 74, 47, 339/49, 204, 205, 248, 252, 253; 24/201 S, 213 CS, 230 F, 230 SL; 287/12, 21, 87; 46/26, 29

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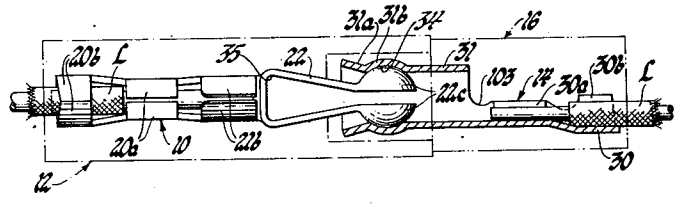
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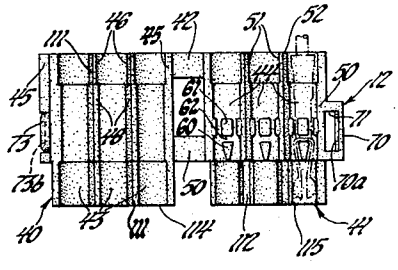
Primary Examiner—Marvin A. Champion
Assistant Examiner—Robert A. Hafer
Attorney—W. E. Finken and W. A. Schuetz

[57] **ABSTRACT**

In a preferred form, this disclosure relates to an electrical connector means comprising a female terminal housed within a female insulator body and a male terminal housed within a male insulator body. The female terminal has a forward portion provided with a tapered entry section and a spherical socket section. The male terminal has the forward portion comprising a pair of spaced arms having hemispherical sections at their forward end which together define a spherical forward end section. The male terminal is connectable to the female terminal by inserting the same therein until its spherical end section seats within the spherical section of the female terminal. The mating parts provide a large contact area and mechanically interlock the male and female terminals and the male and female insulator bodies together.

