

Sept. 22, 1970

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3,530,425

COAXIAL CABLE CONNECTOR

Filed Oct. 22, 1968

2 Sheets-Sheet 1

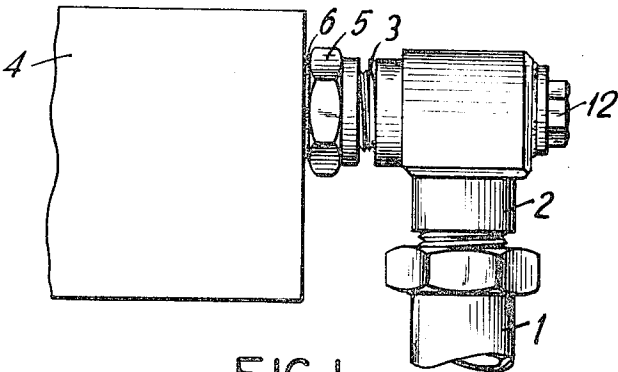


FIG. 1

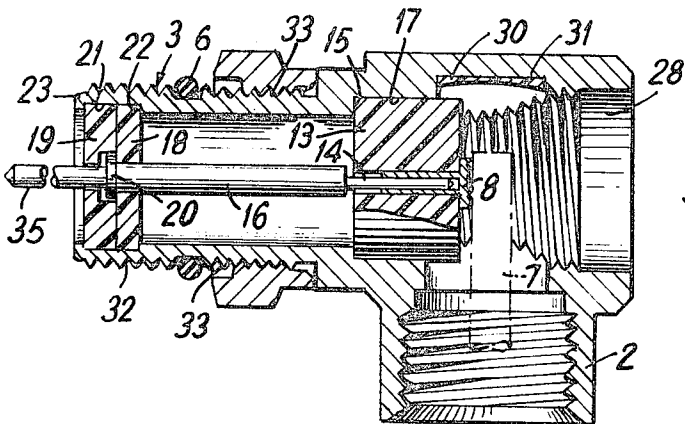


FIG. 2

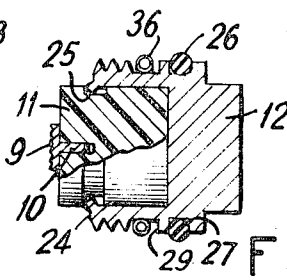


FIG. 3

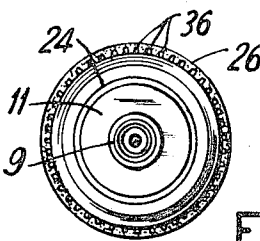


FIG. 3a

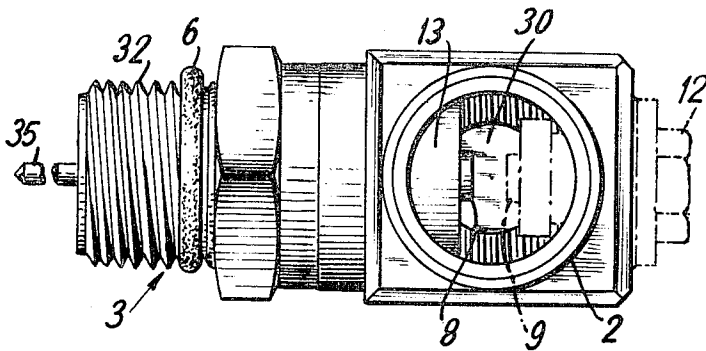


FIG. 5

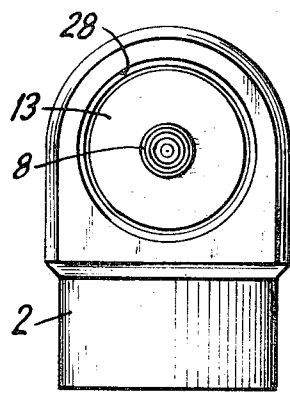


FIG. 4

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2 Sheets-Sheet 2

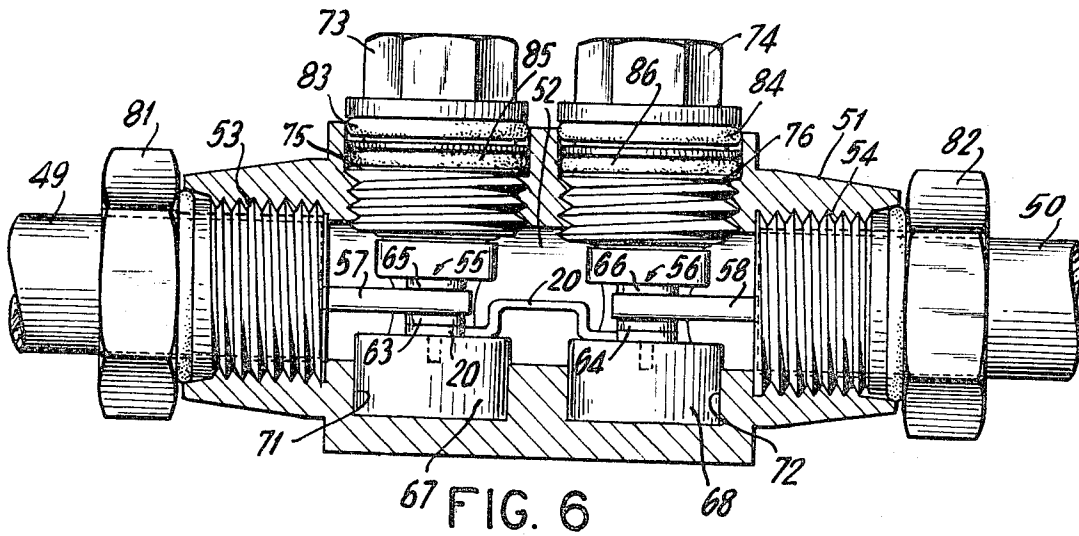
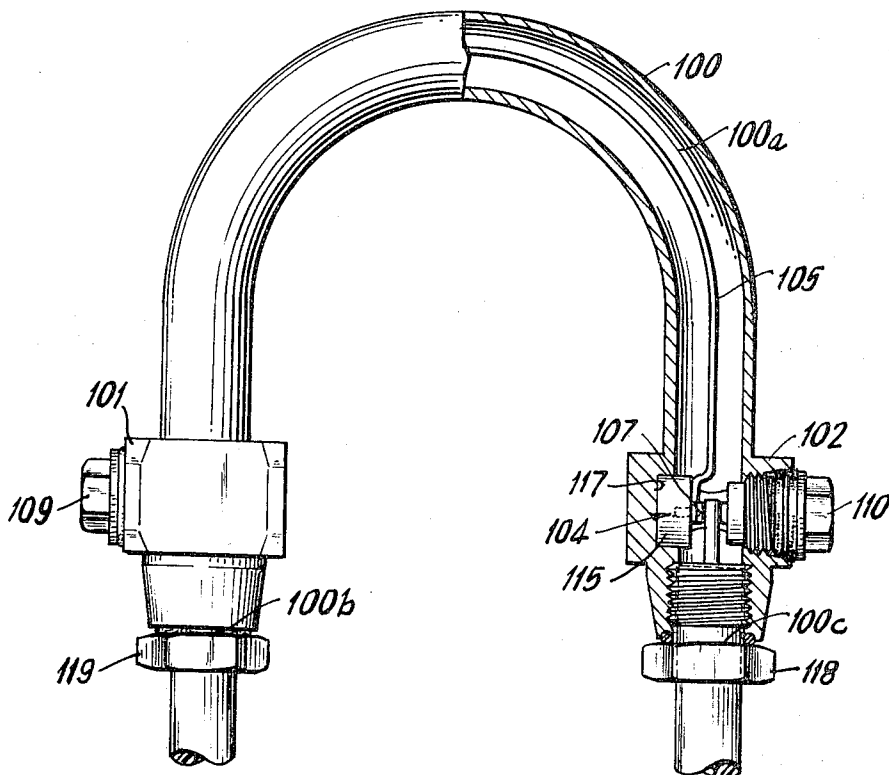


FIG. 7

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3,530,425

COAXIAL CABLE CONNECTOR

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Continuation-in-part of application Ser. No. 672,223, Oct. 2, 1967. This application Oct. 22, 1968, Ser. No. 769,766

Int. Cl. H01r 11/20, 17/18

U.S. Cl. 339—95

9 Claims

ABSTRACT OF THE DISCLOSURE

An impedance matched fixture for joining sections of coaxial cable, at selected angles, or for connecting a coaxial cable to a distribution or similar utility box at an angle to a face of the box. The connector may be straight, curved or L-shaped.

