This invention relates to cable connectors of the type adapted for connecting a plurality of separate sections of coaxial cable, and more particularly to connectors of the type for connecting such sections of cable in angular relationship to each other. Such connectors are commonly referred to as angle connectors or T connectors, and usually include suitable male and/or female contact members adapted for cooperative engagement with opposite type of contacts carried by cooperating coupling members on the ends of the sections of cable to be connected.

Connectors of this general class heretofore available have not proved entirely satisfactory, particularly in cases where the power loss factor is of importance, or where the connectors are used in high frequency applications. Such prior connectors have also been found unsatisfactory because of the inconvenience of assembly and dis-assembly "in the field," in the making and breaking of wire connections in the connectors.

One of the objects of this invention is to provide an improved connector of the character indicated which is constructed and arranged so as to insure maintaining a uniform spacing ratio in correspondence with the spacing of the inner and outer conductors of the cable sections.

Another object is to provide an improved connector of the character indicated which is of relatively small compact form and which is so constructed as to reduce the power loss factor to a minimum.

A further object is to provide an improved connector of the character indicated wherein the connections within the connector proper are made in the process of manufacture and assembly of parts, and thus eliminates the necessity of making wiring connections within the connector "in the field".

Still another object is to provide an improved connector of the character indicated wherein substantially all voids within the connector are filled with suitable dielectric material to insure maintenance of uniform electrical characteristics through the length of the connector.

A still further object resides in the provision of an improved connector of the character indicated which is constructed and arranged so as to exclude dust and air and which is substantially waterproof.

Other objects and advantages of this invention will be apparent from the following description, taken in connection with the accompanying drawings in which:

Fig. 1 is an axial section through a T form of connector, embodying the present invention, taken as indicated on line 1—1 of Fig. 3.

Fig. 2 is a bottom elevational view of the connector.

Fig. 3 is an end elevational view of the connector.

Fig. 4 is an end elevational view of an angle type of connector embodying the present invention.

Fig. 5 is an axial sectional view through the angle connector, taken as indicated on line 5—5 on Fig. 4.

Fig. 6 is a bottom plan view of the angle connector.

Connectors of the type constituting the present invention are of the general class wherein the shell or outer housing is formed of electrically conductive material and is adapted to be connected in circuit with the outer conductors of the coaxial cable sections to be joined together.

In the T form connector illustrated in Figs. 1 to 3 of the drawings there is included a die cast shell 10 of hollow tubular, T formation, comprising a cross leg 11 and an upright leg 12, said legs being joined together in a manner so that the passages or ducts of the said legs are connected together. Mounted telescopically and relatively snugly within the cross leg 11 is a tubular sleeve or body 14 of insulating material, which is substantially coextensive with the length of said cross leg 11 and is provided intermediate its length, in central registration with the passageway of the upright leg 12, with an opening 15. Telescopically within the insulating sleeve 14 is a double ended female contact member 16, which is formed of rod stock. The opposite ends of said member are centrally bored as indicated at 18, and the walls surrounding the bores 17 are slotted as indicated at 19, so that the portions of said walls intermediate the slots in effect form resilient fingers so as to permit obtaining a firm yielding frictional engagement with the surface of a cooperating male contact member, when connected thereto. The inner wall of the insulating sleeve 14, immediately surrounding the resilient portions of the female contacts, is slightly enlarged so as to accommodate slight lateral deflection of the yielding wall portions of the female contacts.

Mounted in telescopic relation in the upright leg 12 is a circular block 20, of insulating material, disposed in abutting relation to the exposed portion of the sleeve 14, registering with the passageway in the leg 12. The block 20 is formed with an upwardly extending boss 21 adapted to be
snugly fitted into the aperture or opening 16 of the sleeve. Mounted centrally in the block 28 is a male contact member 22, formed intermediate in length with an enlargement 24, which constitutes a shoulder adapted to be disposed in abluting relation to the undersurface of the block 28. The upper end of the male contact member 23 is threaded into the intermediate or central portion of the double female contact 16, as clearly seen in the drawings. When the parts are thus assembled, they are axially locked in position within the shell of the connector. For convenience in assembly, the enlargement 24 is formed, as may be seen in Fig. 2 of the drawings, for convenient engagement by a suitable tool for facilitating the threading and unthreading of the male contact member with respect to the double female contact member 16. Snugly telescoped into the lower end of the upright leg 12 is a plug of insulating material 26, formed to accommodate the enlargement 24 of the male contact member.