3 Claims, 11 Drawing Figures





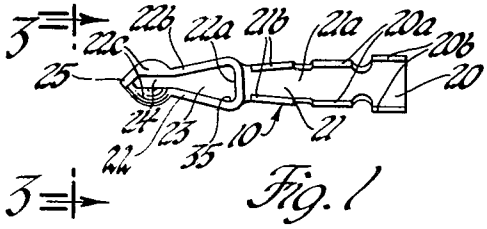


Fig. 1

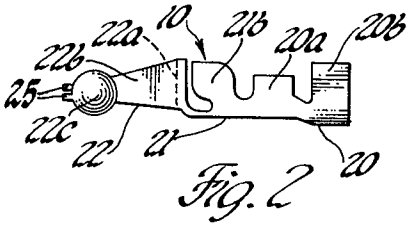


Fig. 2

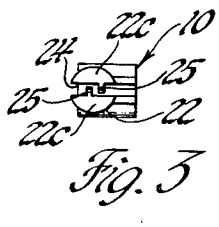


Fig. 3

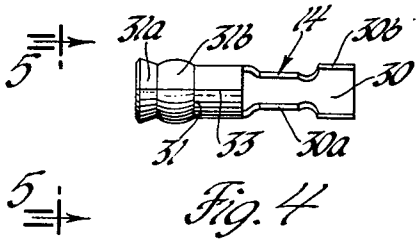


Fig. 4

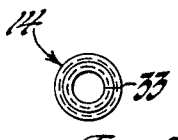


Fig. 5

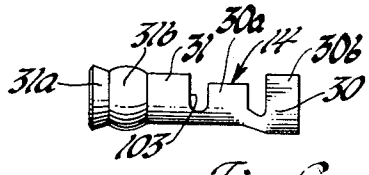


Fig. 6

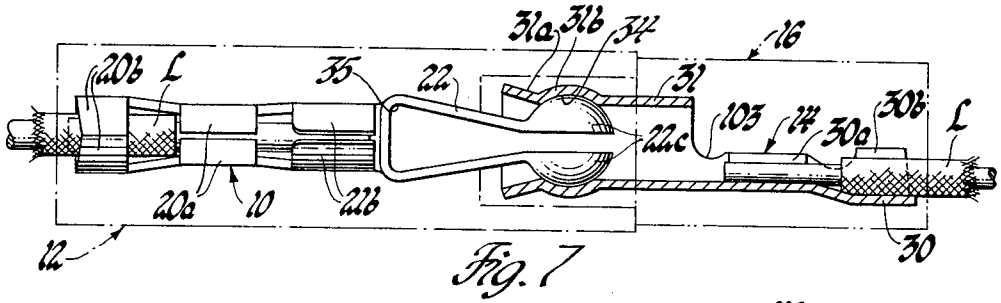


Fig. 7

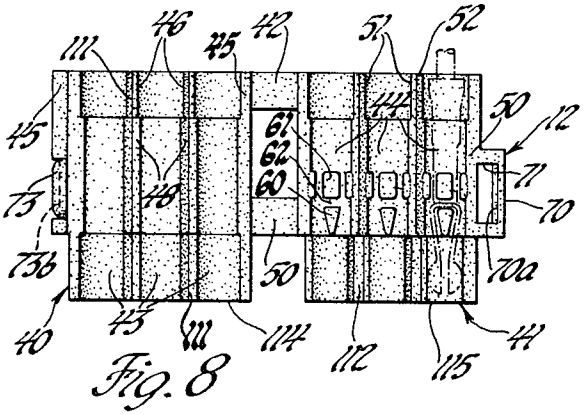


Fig. 8

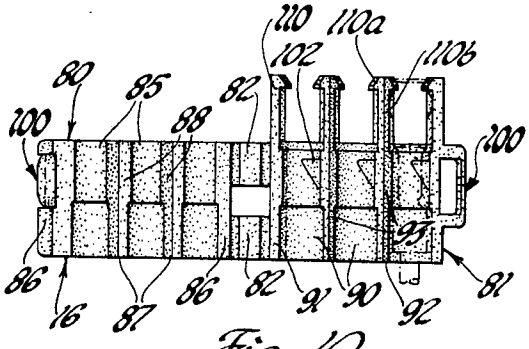


Fig. 10

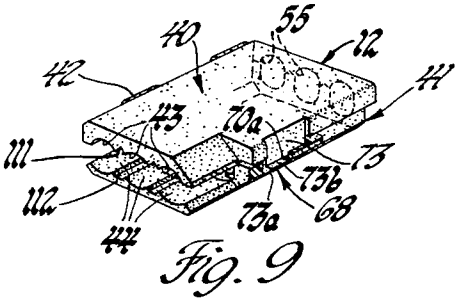


Fig. 9

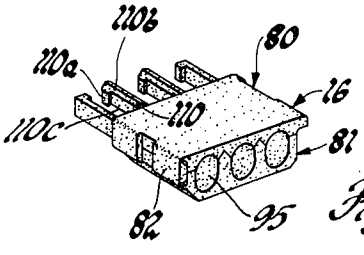


Fig. 11

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BALL AND SOCKET ELECTRICAL CONNECTOR MEANS

The present invention relates to an electrical connector means, and more particularly to an electrical connector means including a female terminal having a spherical socket section and a male terminal having a generally spherical end section which is adapted to seat within the spherical section of the female terminal.

An object of the present invention is to provide a new and improved electrical means comprising a female terminal having a forward end portion provided with a tapered entry section and a spherical socket section and a male terminal having a forward end portion having a pair of spaced flexible arms provided with hemispherical sections at their forward end which together define a spherically shaped forward end, and wherein the hemispherical end sections of the forward portion of the male terminal are deflectable toward each other from their free state position as the male terminal is inserted into the tapered entry section of the female terminal until they reach the spherical section of the female terminal whereupon the hemispherical end sections return toward their free state position and engage the spherical section of the female terminal over a large contact area so as to provide both a good electrical and mechanical connection therebetween.

A further object of the present invention is to provide a new and improved electrical connector means as defined in the preceding object and wherein the male terminal includes a pair of fingers integral with the hemispherical sections at its forward end and which extend across the gap therebetween for preventing entry of foreign material within the spherical end of the male terminal during storage or when not in use.