The sheath of the cable is held to the connector by sleeves which thread into a cast aluminum body. The center conductors of connecting cables are securely held between serrated contacts of pressure terminals. One such contact is swivelly attached to a plug nut which threads into the body of the connector, and the other is mounted within the body of the connector.

Coaxially mounted impedance compensating elements connect the terminals of the connector, effecting electrical connection between the center conductors of the cables, and function to match the impedance of the connector with that of the cable line in which installed. In the L-shaped embodiment of the connector, the impedance compensating element is in the form of a pin which extends from the connector and serves as a probe contact to enter an equipment box to which the connector is attached.

BACKGROUND

This application is a continuation-in-part of application Ser. No. 672,223 "Right-Angle Coaxial Cable Connector" of Vasantrai A. Vachhani filed Oct. 2, 1967, now abandoned.

The invention is in the field of coaxial cable connectors, and more particularly for coaxial cables which carry high frequency signals.

In the many instances where coaxial cables are utilized to transmit microwave signals it is necessary or convenient to join two or more lengths of cable, and to lead the cable around obstructions.

Connectors introduced into coaxial cable lines, and particularly high frequency transmission lines should have the following characteristics; (a) a lasting electrical connection with negligible leakage to ground; (b) impedance match to the line so as to offer no abnormal resistance to signal passage; (c) be impervious to the weather elements, and (d) provide a connection as strong as the cable itself. In addition it is highly desirable to have a fitting which fulfills all of the requirements, yet which can be installed quickly and easily in the field.

It is an objective of this invention to provide a device for connecting the ends of like or dissimilar coaxial cables which connectors have the foregoing characteristics, and which at the same time can be quickly and easily installed under the most difficult field conditions.

It is another objective of this invention to provide pressure contact terminals within the connectors which will

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positively grasp the center conductors of the connected cables.

It is a further objective of the invention to facilitate field installation of high frequency signal carrying coaxial cable in areas where space limitations forestall the bending of the cable.

It is a still further objective of the invention to provide means for attaching a signal cable to a distribution box at a right angle.

It is another and still further objective of the invention to provide means to connect adjacent ends of parallel running coaxial leads.

It is yet another objective of the invention to provide a cable connector which permits the opening, inspection, testing and cleaning of its electrical contacts while retaining the structural connection of the cable sheaths

SUMMARY

Briefly, the connectors of the invention are comprised of a body or housing, within which are positioned a desired number of insulated pressure contact terminals to engage and tightly hold the center conductors of each cable entering the connector. Coaxially mounted impedance matching elements, or pins, connect the terminals to one another or to the circuitry within an associated distribution box.

The pressure contact terminals are comprised of two opposing serrated disks, one of which is stationary and connected to the impedance matching element, and the other of which is swivelly attached to a plug nut which threads into an aperture in the connector body.

The entire assembly is designed to compensate for the discontinuities which it introduces into the line. The invention provides the advantages of enabling the joining of sections of coaxial cable at selected angles, and the connection of a coaxial cable at right angles to a utility or signal distribution box.

The invention has the additional advantage of providing a means for positively securing center conductors of variable size within the connector without bending or otherwise substantially weakening them, and at the same time providing excellent electrical connection.

The invention has the further advantages of enabling visual inspection of the position of the center conductor of each connecting cable with respect to the stationary element of its associated pressure terminal prior to engagement thereby; and of providing radio frequency shielding for the connection.

BRIEF DESCRIPTION OF THE DRAWING

FIG. 1, a plan view of an L connector of the invention as installed connecting a cable to a distribution box.

FIG. 2, a cross sectional view of the L connector of FIG. 1.

FIG. 3, a cutaway plan view of a plug nut of the invention.

FIG. 3a, an end view of the plug nut of FIG. 3 illustrating a serrated contact of the invention.

FIG. 4, an end view of the L connector of FIG. 2.

FIG. 5, a bottom view of the L connector of FIG. 2 with a contact plug inserted in phantom.

FIG. 6, a cross sectional plan view of a straight line connector of the invention with coaxial cables connected.

