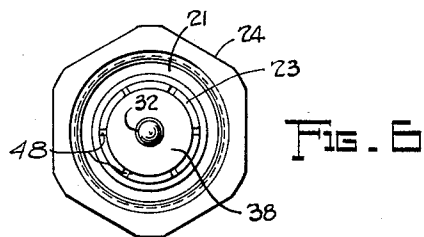
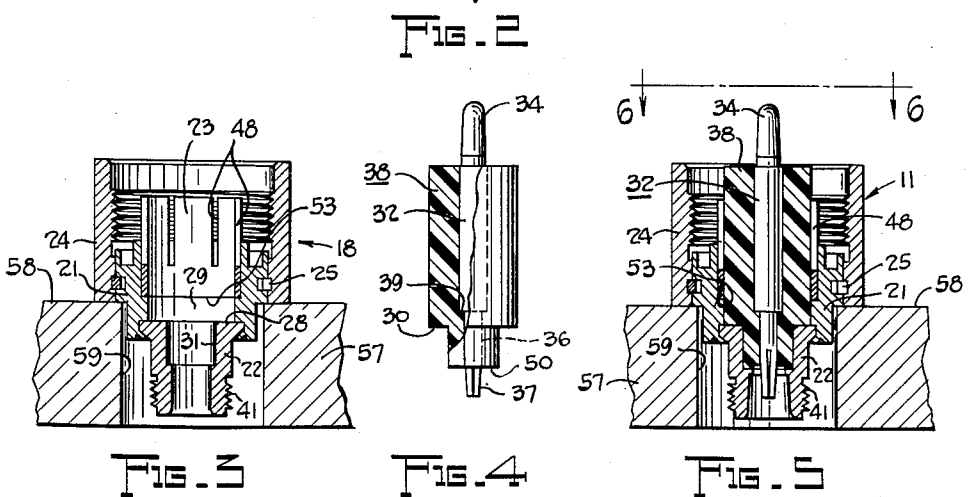
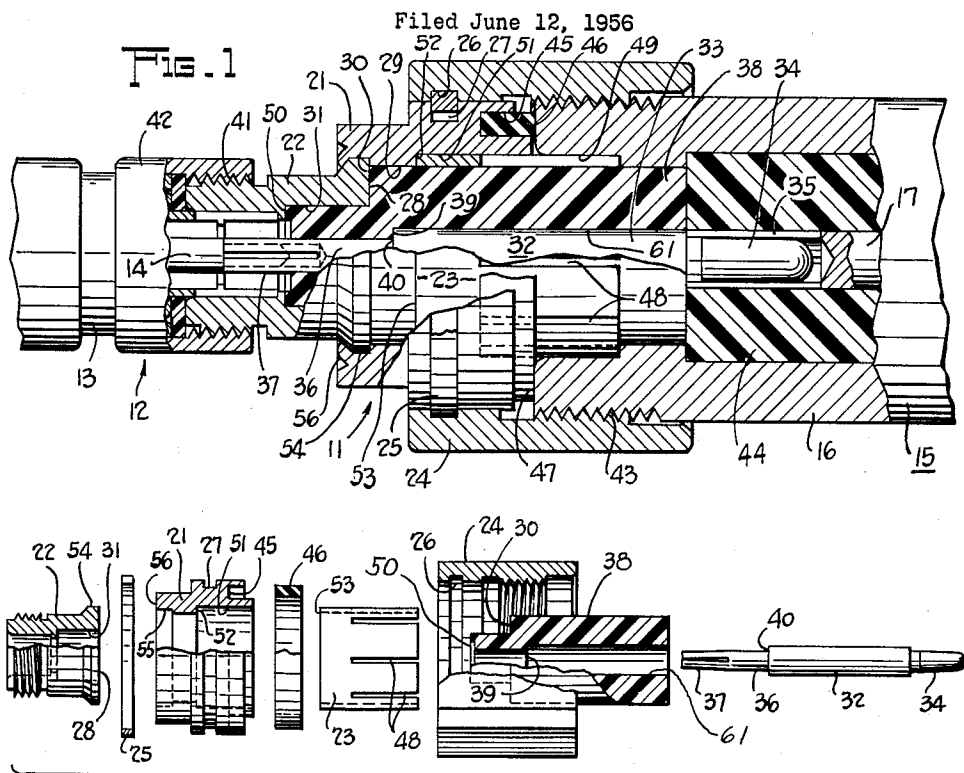


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COAXIAL LINE TRANSITION SECTION AND METHOD OF MAKING SAME



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3,022,482

COAXIAL LINE TRANSITION SECTION AND METHOD OF MAKING SAME

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This invention relates to high frequency coaxial transmission line components and methods of producing them.

