

[54] **SOLDERLESS COAXIAL CONNECTORS**

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Related U.S. Application Data

- [63] Continuation-in-part of Ser. No. 769,773, Aug. 28, 1968, Pat. No. 3,573,712.
 [52] U.S. Cl.**339/89 C, 339/177 R**
 [51] Int. Cl.**H01r 13/54**
 [58] Field of Search 339/89, 177, 205; 85/32, 36; 151/7

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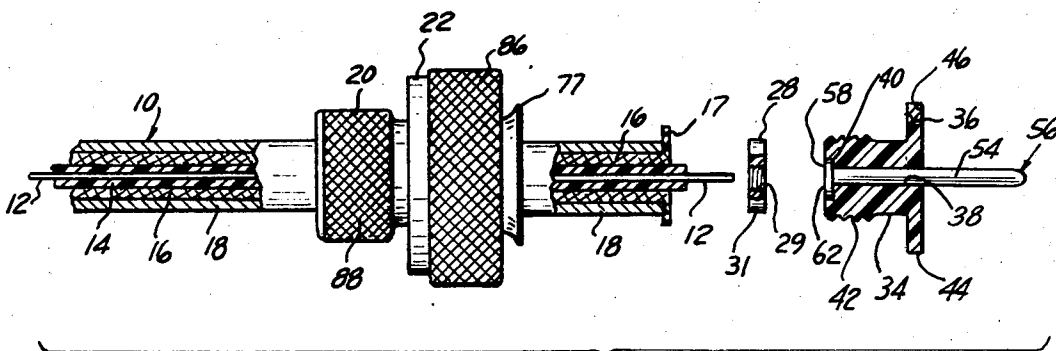
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[57] **ABSTRACT**

Solderless prong and coaxial cable splice connectors for coaxial shielded cables, having a hollow body member provided with a prong or, alternately, with a connecting member contacting the stripped end of the cable inner conductor bent in form of a loop disposed in a transverse plane. The prong, or the connecting member, is electrically insulated from the remaining of the body member which is electrically connected to the outer tubular braided conductor of the cable having its end clamped between a dielectric washer having preferably inner threads for gripping the outer surface of the inner insulation of the coaxial cable and a shoulder portion of the hollow body member.