The outer surface of the end portions of the cross leg 11 are threaded as indicated at 30, for connection to suitable coupling nuts of cooperating connector elements associated with the ends of coaxial cable sections to be joined. The end faces of the cross leg 11 are serrated or notched as indicated at 32 in the drawings, for interlocking engagement with a pair of diametrically spaced apart cooperating lugs formed on the adjacent end of a cooperating connector member. Lugs of the type referred to are indicated at 34, projecting downwardly from the lower end of the upright leg 12 which lugs, it may be understood, are adapted to be seated in aligned notches formed in the end of a cooperating connector member. The purpose of this interlocking relation is to preclude rotation of one connector element with respect to the other, such as may result from vibration. The exterior of the lower end portion of the upright leg 12 is formed with an annular groove 36 in which is interlockingly engaged a spring ring 37, which is also seated in a groove 38 formed in the inner surface of a tubular coupling nut 40. The coupler nut is of generally cylindrical form having the major portion of its exterior surface knurled as indicated at 41, and the interior thereof threaded as indicated at 42 for cooperative engagement with an externally threaded portion of a complementary connector member. It will be noted that the operating portion 24a of the male contact member projects a substantial distance downwardly below the insulating plug 26 and is of sufficient length to insure proper and adequate surface engagement with a cooperating female contact.

The insulating sleeve 14, the insulating block 29 and the insulating plug 26 are preferably formed of a suitable high efficiency dielectric material. It is highly desired that the dielectric characteristics throughout the length of the connector be of substantially the same thickness, and also correspond to the impedance of the coaxial cable sections to which it is connected. It is therefore necessary to eliminate air gaps and voids by reason of the construction or positioning of the elements within the shell of the connector, otherwise there will be a variation in electrical characteristics in the connector which affects the power loss factor as well as the reflection factor. To overcome this difficulty it is preferred that the insulating members be formed of polystyrene, or other equivalent dielectric, and to eliminate all voids or unnecessary space between certain of the elements, certain of the elements are coated with liquid polystyrene which in itself is a solvent for the molded polystyrene insulating elements. Preparatory to assembly of the elements within the connector shell the interior of the legs of the connector as well as the various insulating elements themselves are coated with liquid polystyrene so that when the parts are assembled in position as seen in Fig. 1 of the drawings, substantially all unnecessary voids or air spaces are filled by the liquid insulating material which subsequently becomes a solid. Thus it is possible to obtain a substantially homogeneous insulation within the shell which excludes the entrance of dust and air, and provides a structure which is substantially waterproof, and maintains uniform electrical characteristics throughout the length of the connector.

It will therefore be apparent that by virtue of the construction described, the entire assembly is fabricated completely by the manufacturer and dispenses with the necessity of the assembly and disassembly of the connector "in the field" incident to the making or breaking of wiring connections with the connector, as heretofore has been necessary. By eliminating the necessity of making soldering connections for the conductor wire within the connector, it is now possible to obtain a connector of relatively compact size, occupying a minimum of space.

In the alternate form of my invention represented in Figs. 4 to 6 of the drawings, the connector disclosed is of the angle type. In this construction there is included die cast shell 50 having two tubular legs 51 and 52, joined together at substantially right angles to each other. In this construction I employ a closed end tubular sleeve 53 of insulating material, telescoped within the leg 51, with the closed end portion of the sleeve abutting against the wall constituting a continuation of the inner wall of the leg 51. The upper end portion of the sleeve 53 is formed with an opening 54, disposed in substantially central relation to the passageway formed in the leg 51. Telescoped within the sleeve 53 is a single female contact member 56 of generally the same construction as disclosed in connection with the T form connector. The upper solid end portion of the female contact is disposed in registration with the aperture or opening 54 in the sleeve 53, and snugly telescoped within the transverse leg 51 is a block 57 of insulating material, having a centrally disposed projection 58, snugly fitted within the opening 54 of said sleeve 53. Carried centrally in the block 57 is a male contact 60 having intermediate its length an enlargement 61 adapted to abut against the outer end of the block 57. The inner end of the male contact projects beyond the boss 62, and is threaded into the solid upper end portion of the female contact 56, and thus serves to firmly lock the parts in assembled relation, within the angle connector shell 50.

