April 5, 1966 G. W. ZIEGLER, JR 3,245,027

COAXIAL CONNECTOR

Filed Sept. 11, 1963 2 Sheets-Sheet 1

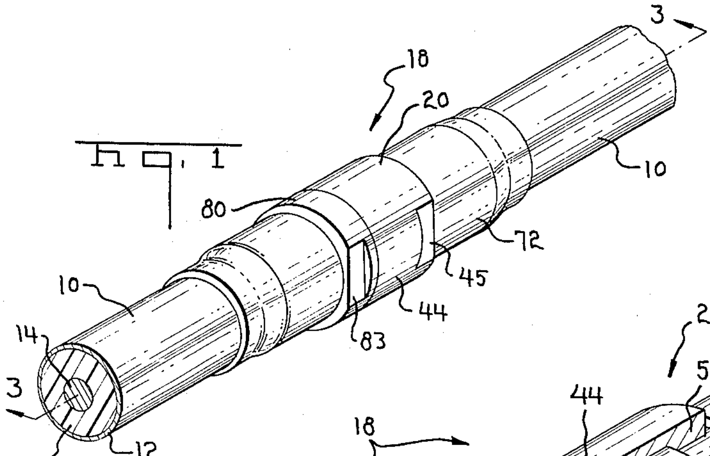

Fig. 1

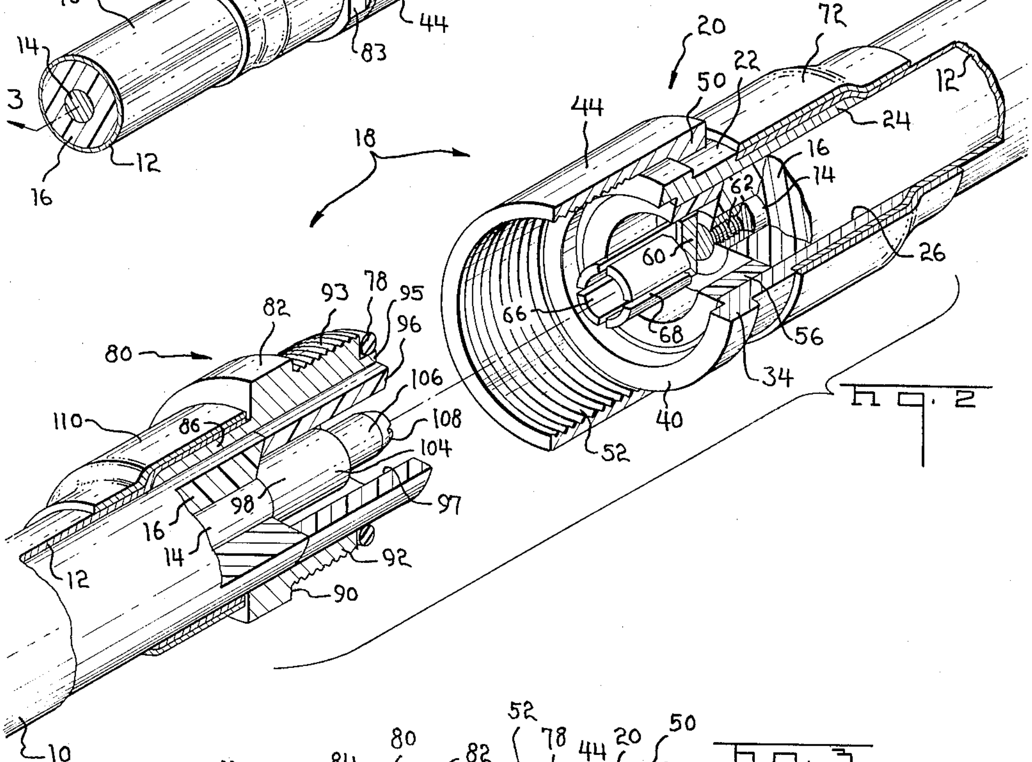

Fig. 2

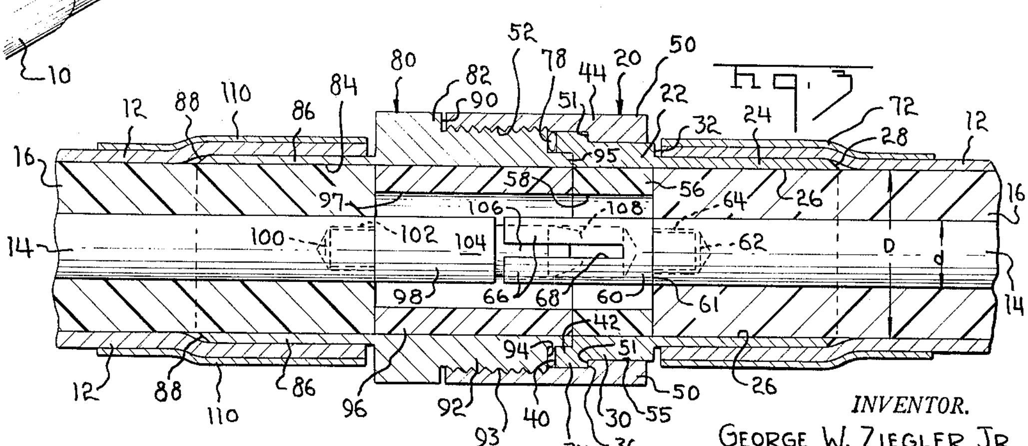

Fig. 3

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COAXIAL CONNECTOR

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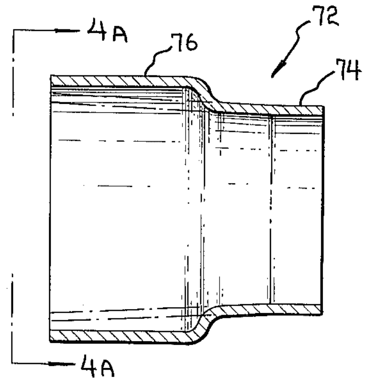
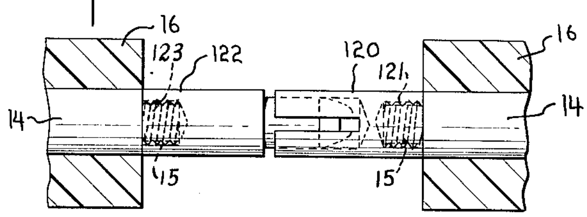
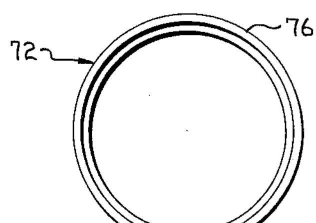


Fig. 4

Fig. 6





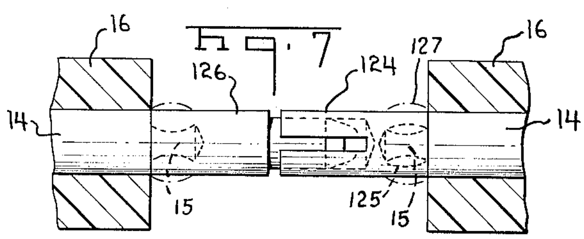


Fig. 7

Fig. 4A

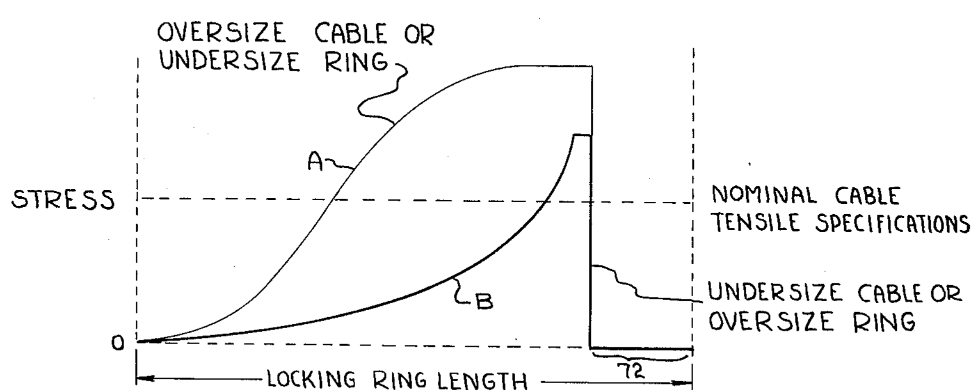


Fig. 5

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3,245,027
COAXIAL CONNECTOR

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9 Claims. (Cl. 339—89)

The present invention relates to an improved coaxial connector of the type utilized to provide a low-loss path for a broad range of signal frequencies.

As is well understood, the basic purpose of an electrical connector is to provide a mechanical and electrical interconnection of electrical signal paths. With respect to power applications wherein the electrical signals are either D.C. or low-frequency A.C. current carrying no intelligence content, design requirements are met by providing a mechanical interconnection which is easily and quickly accomplished and an electrical interconnection which is of low resistance and is stable in the presence of the particular environmental use for which the connector is designed.

The continuing expansion of the use of the so-called radio frequency signals has raised further criteria which must be met by connectors capable of handling the higher frequencies. Among these are the requirements that the connector not introduce distortion into the signal path such that the intelligence content of the signal is altered appreciably. A further requirement is that the connector have characteristics such that signal losses are minimized. A standard measurement of whether or not a given connector meets this latter requirement is the VSWR test. If a connector has a relatively low flat VSWR over the total frequency range through which the connector is designed to operate, then it may be considered as satisfactory, electrically.