Another object of the present invention is to provide a new and improved electrical connector means comprising a female terminal which is housed within a female insulator body and a male terminal which is housed within a male insultator body, wherein the female terminal has a spherical socket section adjacent its forward end and the male terminal has a generally spherical forward end defined by a pair of hemispherical sections carried by flexible arms, and wherein the spherical end of the male terminal has an outer diameter greater than the inner diameter of the female socket portion so that when the male terminal is inserted into the female terminal the spherical forward end of the male terminal is contracted and then expands to seat therein and engage the female terminal over a large contact area, the connection between the male and female terminals providing good electrical contact and providing a mechanical interlock for connecting the male and female terminals together as well as the male and female insulator bodies together.

Yet another object of the present invention is to provide a new and improved electrical connector means as defined in the next preceding object and wherein the male and female insulator bodies comprise first and second portions which are hingedly interconnected adjacent one end and which are adapted to be latched together adjacent the other end when folded across each other, wherein each of the insulator bodies has a plurality of compartments for receiving individual terminals, and wherein one of the insulator bodies has forwardly projecting fingers and the other insulator body has forwardly projecting portions provided with grooves which are of a shape such that the insulator bodies can only be connected together in a certain way so that respective terminals are properly connected together.

The present invention further resides in various novel constructions and arrangement of parts, and further objects, novel characteristics and advantages of the present invention will be apparent to those skilled in the art to which it relates and from the following detailed description of the illustrated embodiments thereof made with reference to the accompanying drawings forming a part of this specification and in which similar reference numerals or characters are employed to designate corresponding parts throughout the several views, and in which:

FIG. 1 is a top plan view of a male terminal of the electrical connector means of the present invention;

FIG. 2 is a side elevational view of the terminal shown in FIG. 1;

FIG. 3 is an end elevational view looking in the direction of the arrows 3—3 of FIG. 1 of the terminal shown in FIG. 1;

FIG. 4 is a top plan view of a female terminal of the electrical connector means of the present invention;

FIG. 5 is an end elevational view of the terminal shown in FIG. 4 and looking in the direction of the arrows 5—5;

FIG. 6 is a side elevational view of the terminal shown in FIG. 4;

FIG. 7 is an enlarged view of the male and female terminals of the electrical connector means of the present invention and showing the same connected together;

FIG. 8 is a top plan view of a male insulator body for the male terminal and showing the same in its open position;

FIG. 9 is a perspective view of the male insulator body shown in FIG. 8 and showing the same in its closed position;

FIG. 10 is a top plan view of a female insulator body of the electrical connector means of the present invention and showing the same in its open position; and

FIG. 11 is a perspective view of the insulator body shown in FIG. 10 and showing the same in its closed position.

Referring to the drawings, a preferred embodiment of the electrical connector means of the present invention is thereshown. The electrical connector means comprises, in general, a male terminal **10** which is adapted to be housed within a male insulator body **12** and a female terminal **14** which is adapted to be housed within a female insulator body **16**.

The male terminal **10** comprises a one-piece, thin metallic member which is stamped from sheet stock and bent to the configuration shown in FIG. **1** by a suitable punch and die apparatus. The male terminal **10** comprises a rearward portion **20**, an intermediate portion **21** and a forward portion **22**. The rearward portion **20** comprises longitudinally spaced crimping flanges **20***a* and **20***b* which are adapted to be crimped onto the bare end and the insulation of an electrical wire or lead L, respectively, and in a manner well known to those skilled in the art. The intermediate portion **21** comprises a flat base **21***a* and, as viewed in FIG. **1**, a pair of spaced, upstanding wings **21***b* at the sides of the base **21***a*. The forward portion **22** comprises a transversely, upstanding flange **22***a* integral with the base **21***a* of the intermediate portion **21**, a pair of flexible forwardly extending arms or legs **22***b* whose rearward ends are integral with the flange **22***a*, and a pair of hemispherical sections **22***c* integral with the legs **22***b* at their forward end. The legs **22***b* and the flange **22***a* define a generally triangularly shaped slot **23**.

As best shown in FIGS. **1** and **3**, the hemispherical forward end sections **22***c* are slightly spaced from each other to define a gap **24**. When the forward portion **22** of the male terminal **10** is in its free state, the forward sections **22***c* together define a generally spherical forward end for the male terminal **10**. The hemispherical sections **22***c* at their forwardmost ends each have a finger **25** which extends substantially across the gap **24** toward the other hemispherical section **22***c*. The fingers **25** prevent or substantially prevent foreign material from entering interiorly of the generally spherical forward end of the male terminal **10** due to the gap **24** therebetween while in storage or not in use.