An object of the invention is to provide an improved unit for interconnecting elements of a coaxial line system.

A more specific object of the invention is to provide an improved transition element or adapter for interconnecting coaxial line elements having different diameters in order to overcome discontinuities in the line and reflections which may be caused thereby.

Another object of the invention is to provide an improved method of assembling transmission line components including an insulator separating a center conductor element from an outside conductor element and mounting one within the other, and especially an improved method of forming coaxial line transition elements for joining coaxial line elements or units having different external diameters and different internal diameters.

Still another object of the invention is to provide interchangeable coaxial transmission line elements enabling connections to be made from radio frequency apparatus to different types or sizes of coaxial transmission line elements.

Other and further objects, features and advantages of the invention will become apparent as the description proceeds.

In carrying out the invention in accordance with a preferred form thereof, in fabricating a transition element for connecting a coaxial line device to one of smaller diameter, a conductive body is formed having a stepped bore with a shoulder therein at the junction of portions of the bore of different diameter. Preferably the conductive body is fabricated from different elements which may be brazed, soldered, or pressed together or otherwise connected electrically and mechanically. An insulator bushing is also formed having a stepped internal diameter forming a shoulder with a stepped bore to form an internal shoulder, and a center conductor pin is formed having a central portion of such diameter as to be received in the bore of the bushing with a stepped diameter and a shoulder fitting against the shoulder in the bushing bore, and with protruding extensions for making electrical connections to the center conductors of coaxial line elements to be connected.

In order to avoid the necessity for lips, flanges, lateral pins or other connecting means, provision is made for gripping the pin in the insulator and the insulator in the body so tightly that axial displacement is prevented. This is accomplished by freezing the insulator bushing to such a low temperature, for example 50° below zero, centigrade that the bushing may be inserted in the body although the normal difference between internal and external diameters of the bushing is made greater than the difference between the diameter of the bore of the body and the external diameter of the center conductor pin.

Preferably the pin is first inserted in the bushing and

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the unit as an assembly is frozen for ready insertion in the body. Consequently when the temperature of the assembly regains the ambient temperature of the body, the insulator is under radial compression and causes very tight gripping of the center conductor pin by the bushing and of the bushing by the body. The order of performing the steps of the assembly may be varied, if desired. For example, the fabrication may also be carried out by inserting the insulator bushing in the conductive body after freezing the insulator, and pressing in the center conductor pin after the parts have been returned to ambient temperature.

The body is preferably assembled of different elements which are fastened mechanically and electrically so as to provide protruding tubular portions for connection to the outside conductors of coaxial line elements to be interconnected, and the center conductor pin is formed with protruding elements for connection to the center conductors or center rods of coaxial line elements.

A better understanding of the invention will be afforded by the following detailed description considered in conjunction with the accompanying drawings, in which:

FIG. 1 is a side view, primarily a longitudinal sectional view of a transition element in accordance with the invention, represented as cut by a plane through the axis, shown with adjacent end portions of larger- and smaller-diameter coaxial line devices interconnected by the transition element;

FIG. 2 is an exploded view of the parts of the transition element illustrated in FIG. 1;

FIG. 3 is a view of a section cut by a plane through the longitudinal axis of the conductive body of the transition element shown in the apparatus of FIG. 1 showing the body supported upright on an assembly block;

FIG. 4 is a view of the center conductor pin employed in the apparatus together with a stepped diameter bushing for mounting it in a conductive body;

FIG. 5 is a view of such a conductive body supported on an assembly block with the assembled apparatus of FIG. 4 inserted therein to constitute a transition element; and

FIG. 6 is an end view of the apparatus of FIG. 5.

Like reference characters are utilized throughout the drawings to indicate like parts.