8 Claims, 7 Drawing Figures



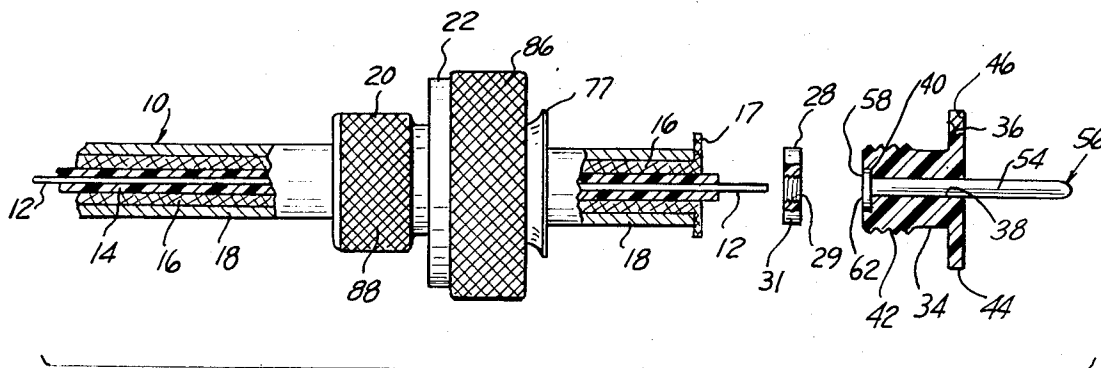


FIG. 1

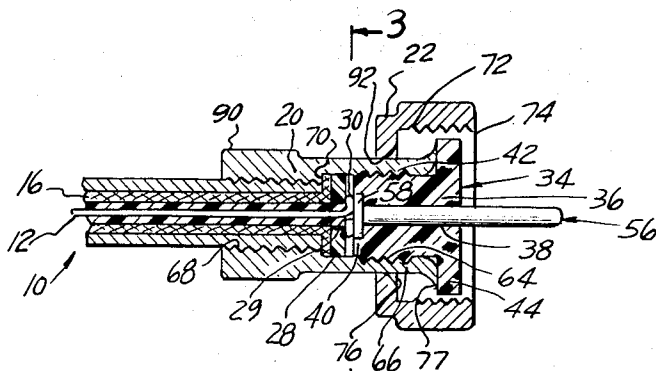


FIG. 2

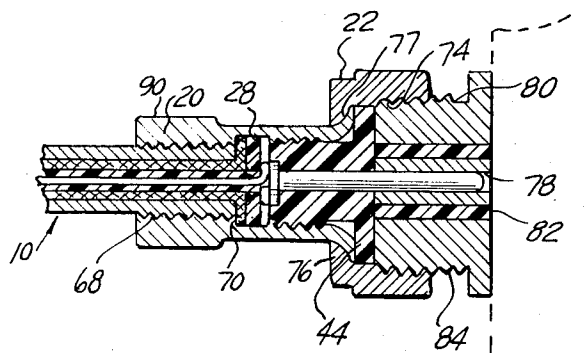


FIG. 4

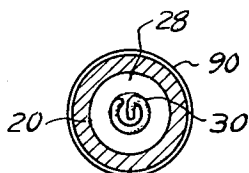


FIG. 3

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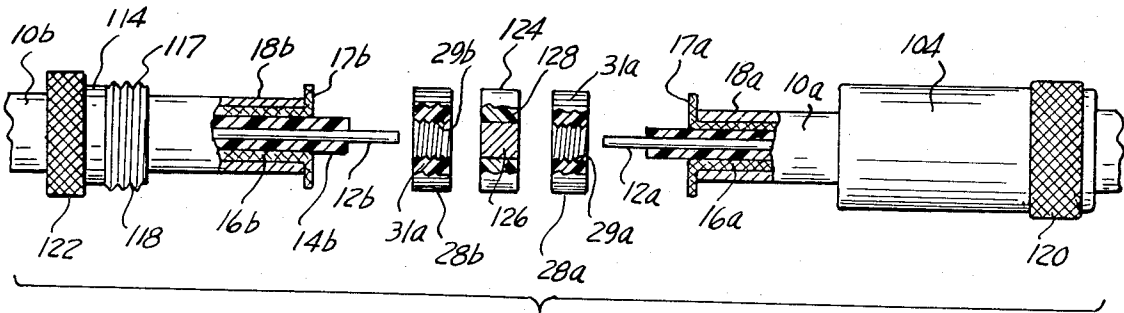


FIG. 5

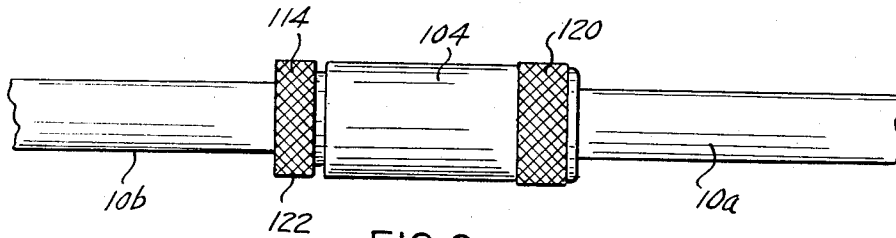


FIG. 6

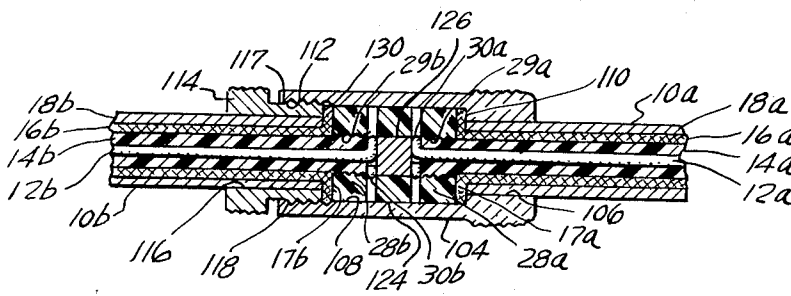


FIG. 7

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SOLDERLESS COAXIAL CONNECTORS**CROSS-REFERENCE TO RELATED APPLICATION**

The present application is a continuation-in-part of application Ser. No. 769,773, filed Aug. 28, 1968, now U.S. Pat. No. 3,573,712.