FIG. 7, a cutaway plan view of a U connector of the invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

FIG. 1 is an overall view of an L connector of the invention as it appears connecting a coaxial lead cable to signal distribution box. Coaxial cable 1 enters and is secured to arm 2 of the connector by means of a threaded sleeve of conventional design. Arm 3 is screwed into the side of box 4. A plug nut 12, which functions as will be explained to retain the center wire of cable 1 within the connector, is illustrated in the seated position, and a lock nut 5 which threads on to arm 3 has been tightened against a ring seal 6 disposed about arm 3, and against the adjacent side of box 4 to seal the junction.

FIG. 2 illustrates in detail the internal structure of the connector of FIG. 1. The body of the connector is in the form of a hollow L; having two legs, 2 and 3. A probe type contact pin 16 is coaxially retained within, and insulated from, arm 3 by the action of three insulator washers 13, 18, 19. Washer 13 rides in a cylindrical recess 17 within arm 3 and is seated through the interior end of arm 3 upon an annular shoulder 15. Washers 18 and 19 ride in a cylindrical recess 21 in the outer end of arm 3, and are buttressed against motion to the interior of arm 3 by an annular shoulder 22. An annular lip 23, rolled in from the outer end of arm 3, retains washer 18 and 19 in place. Pin 16 extends through the center of washers 13, 18 and 19, and is restrained from axial motion by a flange 20 which extends radially from pin 16, and rides in a small chamber 20a provided therefore within washer 19. Pin 16 extends out of arm 3 and is configured to act as a probe contact to engage circuitry within box 4. (See FIG. 1.)

Referring to FIGS. 2 and 4, a circular contact disk 8 is mounted upon the interior face 13a of washer 13 and constitutes the stationary half of a pressure contact to engage the center wire 7 of a cable attached to arm 2. The thickness of washer 13 and disk 8 combined function to position the serrated surface 8a of disk 8 adjacent to the position naturally assumed by the center conductor 7 of a cable secured within arm 2.

A hollow stem 14 extends from the back of disk 8 and telescopically engages the end of pin 16 disposed through washer 13 establishing electrical contact therewith.

Center wire 7 is engaged by an adjustable serrated contact 9 (see FIGS. 3; 3a) which is affixed to a plug nut 12. Plug nut 12 screws into the inner end of arm 3, moving a serrated contact 9 attached to the inner face thereof as hereinafter explained, into position opposite contact 8. As nut 12 is tightened center wire 7 is flattened by the squeezing action of contacts 8 and 9. Both contacts are serrated and bite into center wire 7 establishing clean metal contact.

FIG. 5 is a view into the open end of arm 2 illustrating contacts 8 and 9, in the engaging position upon the opposite sides of the longitudinal axis of arm 2 so as to engage the extended center wire 7 of a coaxial cable installed therein.

An epoxy buffer 30 is disposed within a recess 31 in the side wall of arm 3 opposite the interior end of arm 2 to prevent inadvertent grounding of center conductor 7 against the connector housing.

Referring again to FIGS. 1, 2 and 5, threads 32 are cut on the exterior of the outer end of arm 3, which permit arm 3 to be screwed into a suitable aperture in a distribution box 4.

FIGS. 3 and 3a illustrate the details of construction of plug nut 12. A load bearing cylindrical plastic insert 11 is loosely fitted into a cylindrical bore 12a in one end of nut 12. Contact 9 has a stem 10 extending from the back thereof which fits snugly into a matching bore 10a in insert 11.

An annular groove 25 surrounds the outside of insert 11 where it exits bore 12a; into which a lip 24 is loosely rolled to hold insert 11 loosely in place. Thus assembled, insert 11 and contact 9 are free to rotate with respect

to nut 12; so that upon tightening, contact 9 will not be ground against center conductor 7.

A first elastic ring seal 26 is disposed within an annular groove 27 around the exterior of nut 12, and seals nut 12 to the connector in the usual manner when nut 12 is seated.

A second elastic ring seal 36 is disposed within an annular groove 29 adjacent to groove 27 toward the inside end of nut 12. Seal 36 frictionally engages the wall of a bore 28 in the interior end of arm 3 to aid in retaining nut 12 in place during and after the attaching of center conductor 7 to the connector.