In some cases it is desirable to be able to interconnect a coaxial line device having a relatively large diameter of the outside and inner conductors to a coaxial line device having small diameters. For example, in high frequency thermocouple meters of the type disclosed in the copending application of Henry J. Calderhead, Herbert H. Heller and Clayton F. Waterfield, Serial No. 534,226, filed September 14, 1955, a thermocouple assembly is employed in which a thermocouple element in the form of a straight rod forms the center conductor of a coaxial line unit and it is necessary to make the diameters relatively small because it is impracticable to make thermocouple rods of large diameter. On the other hand, in fabricating a direct-current measurement unit for detecting the magnitude of the unidirectional voltage produced by the thermocouple in response to radio frequency energy passing through the coaxial line element of which it is a part, it is more practical to make the internal diameter of the outside conductor and, accordingly, the

diameter of the center conductor rod larger than in the case of the thermocouple unit. Accordingly, a transition element is provided for interconnecting two such coaxial line elements of different diameters and the transition element is so constructed as to maintain the requisite relationship between external and internal diameters for maintaining the same characteristic impedance in order to avoid reflections and avoid increasing the standing wave ratio.

As illustrated in FIG. 1, a transition element or adaptor 11 is provided for interconnecting a coaxial line element 12 having an outer conductor 13 and a center conductor rod 14 of predetermined diameter ratio to give the desired characteristic impedance and a coaxial line element 15 having an outside conductor 16 and a center conductor rod 17 both of greater diameter than in the case of the element 12 to provide the requisite ratio, taking into consideration the composition of the dielectric material employed, to maintain the same characteristic impedance.

The adaptor or transition element 11 comprises an outside conductor body assembly indicated generally at 18 (FIG. 3) consisting of a conductive shell 21, a protruding conductive bushing 22 for connection to the outer conductor 13 of the smaller diameter coaxial line element 12, a conductor sleeve 23 and a connection nut 24 with a split spring ring 25 for rotatably securing the nut 24 to the shell 21. Conventional grooves 26 and 27 are provided in the nut 24 and the shell or tubular body 21 respectively for retaining the spring ring 25. The connection nut 24 serves for making electrical and mechanical connection to the outer conductor 16 of the larger diameter coaxial line element 15. The radial surface 28 forming the base of the conductive bushing 22 serves as an internal shoulder in the stepped bore of the outer conductor body. The bore of the outer conductor body includes a larger diameter main portion and a bore extension. The main portion consists of the internal cylindrical surface 29 of the shell 21 and the adjacent conductor sleeve 23. The bore extension consists of the inner cylindrical surface 31 of the conductive bushing 22.

For interconnecting the larger diameter center conductor rod 17 of the unit 15 and the smaller diameter center conductor rod 14 of the unit 12, a stepped diameter center conductor rod or pin 32 is provided in the transition element 11. The center conductor rod 32 has a central or main portion 33 with a predetermined diameter so chosen in relation to the internal diameter of the cylindrical bore 29 as to give the desired characteristic impedance, with a protruding portion 34 of sufficiently reduced diameter to fit within slotted tubular end portion 35 of center conductor rod 17 and make resilient connection. The conductor pin 32 has a stepped cylindrical external surface forming a transition to the diameters of the unit 12. A relatively short reduced diameter section 36 has a protruding tubular end portion 37 slotted to form spring fingers to grasp resiliently a suitable reduced diameter pin extension of the center conductor rod 14 of the unit 12.

An insulator bushing 38, composed of a suitable dielectric material of low loss and high insulating properties at high frequencies, such as polytetrafluoroethylene, supports the center conductor rod 32 in the outside conductor body of the transition element 11. The insulator bushing 38 has stepped external and internal diameters to correspond respectively to the internal diameters 29 and 31 of the hollow cylinders 21 and 22 of the outer conductor assembly and the external diameters of the cylindrical outer surfaces of the portions 33 and 36 of the center conductor pin 32. The radial surface 28 at the base of the conductive bushing 22, serving as the bore shoulder in the outside conductor body is abutted by external circular radial shoulder 30 of the stepped diameter bushing 38. Likewise a circular radial surface 39 at inner end of counterbore 61 in the bushing 38

serves as an internal shoulder for engagement by an external shoulder 40 on the stepped diameter center conductor pin 32. In order better to effect the transition and minimize the possibility of reflections, the shoulder 40 of the center conductor pin 32 is further from end 50 of the reduced diameter end of the bushing 38 than the shoulder 28 of the outer conductor. When the present transition device is assembled in a coaxial transmission line the stepped bushing 38 is held against axial shifting by the shoulder 28 and insulator sleeve 44 of the line 15 which supports the center conductor 17 in the outer conductor 16 and against which the bushing 38 is abutted.