BACKGROUND OF THE INVENTION

The present invention relates to the broad field of electrical connectors and more particularly to improved connectors for use with flexible coaxial cables of the type consisting of an inner central conductor, of solid or stranded current conductive metal wire, covered by a cylindrical layer of dielectric material, such dielectric material being in turn covered by a cylindrical tubular metallic braid which forms the outer conductor of the cable. The outer tubular conductor is generally in turn covered with a cylindrical layer of insulation, made of a material having in addition good mechanical and weather resistant properties.

Such coaxial cables are used very extensively today for connection between an aerial for propagation or reception of high frequency radio waves and the input of a radio receiver or the output of a radio transmitter. Connectors are available for connecting coaxial cables to the aerial terminals or to the radio apparatus terminals, or, by way of a coaxial cable splice connector for connecting separate lengths of coaxial cables. Such connectors include a body portion having a hollow prong into which the inner conductor of the coaxial cable is introduced and crimped or soldered; the outer tubular braided connector, after removal of a portion of the outermost insulating covering, is provided with means for either clamping such outer conductor in electrical contact therewith or for soldering the outer braided conductor to the connector body.

The soldered and/or crimped connections effectuate both the adequate electrical connection and the mechanical securing of the coaxial cable in appropriate position when the connector is attached by means of a threaded ring or collar member to the externally threaded surface of an appropriate receptacle for the prong. Such an arrangement, as available in the previous art, has many inconveniences as it requires, for mounting of the connector upon the end of a coaxial cable, the availability of a soldering iron and a certain degree of skill on the part of the person attaching the connector upon the end of the cable. Additionally, in view of the heat required for properly soldering the inner conductor to the hollow prong and the outer tubular braided conductor to the connector sleeve, heat damage may affect the insulating quality of the dielectrics in the cable and in the connector, and such soldered connections do not generally effectuate good mechanical connections. Where crimping is used to effectuate electrical and mechanical connections between the conductors of the cable, such as the inner conductor and a portion of the connector such as the hollow prong, special tools are required, and the crimping operation has a tendency to stress the materials and reduce their normal tensile strength.

A solderless coaxial cable prong connector and a union connector are disclosed in copending application Ser. NO. 769,773, now U.S. Pat. No. 3,573,712 which eliminate the use of a soldering iron. In such solderless coaxial cable plug connectors, a dielectric washer

forming part of each connector structure is slipped over the inner insulation of a properly dressed coaxial cable thus radially fanning out the outer braided conductor of the coaxial cable behind the dielectric washer. The inner conductor of the coaxial cable is then bent into a loop slightly larger in diameter than the diameter of the center hole of the dielectric washer on the other side of the dielectric washer thus holding the dielectric washer securely in place, so as to permit clamping of all the elements by means of the prong body, or alternately of the union body threaded into the hollow connector body. However, the natural resiliency of the outer braided conductor may tend to push the dielectric washer off the end of the coaxial cable, thus hindering a tight mechanical and electrically conductive assembly of the connector. The present invention provides a dielectric washer having a threaded bore for engagement with the outer surface of the cable inner insulation and a simplified assembly for a splice connector eliminating the union element therein.

SUMMARY OF THE INVENTION

The present invention has for its principal object to provide a coaxial cable prong connector and a splice connector having substantially all the advantages of the prior art connectors with respect to weather proofing and clamping of the tubular braided conductor, while providing means whereby the inner conductor is firmly clamped and anchored in an appropriate axial position and in electrical contact with the connector prong or connector member.

Another object of the present invention is to provide a coaxial cable connector wherein the mechanical and electrical connections respectively between the inner conductor of a coaxial cable and the prong body or connecting member, and between the outer tubular braided conductor of the cable and the body of the connector, are effected by way of rigid mechanical clamping means, without resorting to soldering of the diverse conductors with the appropriate portions of the connector.

Still another object of the present invention is to provide a solderless coaxial connector construction having all the structural and electrical advantages of soldered connectors, which permits to effectuate strong mechanical and electrical connections with a coaxial cable, which only requires the use of simple and easily available tools such as a pocket knife and a pair of pliers at most, which is simple to manufacture with a few parts of simple configuration, which is easily and sturdily assembled, and which may be made in any appropriate type of material permitting strong mechanical connections and adequate lossless electrical connections.