The female terminal **14** is of a one piece metal construction which is stamped from sheet stock and bent to the configuration shown in FIGS. **4–6** by a suitable punch and die apparatus. The female terminal **14** has a rearward end portion **30** which is adapted to be connected to an electrical lead and an axially slit forward end portion **31** which is adapted to receive the spherical end sections **22***c* of the male terminal **10**. The rearward end portion **30** comprises spaced pairs of crimping flanges **30***a* and **30***b* which are adapted to be crimped onto the bare end and the insulation of an electrical lead or wire L, respectively, and in a manner well known to those skilled in the art.

The forward portion **31** of the female terminal **14** has a tapered entry section **31***a* at its forward end and a spherical

socket portion 31*b* intermediate its ends. The tapered entry section 31*a* is frustoconical and has a linear taper which progressively decreases proceeding from the forward end of the forward portion 31 of a female terminal 14 toward the socket portion 31*b*. As best shown in FIG. 4, the forward portion 31 of the female terminal 14 is axially slit, as indicated at 33, so that the forward portion 31 can be radially expanded and contracted somewhat.

The spherical socket section 31*b* has an internal diameter of a given nominal value, which diameter is slightly less than the outer diameter or the maximum transverse dimension between the outer pinnacles of the hemispherical sections 22*c* of the male terminal 10 when the latter is in its free state.

The male terminal 10 is adapted to be connected to the female terminal 14 by inserting the same forward end first into the forward end portion 31 of the female terminal 14 until the spherical forward end 22*c* is seated within the spherical section 31*b* of the female terminal 14. As the male terminal is inserted into the female terminal 14, the hemispherical sections 22*c* will engage the inner wall or surface of the tapered entry section 31*a* and be moved or deflected inwardly toward each other from their normal free state position until they clear the neck 34 at the junction of the tapered entry section 31*a* and the socket section 31*b* whereupon the hemispherical sections 22*c* will move outwardly toward their normal free state position and engage the inner periphery of the socket section 31*b*. During this movement the arms 22*b* of the male terminal deflect about their bite portions 35, the arms 22*b* being sufficiently flexible to allow their being flexed inwardly and then outwardly due to their inherent elastic forces tending to return them toward their normal position.

The advantages of the above-defined electrical connector are that (1) the engagement between the male terminal 10 and the female terminal 14 when the former is seated therein is over a relatively large spherical area to insure good electrical contact; (2) the electrical connector means cannot be partially assembled because the tapered entry section 31a will cause the male terminal 10 to be pushed toward the left, as viewed in FIG. 7, if not pushed in past the neck 34 and the spherical socket portion 31*b* prevents displacement in either direction when the male terminal 10 is seated therein; (3) it does not require a high force to effect the connection and (4) alignment problems are not critical, since even if the male and female terminals are not axially aligned the mating spherical parts enable the connection to be readily made.

The male terminal 10 is adapted to be housed within the male insulator body 12 made from a suitable plastic or electrically insulating material. The insulator body 12, as viewed in FIG. 9, comprises an upper portion 40 and a lower portion 41 which are integrally interconnected along one of their side edges by a thin hinge 42. The upper portion 40 on its inner side has three spaced apart grooves 43 of semicircular cross section and the lower portion 41 has three spaced grooves 44 of semicircular cross section. The grooves 43 of the upper portion are defined by spaced end and intermediate walls 45 and 46, the walls 46 of which have triangularly shaped recesses or grooves 48. The grooves 44 in the lower portion are defined by spaced end and intermediate walls 50 and 51, the walls 51 of which have triangularly shaped peaks 52.

The upper portion 40 is adapted to be folded about the hinge 42 over the bottom portion 41 to a closed position, as shown in FIG. 9. When in this position, the triangularly shaped peaks 52 of the walls 51 are received within the triangular shaped recesses 48 of the walls 46 of the bottom portion 41 to insure alignment of the semicircular grooves 43 and 44 with one another. When the insulator body 12 is in its closed position, as shown in FIG. 9, adjacent the grooves 43 and 44 in the top and bottom portions 40 and 41 define elongated circular, cross-sectionally shaped compartments 55 for housing the male terminals 10.