FIGS. 3a and 4 illustrates the concentric circular serrations on the opposing faces of pressure contacts 8 and 9, and the centering of the contacts with respect to the longitudinal axis of arm 3 and nut 12.

The dimensions of contacts 8 and 9 and their respective stems 14 and 10 are selected according to accepted principles of high frequency transmission theory of aid in matching the impedance of the connector to that of the line in which it is installed. Similarly the diameter of that portion of pin 16 located within the hollow area 3a of arm 3, and the internal diameter of area 3a, are selected to effect this impedance match.

FIG. 6 is a cross sectional view of a straight line connector of the invention with opposing ends of coaxial cables 49 and 50 connected thereto.

The connector of FIG. 6 is comprised of a body 51, preferably of die cast aluminum, having a linear channel or bore 52 therethrough, which accommodates the center conductors 57 and 58 of cables 49 and 50 and the connecting circuit of the connector.

The ends 53 and 54 of bore 52 are threaded to receive cable retaining sleeves 81 and 82, respectively, which engage the outer covers of the cables 49 and 50 to secure and seal them to the body 51 of the connector.

Two pressure contact terminals 55 and 56 disposed within channel 52 engage the center conductors 57 and 58 firmly between two serrated contact disks as previously described in connection with FIGS. 2 and 5.

The pressure contact terminals 55 and 56 are each comprised of a pair of matching circular serrated contact disks 63, 65 and 64, 66 respectively, which are the same as, and bear the same relationship to each other as contacts 8 and 9 discussed above. Stationary contacts 63 and 64 are supported by insulating buttons 67 and 68 made of load bearing plastic and capable of withstanding great pressure without deformation. Two recesses 71 and 72 in the side wall of channel 52 provide seats for buttons 67 and 68 respectively, within which they are glued or otherwise retained. Moving contacts 65 and 66 are attached to plug nuts 73 and 74 respectively, in the same manner as contact 9 of FIG. 3 is attached to plug nut 12.

The plug nut-contact assemblies 73-65 and 74-66 are substantially the same as the plug nut-contact assembly 12-9 described above in connection with FIGS. 3 and 3a; and screw into threaded apertures 75 and 76 respectively in body 51 to engage center conductors 57 and 58.

Pressure contact terminals 55 and 56 are connected by an impedance matching element 20. Element 20 is a strip of electrically conducting material, connected at opposite ends to contact 63 and 64; and is bent into the general shape of a curtain rod so as to assume a coaxial position within channel 2. Element 20 is therefore insulated from body 51 of the connector by plastic buttons 67 and 68.

To connect cables 49 and 50 by means of the invention, their prepared ends are placed into sleeves 81 and 82 respectively, which grasp the outer covering of the cables and screw into the threaded ends 53 and 54 of channel 52, positioning center conductors 57 and 58 adjacent stationary contacts 63 and 64. Plug nuts 73 and 74 are then tightened, squeezing enter wires 57 and

58 between serrated contacts 63, 65 and 64, 66 respectively.

First ring seals 83 and 84, and second ring seals 85 and 86 seal and retain plug nuts 73 and 74 to housing 51 as explained in connection with FIGS. 2 and 3.

FIG. 7 is a cutaway view of another embodiment of the invention, in the form of a U connector. The connector is comprised of a hollow U-shaped body 100, with a central coaxial channel or bore 100a therethrough, and having identical terminal and housings 101 and 102 at its ends.

Terminal housing 101 and its contents are identical to terminal 102. Housing 102 contains a pressure terminal 104, which is substantially the same as terminals 55 and 56 in the straight line connector of FIG. 6. A stationary contact 107 is set in a supporting plastic button 115 installed in recess 117 in housing 102. An impedance matching and connecting element 105 is connected to the stationary contact 107 of the pressure terminal 104, and to a like terminal in housing 101, and bends outwardly therefrom in the manner of element 20 of the straight-line connector illustrated by FIG. 6, to assume a coaxial position within section 100a.

Plug nuts 109 and 110, and their attached contacts are exactly like plug nut-contact assembly 12-9 previously described with reference to FIGS. 3 and 3a; and function in the same manner.

The ends 100b and 100c of U-shaped section 100 are threaded to receive cable retaining sleeves 118 and 119 in the manner previously described.