Other objects and advantages of the present invention will be apparent to those skilled in the art from the detailed description hereinafter of a few examples of embodiments thereof, when such description is read in conjunction with the attached drawings wherein like numerals refer to like or equivalent parts and in which:

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a partial exploded view of a typical coaxial cable, with an end thereof properly dressed previously to attaching thereto a coaxial cable prong connector

according to an example of the present invention, with parts of the prong connector disposed in order of installation;

FIG. 2 is a longitudinal sectional view of the plug connector of FIG. 1 after assembly;

FIG. 3 is a cross-sectional view from line 3—3 of FIG. 2;

FIG. 4 is a view similar to FIG. 2, but showing the prong connector mounted upon an appropriate conventional input or output female receptacle;

FIG. 5 shows a partial exploded view of a coaxial cable splice connector according to the present invention, showing a solderless coaxial cable splice connector for joining the ends of two coaxial cables together, with the ends of the coaxial cables properly dressed and with parts of the connector disposed in order of installation;

FIG. 6 is a view after assembly of the splice connector of FIG. 5; and

FIG. 7 is a longitudinal sectional view of the coaxial cable splice connector of FIGS. 5 and 6.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring now to the drawings and more particularly to FIG. 1 thereof, a typical coaxial cable 10 comprises an inner conductor 12 made of a solid wire or, alternately, made of stranded wire of an electrically conductive metal such as copper or the like, surrounded by an insulation in the form of a cylindrical layer 14 of dielectric material such as polyethylene or Teflon, or the like, which is in turn surrounded by a cylindrical tubular metallic braid conductor 16, forming the outer conductor of the cable. The outer tubular braided conductor 16 is generally in turn surrounded by a tubular or sleeve-like covering 18 of a weather resistant material such as a rubber or a polyvinyl plastic.

Typical of such coaxial cables are RG/U 58 coaxial cable having an outer diameter of 0.208 inch, RG/U 59 having an outer diameter of 0.255 inch, etc.

Preparatory to attaching the connector of the invention at the end of the coaxial cable 10, the cable is dressed by removing the outer covering 18 from approximately one-half inch from the end of the cable, as shown. The outer tubular braided conductor 16 and the inner dielectric layer 14 are cut off at about one-fourth inch from the end of the cable, such that, as shown, about one-fourth inch of the center inner conductor 12 is exposed and about seven-thirty-seconds to one-fourth inch of the outer tubular braided conductor 16 is exposed. A hollow metallic sleeve member 20 and a metallic collar member 22, forming part of the prong connector of the invention, are threaded over the cable 10, as shown. The end of the tubular braided conductor 16 is subsequently pushed back or radially fanned out as shown at 17, thus exposing a portion of the inner insulator 14.

A dielectric insulating washer 28 having inner bore threads 29 and preferably serrations 31 on its outer surface to facilitate handling of the dielectric washer 28 is then threaded over the inner dielectric insulation layer 14 on the end of the cable 10 into a firm mechanical engagement such that the fanned out end portion 17 of the tubular braided conductor 16 is firmly disposed between the insulator washer 28 and the end of the

outer covering 18 of coaxial cable 10. The exposed end of the inner conductor 12 is subsequently bent and formed in a small radius loop 30 disposed in a transverse plane (FIGS. 2 and 3).

The prong connector according to the present invention further includes a plug member 34 made of a dielectric material and forming a hollow body member 36 provided with a longitudinally disposed bore 38 having an enlarged diameter portion 40. The periphery of the rearward portion of the hollow body member 36 is threaded as shown at 42 and the forward portion thereof forms an enlarged diameter shoulder portion 44 having a knurled peripheral surface 46. The inner longitudinal bore portion 38 of the dielectric hollow body member 36 is adapted to receive, under press fit, the body portion 54 of a prong 56 having an enlarged shoulder rearward portion 58 adapted to engage the enlarged inner diameter bore portion 40 of the insulating hollow body member 36 and forming an anterior electrical contact and mechanical clamping surface 62.