Snugly fitted in the outer end of the transverse leg 51 is a plug of insulating material 65, which is formed for snugly embracing the enlargement 61 of the male contact 60. The opposite ends of the angle connector shell are constructed and/or provided with auxiliary elements for connection to cooperating connector elements in a manner similar to that described in connection with the T form connector disclosed in Figs. 1 to 3 of the drawings, and need not again be described. The insulating members 53, 57 and 65 are preferably of suitable material such as polystyrene
and the various parts within the angle connector shell are preferably coated with liquid polystyrene to fill up undesired voids therein and to ensure homogeneous insulation between the internal contacts or conductors formed by the connection of a male contact to the female contact, with respect to the shell proper, which, as above stated is adapted to be connected in circuit with the outer conductors of the respective sections or coaxial cable to be joined together.

Although I have herein shown and described certain preferred embodiments of my invention, manifestly it is capable of modification and re-arrangement of parts without departing from the spirit and scope thereof. I do not, therefore, wish to be understood as limiting this invention to the precise embodiments herein disclosed, except as I may be so limited by the appended claims.

I claim as my invention:

1. In an electric connector for coaxial cables, a metallic casing having angularly disposed intersecting legs, tubular insulating sleeves mounted in said legs and snugly engaging the inner walls thereof, said sleeves being formed for abutting interlocking engagement to provide a substantially homogeneous insulating structure free of voids to insure the maintenance of uniform electrical characteristics throughout the length of the connector, electrical contacts snugly mounted within their respective insulating sleeves, and means for detachably connecting said sleeves and contacts in assembly relation. 

2. In an electric connector for coaxial cables, a metallic casing having angularly disposed intersecting legs, tubular insulating sleeves mounted in said legs and snugly engaging the inner walls thereof, said sleeves being formed for abutting interlocking engagement to provide a substantially homogeneous insulating structure free of voids to insure the maintenance of uniform electrical characteristics throughout the length of the connector, electrical contacts snugly mounted within their respective insulating sleeves, and means for detachably connecting said sleeves and contacts in assembly relation.

3. In an electric connector for coaxial cables, a metallic casing having angularly disposed intersecting legs, a pair of tubular insulating sleeves of substantially uniform cross sectional area mounted in said legs and snugly engaging the inner walls thereof, said sleeves being formed for arcurate abutting interlocking engagement to provide a substantially homogeneous insulating structure free of voids to insure the maintenance of uniform electrical characteristics throughout the length of the connector, electrical contacts snugly mounted within their respective insulating sleeves and means provided on said contacts for detachably connecting said sleeves and contacts in assembly relation.

4. In an electric connector for coaxial cables, a metallic casing having angularly disposed intersecting legs, a pair of tubular insulating sleeves of substantially uniform cross sectional area mounted in said legs and snugly engaging the inner walls thereof, said sleeves being formed for arcurate abutting interlocking engagement to provide a substantially homogeneous insulating structure free of voids to insure the maintenance of uniform electrical characteristics throughout the length of the connector, electrical contacts snugly mounted within their respective insulating sleeves, and means provided on said contacts for detachably connecting said sleeves and contacts in assembly relation, said metallic casing being in the form of a T connector.

5. In an electric connector for coaxial cables, a metallic casing having angularly disposed intersecting legs, a pair of tubular insulating sleeves of substantially uniform cross sectional area mounted in said legs and snugly engaging the inner walls thereof, said sleeves being formed for arcurate abutting interlocking engagement to provide a substantially homogeneous insulating structure free of voids to insure the maintenance of uniform electrical characteristics throughout the length of the connector, electrical contacts snugly mounted within their respective insulating sleeves, and means provided on said contacts for detachably connecting said sleeves and contacts in assembly relation, said metallic casing being in the form of an elbow connector.

EDWARD CLARKE QUACKENBUSH.

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