The radius of curvature of section 100, its interior diameter, as well as the size and shape of connecting element 105 and the elements of its pressure terminals, are all tailored according to accepted electrical principles to compensate for the discontinuities introduced into the transmission line by the change in direction of the cable and the presence of the connector, and thereby match the impedance of the connector to that of the line for which it is designed.

The connectors of the invention thus provide a means for quickly and easily achieving cable junctions in the field which provide excellent electrical connections with minimum obstruction to signal flow; and which are structurally strong and provide complete protection from the weather elements.

What is claimed is:

1. A coaxial cable connector comprising:
 - a housing having a passage therethrough, and a plurality of threaded apertures therein communicating with said passage,
 - means to attach the prepared ends of coaxial cables connecting to said housing, so that the center conductors thereof extend into said passage,
 - a plurality of pressure terminal means positioned across said passage to engage the center wires of coaxial cables connecting to said housing, said terminal means having two opposing contacts, one of which is stationary and attached to but insulated from said housing and the other of which is swivelly connected to but insulated from a plug nut which screws into one of the threaded apertures in said housing, and
 - means attached to said stationary contacts and disposed coaxially within said passage to effect an impedance matched connection between the center conductors of the connecting cables.
2. The cable connector of claim 1 wherein said housing and the passage therethrough are arcuate.
3. A coaxial cable elbow connector comprising a generally L-shaped hollow body,
 - a first arm of said body comprising a housing for and means to coaxially position within said first arm the center conductor of a prepared end of a coaxial cable,

a second arm of said body comprising a housing for a center conductor contact pin, means to coaxially retain said pin within said second arm,

- a center conductor contact pin disposed coaxially within said second arm, one end of which comprises an electrical pressure contact disposed within said body so as to lie adjacent to the extended center wire of said coaxial cable, and the other end of which comprises a probe contact extending from the extremity of said second arm, said electrical pressure contact comprising a serrated contact disc and a tubular stem extending from said disc telescopically fitting over an end of said center conductor contact pin, said disc and stem being sized to contribute to the impedance match of the connector, and plugging means threaded into an aperture in the end of said second arm nearest the apex of the L, comprising a plug nut, an insulating insert disposed within said plug nut, a pressure disc attached to said insulating insert for pressing the center wire of said coaxial cable against said pressure contact, and impedance matching means protruding from the back of said disc to aid in compensating for the line discontinuity created by the junction.

4. The connector of claim 3 wherein the means to retain said center conductor contact pin with said second arm is comprised of:

- a plurality of dielectric washers disposed about said pin at preselected positions, to retain said pin in coaxial alignment within said second arm,
- and flange means integral said pin disposed between two of said washers positioned in closely spaced relationship to prevent longitudinal movement of said pin.

5. The connector of claim 4 further including means to attach said connector to a cooperating receptacle, comprised of:

- a first threaded section upon the exterior of said second arm to enable threading into a suitable threaded receptacle,
- an annular channel in said second arm disposed behind said first threaded section, and a ring seal disposed therein to seal said second arm to the receiving receptacle,
- a second threaded section of said second arm behind said annular channel, and a compensating nut threaded thereon, which nut may be threaded against said seal and the receiving receptacle.

6. The connector of claim 4 wherein said second arm has a cavity in the interior wall thereof across the end of said first arm,

- said cavity having dielectric material therein to prevent the grounding of the extended center wire of said coaxial cable to said body.

7. The connector of claim 9 wherein said electrical contact disk and said pressure disk are serrated to assure a firm grip upon the center wire of said coaxial cable.

8. The connector of claim 7 wherein said cylindrical center conductor contact pin has four areas of different diameter comprising:

- a first area of the smallest diameter covered by the tubular stem of said electrical contact,
- a second area of the largest diameter comprising said flange means integral said pin,
- a third area of diameter intermediate that of said first and second areas comprising that portion of said pin extending between said first and second areas,
- and a fourth area of diameter intermediate that of said first and third areas extending outside said body, whereby said contact pin, said electrical contact, said second leg, and said dielectric retaining means are electrically matched to preserve the line impedance.

9. The connector of claim 6 wherein said plug includes

an annular end portion, said insulating insert includes an annular channel, and said end portion of said plug is rolled into said channel to provide a loose fit therewith, whereby said insulating insert is held within said plug and allowed to rotate freely therein.

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U.S. Cl. X.R.

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