The plug member 34 is screwed into the hollow sleeve member 20 as shown in FIG. 2, by engaging the thread 42 of the plug member 34 with a corresponding inner thread 64 on the internal bore 66 of the forward end of the hollow sleeve member 20. The hollow sleeve member 20 has a reduced diameter bore 68 adapted to engage the peripheral surface of the insulating covering 18 of the cable and defining an inner annular transverse abutment surface 70. When the plug member 34 is tightly screwed into the hollow sleeve member 20, as shown in FIG. 2, the bent over looped end 30 of the inner conductor 12 is thus tightly secured by being clamped between the rearward end surface 62 of the prong 56 and the forward surface of dielectric washer 28, thus affording a continuous electric path from the inner conductor 12 to the prong 56, while, at the same time, a strong mechanical and electrical connection is effected between the hollow sleeve member 20 and the outer braided conductor 16, by way of the braided conductor 16 being securely clamped at its fanned out end portion 17 between the annular abutment surface 70 of the hollow sleeve member and the dielectric washer 28 securedly threaded on the end of the inner insulation 14.

The collar member 22 has an internal bore 72 provided with an internal thread 74 proximate the forward end thereof, and is formed with a rearwardly disposed inwardly extending shoulder portion 76 adapted to engage the rearward surface of an outwardly extending flange portion 77 formed on the end of the sleeve member 20 when the connector is used to securely fasten the plug member with the prong 56 inserted in the usual manner in the recess 78 of a receptacle 80 forming the terminal of the equipment, not shown, to which cable 10 is electrically connected, as shown in FIG. 4. The recess 78 is insulated by means such as, for example, an insulating sleeve 82 from the body of the receptacle 80 and the peripheral surface thereof is provided with a thread 84 adapted to engage the thread 74 within the collar member 22. In this manner, a solid mechanical attachment of the coaxial cable 10 is accomplished by means of the prong connector of the invention, while a continuous electrical path is effected from the inner conductor 12 of the cable to the recess 78 of the receptacle and from the outer tubular braided

conductor 16 of the cable to the body 80 of the receptacle.

In order to facilitate manipulation of the prong connector of the invention, a portion of the peripheral surface of the collar member 22 is preferably provided with a knurled surface as shown at 86 in FIG. 1, and a portion of the rearward end of the hollow sleeve member 20 is also provided with a knurled surface as shown at 88 in FIG. 1. Knurled surface 88 on the hollow sleeve member 20 causes an expansion of the metal where such knurled surface is formed, which in turn causes an increase of diameter of the hollow sleeve member, as shown at 90 in FIG. 2, or alternately, the hollow sleeve member may be provided with a slightly enlarged rear end portion 90 of a diameter larger than the bore 92 formed by the shoulder portion 76 of the collar member 22.

As shown in FIGS. 5—7, the principles of the present invention may be adapted to a coaxial cable splice connector for connecting together the separate ends of a pair of coaxial cables 10a and 10b. The ends of the coaxial cables 10a and 10b are properly dressed, as previously explained, by removing the outer insulation coverings 18a and 18b approximately one-half inch from the ends of the cables. The outer tubular braided conductors 16a and 16b and the inner dielectric layers 14a and 14b are cut off at about one-fourth inch from the ends of the cables such that about one-fourth inch of the inner conductors 12a and 12b is exposed and about one-fourth inch of the outer tubular braided conductors 16a and 16b is exposed.

The end of the cable 10a, for example, is passed through a hollow metallic sleeve 104. The sleeve 104, as best shown in FIG. 7, has a longitudinal bore 106 having an internal diameter corresponding to the outer diameter of the coaxial cable 10a and provided with an enlarged diameter bore portion 108, such that an annular shoulder abutment 110 is formed at the junction between the two bore portions. The end of the enlarged diameter bore portion 108 is internally threaded as shown at 112.

The end of the cable 10b is passed through a hollow metallic plug 114 having a longitudinal bore 116 accepting the cable 10b therethrough. One end of the hollow plug 114 has a reduced diameter portion 117 provided with an external thread 118 for engagement with the internal thread 112 of the hollow sleeve 104.

In order to improve finger grip on both the hollow sleeve 104 and the hollow plug 114, a portion of the peripheral surface of the hollow sleeve 104 is preferably provided with a knurled surface as shown at 120, at FIGS. 5 and 6 and the peripheral surface of the hollow plug 114 is also provided with a knurled surface as shown at 122.