The insulator body 12 shown in FIGS. 8 and 9 is for use with three male terminals disposed side by side, although the insulator body could be made so as to accommodate any number of male terminals. When the insulator body is in its open position, as shown in FIG. 8 the male terminals are adapted to be positioned and retained within the grooves 43 of the lower portion 41. To this end, the lower portion 41 has spaced abutments 60 and 61 which extend transversely within the grooves from their bottoms. The abutment 60 is generally triangularly shaped and is adapted to be received within the slot 23 in the forward portion 22 of the male terminal 10, the flange 22*a* of the latter being received within the space 62 between the abutments 60 and 61. The abutment 61 is generally rectangularly shaped and is adapted to be straddled by the wings or flanges 21*a* of the intermediate portion 21 of the male terminal 10.

The flange 22*a*, which is received in the space 62 between the abutments 60 and 61, serves to prevent the terminal 10 from being forwardly or rearwardly displaced relative to the insulator body housing 12. Likewise the wings 21*a* straddle the abutment 61 and serve to position the male terminal 10 within the lower portion so as to limit relative sidewise movement thereof. After the male terminals 10 are positioned within the lower portion 41 of the male insulator body 12, as shown in FIG. 8, the top portion 40 is then moved about the hinge 42 over the bottom portion 41 to close the insulator body 12.

The male insulator body 12 also includes a releasable latching means 68 to hold the insulator body 12 in its closed position. To this end, the lower portion 41 of the insulator body 12 has a catch member 70 formed integral with its right side wall 50, as viewed in FIG. 8. The catch member 70 has a rectangular opening 71. The upper portion 40 of the insulator body 12 has a deflectable latch member 73 integral with its left side wall 45. As viewed in FIG. 8, the latch member 73 is in the form of an upwardly extending projection provided with a tapered head 73*a* at its upper end. When the upper portion 40 is swung over the lower portion 41, the head 73*a* of the latch member 73 is received within the opening 71 and engages the side 70*a* of the catch member 70. As the tapered head 73*a* engages the side 70*a* of the catch member 70 it is deflected inwardly toward the end wall 50 of the lower portion 41 until it clears the side wall 70*a* whereupon it returns toward its normal free state position due to its inherent elastic forces. When in this position the underside 73*b* of the head 73 engages the side 70*a* of the catch member 70 to retain the insulator body 12 in its closed position.

The female terminals 14 are adapted to be housed within the female insulator body 16. The female insulator body 16, like the male insulator body 12, comprises an upper portion 80 and a lower portion 81 which are integrally connected along one side edge by integral hinges 82. The upper portion 80 of the insulator body 16 has three spaced grooves 85 of semi-circular cross section and with respective ones of the grooves 85 being separated by end and intermediate walls 86 and 87. The intermediate walls 87 have triangularly shaped recesses 88. The lower portion 81 has three spaced grooves 90 of semi-circular cross-sectional shape and with respective ones of the grooves 90 being separated by end and intermediate walls 91 and 92. The walls 92 have triangularly shaped peaks 93 which are received within the recesses 88 when the upper portion 80 is folded thereover to align the grooves 85 and 90 so that they form compartments 95 of circular cross-sectional shape.

The upper portion 80 of the insulator body 16 is adapted to be folded about the hinge 82 across the lower portion 81 to a closed position, as shown in FIG. 11. The female insulator body 16 comprises a releasable latching means 100, which is of an identical construction as the releasable latching means 68 of the male insulator body 12, in order to retain the upper and lower portions 80 and 81 in their closed position. The lower portion 81 of the female insulator body portion 16 also has a transversely extending abutment 102 extending transversely of the intermediate and end walls 91 and 92 and into the grooves 90. The female terminals 14 are adapted to be housed within the female insulator body 16 by positioning the same within the grooves 90 of the lower portion 81. As they are

positioned therein, the transverse abutments **102** are received within side slots **103** at the junction of the forward and rearward portions **31** and **30** of the female terminals **14** to securely retain the same therein and against forward and rearward movement relative to the insulator housing **16**. After the female terminals **14** are positioned therein the upper portion **80** is adapted to be folded about the hinge **82** over the lower portion **81** and latched in place by the releasable latching means **100**.