In order to mate conventional connection elements for coaxial lines, the outer surface of the end portion of the conductive bushing 22 is threaded as shown at 41 to receive a connection nut 42 mounted rotatably in a conventional manner on the outer conductor 13 of the smaller diameter unit 12; and likewise the outer surface of the end portion of the outside conductor 16 of the unit 15 is threaded as shown at 43 for mating the connection nut 24. As in conventional coaxial line elements, the element 12 is provided with an insulator bushing supporting center conductor rod 14 in the outside conductor 13. Preferably the inner end of the shell 21 of the transition element 11 is provided with an annular groove 45 to receive resilient gasket material 46 for resiliently abutting the end surface 47 of the outside conductor 16 of the unit 15.

The parts of the transition element 11 are shown in exploded form for greater clarity in FIG. 2, from which it will be observed that the conductive sleeve 23 may be provided with axial slots 48 to form spring fingers for enabling good electrical connection to be made with the tubular outer conductor 16 of the unit 15 at the ends of such fingers which abut a shallow radial shoulder 51 at the inner end of a tapered counterbore 49 in the end of the conductor 16.

The method of forming and assembling the transition elements 11 will be understood more readily from a consideration of FIGS. 2 to 5. The conductive parts are first formed by machining or the like from metal blanks of a suitably highly conductive material such as brass or copper to produce the forms shown in FIG. 2. The gasket 46 and the insulating bushing 38 may be formed as in conventional practice by molding or the like in the form shown, the insulator bushing 38 having the stepped diameter bore and the stepped diameter outer surface formed therein when the bushing is molded.

Before the conductor shell 21 is assembled with the bushing 38, the conductive bushing 22 and the conductive sleeve 23 are secured thereto. The sleeve 23 is secured to the shell 21 by inserting the sleeve 23 in the bore 51 against the shoulder 52 and soldering the end surface 53 to the shoulder 52 and the outer surface of the sleeve 23 to the portion of the bore 51 adjacent the shoulder 52 by applying solder along the junction surfaces. The conductor bushing 22 is provided with a lip 54 around the base 28, adapted to fit within a counterbore 55 in the shell 21, and the lip 54 is secured in the counterbore 55 by staking over edges 56, as shown in FIG. 1. In this manner, electrical and mechanical connection is made between the conductor sleeve 23 and the conductor bushing 22.

It will be observed that the shoulders 28 and 39 locate the bushing 38 and the center conductor pin 32 with respect to axial movement toward the left. However, when it is desired to disassemble the apparatus illustrated in FIG. 1 by unscrewing the end 24 and pulling the unit 15 out to the right, it is necessary that the center conductor pin 32 and the bushing 38 be secure enough in the outside conductor body of the unit 11 so that the center conductor pin 32 will not be pulled out of its assembly if the center conductor rod 17 should be too tight in the spring socket 35.

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In accordance with the invention, the center conductor pin 32 and the bushing 38 are gripped very tightly in the outside conductor body consisting of the elements 21 and 22, as well as the solid portion of the conductor sleeve 23 to the left of the slots 48. This is accomplished by freezing the insulator bushing 38 and taking advantage of the differential expansion thereof with respect to the metal parts 32 or 21, 22 and 23.

For example, in one method of assembly, the center conductor pin 32 is first inserted in the insulator bushing 38, as illustrated in FIG. 4, to form a unitary assembly which is placed in a refrigerating chamber at a temperature substantially below that of the ambient temperature; for example, about 60° F. below zero. Excellent results are obtained, however, at temperatures between about minus 40° and minus 75° F. The dimensions at ambient temperature may be such that the pin 32 makes either a good push fit or tight fit in the bore of the insulator bushing 38. At the greatly reduced temperature, owing to the differential expansion, the bushing 38 tends to contract more than the outer conductor body and therefore the external diameters of the bushing 38 shrink considerably with respect to the internal diameters of the cylindrical surfaces 29 and 31 of the outer conductor body. Accordingly, the unitary assembly of FIG. 4 may be inserted readily in the outer conductor body assembly of FIG. 3 upon removal of the assembly of FIG. 4 from the refrigerator chamber or while all parts are within the refrigerator chamber.