The ends of the outer tubular braided conductors 16a and 16b of cables 10a and 10b, respectively, are radially fanned out as shown at 17a and 17b, and the dielectric washers 28a and 28b, of identical construction, and each provided with an internally threaded bore 29a and 29b and an outer surface having serrations as shown at 31a and 31b are threaded on the exposed ends of the cable inner insulators 14a and 14b. In this manner, the dielectric washers 28a and 28b are securely held in position over the coaxial cable inner dielectric layers 14a and 14b, respectively, with the

outer braided conductors 16a and 16b of the cables maintained in a radially fanned out configuration. The ends of the inner conductors 12a and 12b are bent over and formed into small radius loops 30a and 30b, respectively, disposed in a transverse plane.

The hollow sleeve 104 is then slipped towards the end of the coaxial cable 10a such that the fanned out end portion 17a of the outer tubular braided conductor 16a engages the annular shoulder abutment 110 formed between the enlarged bore portion 108 and the reduced portion 106 of the sleeve 104, thus providing an electrically conductive path between the tubular braided conductor 16a and the body of the hollow sleeve 104, the dielectric washer 28a being situated within the enlarged bore portion 108 of the hollow sleeve 104. A cylindrical plug member 124 made of an electrically conductive metallic slug 126 substantially centrally disposed within a dielectric ring 128 substantially of the same diameter as the reduced diameter portion 117 and the dielectric washers 28a and 28b, is then inserted into the bore 108 of the hollow sleeve 104, such that the face of the slug 126 engages the surface of the loop 30a formed at the end of the inner wire 12a of the cable 10a. To complete the assembly, the hollow plug 114 is tightly screwed into the end of the hollow sleeve 104. After the splice connector of the invention is assembled, as shown at FIG. 7, the fanned out end portion 17b of the outer threaded conductor 16b of the coaxial cable 10b is firmly clamped between the annular end face 130 of the hollow plug 114 and the corresponding face of the dielectric washer 28b, and the fanned out end portion 17a of the tubular braided conductor 16a of the coaxial cable 10a is securely clamped between the annular shoulder portion 110 of the hollow sleeve 104 and the face of the dielectric washer 28a, thus insuring a continuous electrical path between the outer braided conductors of the respective cables, through the body of the hollow sleeve 104 and the hollow plug 114. The small radius loop 30b on the inner conductor 12b of the cable 10b is securely clamped between the dielectric washer 28b and one surface of the metallic slug 126, while the second radius loop 30a is similarly clamped between the other end of the metallic slug 126 of the cylindrical plug member 124 and the face of the dielectric washer 28a, thus providing a continuous electric path between the inner conductors 12a and 12b of the respective coaxial cables. The continuous electric path between the inner conductors 12a and 12b is properly insulated from the hollow sleeve 104, and the clamping of the diverse conductors by way of the elements of the splice connector of the invention results in a strong mechanical connection between the two cables providing separate continuous electric paths between the separate conductors of the cable, proper insulation of an electric path from the other, and adequate weather protection of the connection.

Although not shown at FIGS. 5—7, if so desired, the internal bore 116 of the hollow plug member 114 and the reduced diameter bore portion 106 of the hollow sleeve 104 may be provided with a thread, substantially alike the thread 68 of the hollow sleeve member 20 of the prong connector of FIGS. 1—4, for gripping the outermost layer of insulation of the respective coaxial cables.

The diverse elements forming the solder less prong connector of FIGS. 1-4 and the diverse elements forming the splice connector assembly of FIGS. 5-7 have obviously appropriate dimensions, and the dielectric washers have appropriate thickness, that insure proper clamping of the diverse elements in assembly and proper clamping of the separate cable conductors to provide a strong mechanical assembly and safe electrically conductive paths.

It is obvious that the structures described in the foregoing description and in the accompanying drawings are given by way of illustration only, and various different modifications and embodiments may be made by those skilled in the art without departing from the scope of the invention as expressed in the following claims.

I claim:

1. In a connector for mounting on the end of a coaxial shielded cable of the type having an inner conductor surrounded by a tubular dielectric material in turn surrounded by an outer tubular braided conductor in turn surrounded by a dielectric material covering, wherein said connector comprises:

an electrically conductive hollow sleeve member having a first longitudinal bore adapted to accept the coaxial cable, a second longitudinal bore of enlarged diameter provided with an internal thread and an annular abutment surface disposed between said first and second bores;

a dielectric washer disposed surrounding the dielectric material surrounding the inner conductor, the end of the tubular conductor being fanned out radially so as to be normally engaged between one side of said dielectric washer and said annular abutment in the hollow sleeve member, the projecting end of the inner conductor being bent over on the other side of said dielectric washer;