The female insulator body **16** also has a plurality of spaced forwardly extending fingers or projections **110** integral with the lower portion **81** and which are adapted to be received within axially extending grooves **111** and **112** formed in spaced forwardly extending sections **114** and **115** integral with the upper and lower portions **40** and **41** of the male insulator body **12**, respectively. The forwardly extending fingers **110** have transversely extending sections **110*a*** which are adapted to engage the forward ends of the female terminals **14** and aid in preventing the same from being moved forwardly relative to the insulator body **16**. The fingers **110** along their upper and lower sides **110*b*** and **110*c*** are respectively triangularly and trapezoidally shaped and the grooves **111** and **112** in the forwardly extending sections **114** and **115** of the male insulator body **12** are triangularly and trapezoidally shaped and slidably receive the sides **110*b*** and **110*c*** of the fingers **110**. The reason for providing different shaped sides for the fingers **110** is so that the female insulator body **16** cannot be wrongly connected to the male insulator body **12**. Since various terminals are connected via leads to different electrical parts, this provision insures that the respective terminals cannot be wrongly connected together.

When the terminals **10** and **14** are respectively placed in their respective insulator bodies **12** and **16**, they are adapted to be connected together by inserting the fingers **110** of the female insulator body **16** into the space between the sections **114** and **115** of the male insulator body **12**. As the forwardly projecting fingers **110** are received within the grooves **111** and **112** of the forward sections **114** and **115**, the male terminals **10** and the female terminals **14** will be brought into mating engagement until the spherical end portions **22*c*** of the male terminals **10** seat within the spherical socket sections **31*b*** of the female terminals whereupon both the terminals **10** and **14** and the insulator bodies **12** and **16** will be connected together. The mechanical connection between the male and female terminals **10** and **14** thus also provides a mechanical connection between the male and female insulator bodies **12** and **16**.

It should be noted that the male and female insulator bodies **12** and **16** are relatively thin, as viewed in FIGS. **9** and **11**, and are of a very compact construction. This is especially advantageous where space requirements dictate that relatively thin connectors be employed.

Although the illustrated embodiment hereof has been described in great detail, it should be apparent that certain modifications, changes, and adaptations may be made in the illustrated embodiment, and that it is intended to cover all such modifications, changes and adaptations which come within the spirit of the present invention.

What is claimed is:

1. An electrical connector means comprising: a female terminal and a male terminal which is adapted to be connected to the female terminal; said female terminal having a rearward portion which is adapted to be connected to an electrical lead and an annular, hollow forward portion, said forward portion having a spherically shaped section adjacent its forward end whose inner surface is of a given diameter and a tapered entry section whose taper progressively decreases proceeding from the forward end toward the spherical section of said forward portion, a male terminal having a rearward portion which is adapted to be connected to an electrical lead and a forward portion, said forward portion including a pair of spaced, flexible forwardly extending arms and a pair of spaced hemispherical sections integral with the arms at their forward ends, said hemispherical sections being aligned and together defining a generally spherical forward end section having an outer diameter slightly larger than said given diameter when in its free state, said hemispherical sections each having an integral finger at its forward end extending toward the other hemispherical section, said fingers substantially preventing entry of foreign material into the generally spherical end section of said male terminal, said male terminal being connectable to said female terminal by inserting its forward end into the forward end of said female terminal until said spherical forward end section of said male terminal is seated in the spherical section of said female terminal, said arms and said hemispherical sections of said male terminal being flexed toward each other from their free state position by said tapered entry section of said female terminal when being inserted in said female terminal until said hemispherical sections clear the tapered entry section whereupon they return toward their free state position and with the hemispherical sections of the male terminal engaging the spherical section of the female terminal over a large area to provide both an electrical and mechanical connection between the male and female terminals.