However, upon equalization of temperatures, as the parts regain ambient temperature, the outer cylindrical surfaces of the insulator bushing expand against the internal bore surfaces 29 and 31 of the outside conductor body, illustrated in FIG. 3, so that the material of the insulator bushing is in radial compression. Consequently, the bushing 38 is gripped very tightly within the outside conductor body. Owing to the slight degree of plasticity of the insulator bushing and the fact that the material is in radial compression, the insulator bushing 38 also grasps the center pin 32 very tightly notwithstanding what may have been the original relationship between the diameters of the pin 32 and of the bore of the bushing 38. It will be understood that when this method of assembly and securement is employed, the original external diameters of the bushing 38 at ambient 70° normal temperature, preferably in both the larger and smaller diameter portions, exceed those of the internal cylindrical surfaces 29 and 31 of the outside conductor body.

An alternative method of assembly which may be employed, if desired, consists of first freezing the insulator bushing 38 to the greatly reduced temperature for insertion in the outside conductor body, then after such insertion permitting the assembly of the outside conductor body and the insulator 38 to warm up to ambient temperature. This tightens the insulator 38 in the outside conductor body. Owing to the plasticity of the material of the insulator 38 at ambient temperature the center conductor pin 32 may be mounted by pressing it in place.

Preferably, as shown, the volume of the material in the bushing 38 around its center hole is greater than the volume of the center hole. Accordingly, in consequence of the effect of internal strains upon freezing, the inner surface as well as the outer surface of the bushing has been found to pull away from the positions occupied by these surfaces at ambient temperature. For this reason, and because of the differential expansion of metal and insulator material, it is quite feasible to perform the entire assembly operation at the low temperature. At approximately 60° F. below zero, the pin 32 slips readily into the bushing 38 and the bushing 38 slips readily into the conductor body. Then as the temperature rises the bushing surfaces press toward the metal surfaces and the parts are tightly gripped at any ambient temperatures which may be expected, such as within the range from zero to 100° F.

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Whichever method of assembly is employed, the difference between the outside diameter of each portion of the pin 32 and the inside diameter of the corresponding portion of the outside conductor body is made less at the normal ambient temperature of 70° F. than the difference between the internal diameter or bore diameter of the bushing 38 and the outside diameter thereof for the same corresponding portions at the normal ambient temperature. Consequently, after freezing the material of the bushing 38 and permitting it to re-expand upon returning to ambient temperature, the material is compressed into a space less than that which it normally occupies and is held in radial compression, therefore exerting great gripping force upon the surfaces of the pin 32 and the outside conductor body consisting of the elements 21, 22 and 23.

A jig 57 having a flat horizontal upper surface 58 to engage supportingly a circular radial shoulder of the outside conductor assembly and also having a vertical bore 59 to receive the downwardly directed bushing 22 may be provided for holding the outside conductor parts with their axis vertical during assembly, as illustrated in FIG. 3, to facilitate insertion of the insulator 38 therein, or the dropping of the insulator and then the center pin. Whether the assembly be accomplished by first making the sub-assembly of FIG. 4 and then dropping the frozen sub-assembly into the jig supported outside conductor, or by freezing the insulator 38 and the center pin 32 apart from one another and then dropping them sequentially into place, the parts are located automatically (FIG. 5) in correct axial relationships by the shoulder pairs 28, 39 and 39, 40.

Although the coupling nut 24 is shown in FIG. 3 as already assembled with the outside conductor body, the invention is not limited to the performance of this assembly operation prior to assembly with the insulator bushing 38 and center conductor pin 32. The nut 24 is assembled by pressing the spring ring 25 into the groove 27 in the shell 21, to enable the nut 24 to be slid in place axially. Then the expansion of the spring ring 25 into the groove 26 for one-half the depth of the spring ring 25 secures the nut 24 against axial displacement while permitting rotation thereof.