a plug member comprising a cylindrical body and a coaxially disposed electrically conductive elongated prong member having a rearward flat surface and being electrically insulated from said body, said body being provided with a thread on the peripheral surface thereof for engagement with the internal thread in the hollow sleeve member, the relative length of said plug member and said hollow sleeve member being such that when the plug member is threaded tight into the hollow sleeve member said inner conductor is clamped between said dielectric washer and the rearward flat surface of said electrically conductive elongated prong member in said plug member and said outer tubular braided conductor is, clamped between said side of said dielectric washer and the annular abutment surface of said hollow sleeve member;

a forwardly disposed enlarged diameter shoulder portion on the periphery of the end of said hollow sleeve member engaging said plug member; and

a collar member having a rearwardly disposed inwardly extending shoulder portion for engagement with the enlarged diameter shoulder portion of said hollow sleeve member, said collar member having an internal thread for engagement with an external thread of a receptacle for said prong member;

the improvement characterized by said dielectric washer having a bore provided with a thread for gripping engagement with the tubular dielectric material surrounding the inner conductor of said coaxial shielded cable.

2. The improvement of claim 1 wherein said dielectric washer has a peripheral surface provided with serrations.

3. A coaxial cable splice connector for joining the ends of a pair of coaxial cables of the type having an inner conductor surrounded by an inner dielectric material in turn surrounded by an outer tubular braided conductor in turn surrounded by an outer dielectric material, said splice connector comprising:

an electrically conductive hollow sleeve member having a first longitudinal bore adapted to accept the first of said coaxial cables, a second longitudinal bore of enlarged diameter provided with an internal thread and an annular abutment surface disposed between said first and second bores;

an electrically conductive hollow plug member having a longitudinal bore adapted to accept the second of said coaxial cables, and an end provided with external threads for engagement with the internal threads of said hollow sleeve member;

a first dielectric washer, disposed surrounding the inner conductor proximate the end of the first said coaxial cables, the end of the outer tubular braided conductor of said coaxial cable being fanned out radially so as to be normally engaged between a side of said first dielectric washer and the annular abutment in said hollow sleeve member, the projecting end of the inner conductor of said first coaxial cable being bent over on the other side of said first dielectric washer;

a second dielectric washer disposed surrounding the inner conductor proximate the end of the second of said coaxial cables, the end of the outer tubular braided conductor of said second coaxial cable being fanned out radially so as to be normally engaged between a side of said dielectric washer and the end of the hollow plug member, the projecting end of the inner conductor of said second coaxial cable being bent over on the other side of said second dielectric washer; and

a cylindrical plug member disposed between the first dielectric washer and the second dielectric washer, said cylindrical plug member having an outer tubular portion of a dielectric material and an inner cylindrical portion of an electrically conductive material;

whereby when the hollow plug member is threaded tight into the hollow sleeve member with the external threads of said hollow plug member engaged with the internal threads of said hollow sleeve member, the first dielectric washer, the cylindrical plug member, and the second dielectric washer are tightly clamped inside the longitudinal bore of enlarged diameter of the hollow sleeve member and the end of the hollow plug member, with the fanned out end of the outer tubular braided conductor of the first coaxial cable disposed in clamped engagement between said annular abutment surface and said first dielectric washer, the bent over end of the inner conductor of said first

coaxial cable disposed in clamped engagement between said first dielectric washer and said cylindrical plug member, the bent over end of the inner conductor of said second coaxial cable disposed in clamped engagement between said cylindrical plug member and said second dielectric washer and the fanned out end of the outer tubular braided conductor of said second coaxial cable disposed in clamped engagement between the end of said hollow plug member and said second dielectric washer.

4. The connector of claim 3 wherein at least one of said dielectric washers is disposed surrounding the dielectric material surrounding said inner conductor.

5. The connector of claim 4 wherein at least one of said dielectric washers is provided with internal threads for firmly gripping the inner dielectric material of the coaxial cable associated therewith.

6. The connector of claim 5 wherein said dielectric washer has a peripheral surface provided with serrations.

7. The connector of claim 3 wherein the hollow sleeve member is provided with a knurled surface on at least a portion of the outer surface thereof.

8. The connector of claim 7 wherein the hollow plug member is provided with a knurled surface on at least a portion of the outer surface thereof.

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