2. An electrical connector means comprising: a female terminal having a rearward portion which is adapted to be connected to an electrical lead and an annular, hollow forward portion, said forward portion having a spherically shaped section adjacent its forward end whose inner surface is of a given diameter, said female terminal also having a slot in its side between its opposite ends, a male terminal having a rearward portion which is adapted to be connected to an electrical lead, an intermediate portion and a forward portion which is adapted to be connected to the forward portion of the female terminal, said intermediate portion including a base and a pair of spaced wings extending transversely of the base, said forward portion including a pair of spaced, flexible forwardly extending arms and a pair of hemispherical sections at the forward ends of the arms which together define a generally spherical forward end whose outer diameter is slightly larger than said given diameter when in its free state, said forward portion also having a transversely extending flange portion integral with the base of the intermediate portion and said arms, a female insulator body for housing said female terminal, said female insulator body including first and second portions which are integrally connected together by a hinge means, said first and second portions each having at least one semicircular recess therein said first and second portions being adapted to be folded along said hinge means between an open position in which said female terminal can be inserted in the recess of said second portion and a closed position in which said recesses define a generally circular cross-sectionally shaped compartment for housing the female terminal, releasable latching means for latching the first and second portions of said female insulator body together in their closed position, said second portion including a transverse abutment extending within the recess and which is adapted to be received within the slot in the female terminal to retain the latter within the female insulator body; said female insulator body also including forwardly projecting fingers, a male insulator body for housing the male terminal, said male insulator body including first and second portions integrally hinged by a hinge means and with each portion having a semicircular recess therein, said first and second portions of the male insulator body being adapted to be folded about the hinge means between an open position in which said male blade terminal can be inserted in the recess of the second portion and a closed position in which the recesses together define a generally circular shaped compartment for containing the male terminal, releasable latching means for latching the portions of the male insulator body together in their closed position, said second portion of said insulator body including a pair of spaced abutments extending into the recess thereof which define a space therebetween, said transversely extending flange portion of said male terminal being received within said space whereby the male blade terminal is securely retained within the male insulator body and with said wings straddling said second abutment,

said first and second portion of said male insulator body having forwardly extending portions provided with spaced grooves which are adapted to slidably receive the fingers of the female insulator body when the latter is inserted therein, said male terminal and male insulator body being connectable to the female terminal and female insulator body by inserting the fingers within the grooves of the forwardly projecting portions of the male insulator body, said fingers as they are being inserted therein causing the hemispherical sections of the male terminal to be deflected upon engagement with the female terminal until the latter seats within the spherical socket section of the female terminal, said male terminal engaging said spherical socket section of the female terminal over a large area to provide both an electrical and mechanical connection therebetween as well as a mechanical connection between the male and female insulator bodies.

3. An electrical connector means comprising: a female terminal having a rearward portion which is adapted to be connected to an electrical lead and an annular, hollow forward portion, said forward portion having a spherically shaped section adjacent its forward end whose inner surface is of a given diameter; a male terminal having a rearward portion which is adapted to be connected to an electrical lead, an intermediate portion, and a forward portion which is adapted to be connected to the forward portion of the female terminal, said male terminal including a pair of spaced flexible forwardly extending arms and a pair of hemispherical sections at the forward ends of said arms which together define a generally spherical forward end whose outer diameter is slightly larger than said given diameter when in its free state; a female insulator body for housing said female terminal and including first and second portions integrally connected together by a hinge means, said first and second portions each having at least one recess therein, said first and second portions being adapted to be folded along said hinge means to a closed position when said female terminal has been inserted in the recess of one of said portions, said female insulator body having means for retaining said female terminal therein, releasable latching means for locking first and second portions in their closed position; a male insulator body for housing the male terminal, said male insulator body including first and second portions integrally connected by hinge means and each having at least one recess therein, said first and second portions of said male insulator body being adapted to be folded about the hinge means to a closed position when the male terminal has been inserted into the recess of one of said portions, said male insulator body having means for retaining the male terminals therein, releasable latching means for locking the portions of the male insulator body in their closed position, said male terminal and male insulator body being connectable to the female terminal and female insulator body by inserting the forward end of the male terminal into the forward end of the female terminal until the spherical forward end of the male terminal is seated in the spherical forward end of the female terminal, said male terminal engaging said spherical socket section of the female terminal over a large area to provide both an electrical and mechanical connection therebetween as well as a mechanical connection between the male and female insulator bodies.

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