The sequential assembly process described, including the chilling and the gravitational locating and holding, is highly useful to facilitate assembly of small parts fitting closely, which would otherwise be difficult to assemble because of the small diameters involved. This is true even in structures such as illustrated where tight gripping of parts in actual operation of equipment is not necessary because the parts are locked or trapped in position during operation by adjacent other components of a coaxial system.

The construction and method of assembly of the coaxial line element which has been described is adapted for transition elements with stepped diameters of the center conductor pin 32, the bushing 38, and the outside conductor body, for enabling transition to be accomplished between coaxial line elements of different diameters. However, the invention is not limited thereto and the shoulders illustrated are not requisite to the tight gripping of the assembled parts within each other. Consequently, the same method of assembly may be employed in the case of uniform-diameter external and internal conductor parts and uniform diameter bushings where component elements of coaxial line apparatus are to be produced with a center conductor rod firmly mounted within an outside conductor element and insulated therefrom without the employment of lips, flanges, pins or the like to prevent axial displacement.

In accordance with the provisions of the patent statutes, the principle of operation of the invention has been described together with the apparatus now believed to represent the best embodiment thereof, but it is to be understood that the apparatus shown and described is

only illustrative and that the invention may be carried out by other arrangements.

What we claim and desire to secure by Letters Patent of the United States of America is:

1. An element for connecting relatively large diameter slide terminal inner and screw terminal outer conductors of one coaxial electrical transmission line of given characteristic impedance to relatively small diameter corresponding conductors of another such line of substantially the same characteristic impedance and similar slide and screw terminals, said element comprising rigid metal conductor tube means formed with an internal stepped diameter wall having an annular shoulder intermediate and spaced from both its ends and constituting the juncture between relatively large and small diameter cylindrical portions of said internal wall, said tube means having on its opposite ends screw fastening means formed and adapted to interfit one with the outer conductor screw terminal of the one large diameter transmission line and the other with the outer conductor screw terminal of the other small diameter transmission line and readily to effect progressive drawing together axially and securing of the element and each of the transmission lines; stepped diameter conductor pin means having an annular shoulder intermediate and spaced from both its ends, said pin means extending through the conductor tube means in coaxial relation and being separated therefrom by an annular space, said pin means having on its opposite ends terminal portions formed and adapted to interfit with and effect sliding frictional electrical connections one with the inner conductor slide terminal of the one transmission line and the other with the inner conductor slide terminal of the other such line upon drawing together axially the pin and the respective inner conductors; solid dielectric body means surrounding the pin means in said space and constituting a support for the pin means in the tube means; the shoulder of the tube means being axially spaced beyond that of the pin means with respect to that end of the element having terminals adapted to interfit with the large transmission line; said pin means having a cylindrical main portion with the maximum cross-sectional area of the pin means located within and concentric to the large diameter portion of said internal wall; said main pin portion, large diameter wall portion and one portion of said dielectric body means being definitive of a main coaxial line section substantially of predetermined characteristic impedance; said portion of the dielectric body means completely filling the annular space between the pin means and the conductor tube throughout the axial extent of said large diameter portion; another portion of the pin means with the small diameter wall portion and another portion of said dielectric body means being definitive of another coaxial line section having substantially said predetermined characteristic impedance; the dielectric body means including a third portion between and locatingly abutted against both the pin and the tube shoulders, said third portion being embraced by and having the same diameter as the large internal wall portion and embracing and having the same cross section as said other pin portion; and said dielectric means being of integral construction throughout its axial extent from the tube shoulder to one of its ends at the axial limit of its said one portion and from the pin shoulder to the other of its ends at the axial limit of its said other portion.

2. A connecting element as in claim 1 in which one end of the dielectric body means projects axially from one end of the conductor tube means and has on said projecting end a radial face spaced axially beyond the conductor tube for endwise abutment against the large transmission line.

3. A connecting element as in claim 1 in which said one, said third and said other portions of the dielectric body means are integral and constitute a one piece

stepped diameter annular insulator in supporting contact with the pin throughout the major portion of its length.

4. A connecting element as in claim 1 in which said one terminal end portion of the pin projects axially beyond said one end of the conductor tube means and beyond the one end of the dielectric body means.

5. A connecting element as in claim 1 in which the conductor tube means includes a main member formed with a counterbore which forms a cylindrical internal socket and a radial shoulder delineating the axial extent of the socket, and in which a tubular cylindrical sleeve closely embracing the dielectric body means in supporting relation is received in said socket with one of its ends abutted locatingly against the last mentioned shoulder and with the other of its ends projecting axially beyond the counterbored main member.

6. A connecting element as in claim 5 in which the sleeve is axially slotted from its said other end and the slots extend into the counterbore of the main member.

7. A connecting element as in claim 1 in which the conductor tube means includes a main member and a separate bushing member secured together mechanically in coaxial electrically conductive relation, the main member being formed with said large diameter portion of the internal wall, the bushing member being formed with said small diameter portion of the internal wall, and the bushing member having a radial end face constituting said tube shoulder.

8. A connecting element as in claim 1 in which the conductor tube means is formed on its one end with a reduced section portion and with a radial external shoulder axially spaced from such one end in a plane transverse to the axis of the element and intermediate and spaced from the axial limits of the dielectric body means, said reduced section portion being adapted to be received within and centered by the outer conductor of such large transmission line in effecting connection of the element to such large line, an annular recess being formed in said external shoulder, and a resilient deformable seal being seated in said recess and projecting axially from the external shoulder but short of said one end of the tube means for engagement with such outer transmission line conductor subsequent to the centering of said reduced portion as the element and the large line are drawn together.

9. An element for connecting standard terminal fittings on the center and outer conductors of a relatively large diameter high-frequency coaxial transmission line to the corresponding but smaller diameter fittings on the conductors of such a line of relatively small diameter, said element comprising a center conductor pin having a central cylindrical portion of predetermined diameter, a first terminal portion extending axially therefrom at one end and adapted to make a slip friction fit connection to the center conductor terminal of such large line and a second terminal portion of lesser diameter than said central portion extending axially from the other end of the latter and adapted to make a slip friction fit connection to the center conductor terminal of the small line and providing a radial shoulder at the juncture of the central and second terminal portions; an insulator bushing having a main bore from one end for receiving the central portion of said pin, an extension bore of smaller diameter for receiving the lesser diameter second terminal portion of the pin, and a shoulder at the juncture of the main and extension bores abutted against the pin shoulder, said bushing comprising a cylindrically surfaced one piece integral member having a uniform external diameter from the one end of the bushing to a point intermediate the ends of the bushing and a reduced external diameter for the remainder of the length of the bushing providing a single external shoulder spaced from both bushing ends, a conductor bushing surrounding the reduced portion of the insulator bushing and abutted against the external shoulder of the insulator

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bushing, said conductor bushing including means adapted to make electrical and rigid mechanical connection to the outer conductor terminal of the small line, a conductor sleeve with a conductive connection to the conductor bushing surrounding and tightly embracing the larger diameter portion of the insulator bushing to form a body with said conductor bushing, and said body including means for connecting it electrically and rigidly mechanically to the outer conductor terminal of the large line, said insulator bushing being under compressive stress securing solely by frictional engagement said pin in said body against axial movement out the one end of the bushing.

10. An element for connecting standard terminal fittings on the center and outer conductors of a relatively large diameter high-frequency coaxial transmission line to the corresponding but smaller diameter fittings on the conductors of such a line of relatively small diameter, said element comprising a center conductor pin having a central cylindrical portion of predetermined diameter, a first protruding portion extending axially therefrom at one end of the pin for connection to the center conductor terminal of the large diameter coaxial line and a portion of less diameter than the said central portion with a second protruding portion extending axially from the lesser diameter portion at the other end of the pin for connection to the center conductor terminal of the small diameter coaxial line, an insulator bushing having a main bore from one end of length substantially equal to the central portion for receiving the latter and an extension smaller diameter bore for receiving the lesser diameter portion of the pin, said bushing having a uniform external diameter from the one end of the bushing to a point beyond the junction of the main bore with the extension bore, and a reduced external diameter surrounding the remainder of the extension bore, a conductor bushing surrounding the reduced diameter portion of the insulator bushing, extending axially therefrom and being adapted to make electrical connection to the outer conductor terminal of such small diameter line, an annular conductive body formed with a socket and having a conductive connection to the conductor bushing, a conductor sleeve fast in the socket and having one end portion projecting axially from one end of the conductive body, said sleeve being thin radially relative to the body and said one projecting end portion of the sleeve being radially yieldable, the one end of the insulator bushing projecting axially beyond the sleeve, said sleeve throughout its length surrounding and tightly embracing the larger diameter portion of the insulator bushing, and forming a rigid conductor tube body with said conductor bushing, the pin being centered in and separated by an annular space from the tube body, a connection nut rotatably mounted on the conductor tube body for effecting connection to the outer conductor terminal of the large diameter line, said insulator bushing being radially confined in and completely filling the space between the conductor tube body and the central portion of the pin over an axial distance greater than the maximum diameter of the insulator bushing and being under compressive stress securing solely by frictional engagement said center conductor pin in said conductor tube body against axial movement out the one end of the insulator bushing.

11. An element for connecting standard terminal fittings on the center and outer conductors of a relatively large diameter high-frequency coaxial transmission line to the corresponding but smaller diameter fittings on the conductors of such a line of relatively small diameter, said element comprising a center conductor pin having a central cylindrical portion of predetermined diameter, a first terminal portion extending axially therefrom at one end and adapted to make a slip friction fit connection to the center conductor terminal of such large line and a second terminal portion of lesser diameter than said

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central portion extending axially from the other end of the latter and adapted to make a slip friction fit connection to the center conductor terminal of the small line and providing a radial shoulder at the juncture of the central and second terminal portions; a deformable plastic insulator bushing received over the pin, said bushing having a stepped external surface providing a major portion having a uniform external diameter from the one end for a predetermined length of the bushing, a minor portion of less axial length than the major portion and, at the juncture of the major and minor portions an external radial shoulder, the bushing comprising a cylindrically surfaced one piece integral member having bore portions of different diameters providing an internal shoulder abutted against the pin shoulder, a tubular conductive body mounted upon said bushing and having internal chamber portions of different diameters providing an internal shoulder abutted against the external shoulder of the bushing, the conductive body having a reduced diameter portion surrounding the second terminal portion of the pin and adapted for connection to the outer conductor terminal of the small line; means on and carried by the body for connecting it to the outer conductor terminal of the large line; said insulator bushing in its unstressed condition, having differences between the external and internal diameters of its several portions exceeding the differences between the corresponding internal diameters of the body and external diameters of the pin, said insulator bushing also being radially confined in and, throughout its axial extent and over an axial distance greater than its maximum diameter, completely filling the space between the conductor body and the pin and being under radial compressive stress in assembly securing solely by frictional engagement said pin in said bushing against axial movement out the one end of the bushing and said bushing in said body.

12. An element for connecting standard terminal fittings on the center and outer conductors of a relatively large diameter high-frequency coaxial transmission line to the corresponding but smaller diameter fittings on the conductors of such a line of relatively small diameter, said element comprising a center conductor pin having a central cylindrical portion of predetermined diameter, a first terminal portion extending axially therefrom at one end for connection to the center conductor terminal of such large line and a second terminal portion of lesser diameter than said central portion extending axially from the other end of the latter for connection to the center conductor terminal of such small line and providing a radial shoulder at the juncture of the central and second terminal portions; an insulator bushing comprising a cylindrically surfaced one piece integral member having a stepped diameter bore received over the center pin and having a stepped diameter external surface providing cylindrical portions of relatively large and small diameters and an external radial shoulder at their juncture, a conductive bushing mounted upon the small portion of said insulator bushing, surrounding the lesser diameter portion of the pin and formed and adapted for facile connection to the outer conductor terminal of such small line, a conductor sleeve surrounding and tightly embracing the large portion of the insulator bushing, means electrically and rigidly mechanically connecting the conductive bushing to one end of the sleeve to form a conductor tube body, the sleeve being axially slotted through its other end and, throughout its length, closely embracing and gripping the insulator bushing, the conductor tube body including a shoulder abutted against the external insulator bushing shoulder, means carried by said conductor tube body for connecting it to the outer conductor terminal of the large line, and said insulator bushing being under radial compressive stress securing solely by frictional engagement said pin in said

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insulator bushing against axial movement out of said
other end of the sleeve.

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