A standard test as to whether or not a given connector meets mechanical criteria is the pull test wherein the connector is secured to cable and subjected to tensional loading to the point of destruction of either connector or cable. If the connector maintains satisfactory electrical characteristics and does not pull apart or cause the cable to pull apart at some point below the nominal rated force required for cable breakage, there is a strong indication that the connector is mechanically satisfactory.

In efforts to meet the requirements for mechanical strength, the prior art has most often turned to relatively bulky and complicated interminating parts which require a considerable amount of assembly time and special preparation of the cable to which the connector is attached. As a direct result of this practice, electrical requirements have either been neglected or compromised.

It is one object of the present invention to provide a coaxial connector having superior electrical characteristics over a broad range of signal frequencies and at the same time provide a connector having features permitting the rapid installation of connector parts to achieve a mechanical interconnection exceeding the nominal pull strength of the cable to which the connector is attached.

It is a further object of the invention to provide a simple and inexpensive coaxial connector having a relatively low VSWR over a broad range of signal frequencies.

It is another object of the invention to provide an improved coaxial connector construction capable of being employed without special additional adaptor sections, but readily mateable with adaptors if such is desired.

It is yet another object of the invention to provide a novel means of securing connector parts to coaxial cable wherein the connection with the cable is assured despite considerable tolerance deviations in the cable or in the connector parts.

Other objects and attainments of the present invention

will become apparent to those skilled in the art upon a reading of the following detailed description when taken in conjunction with the drawings in which there are shown and described illustrative embodiments of the invention; it is to be understood, however, that these embodiments are not intended to be exhaustive nor limiting of the invention, but are given for purposes of illustration in order that others skilled in the art may fully understand the invention and the principles thereof and the manner of applying it in practical use so that they may modify it in various forms, each as may be best suited to the conditions of a particular use.

In the drawings:

FIGURE 1 is a perspective view of an embodiment of the connector assembly of the invention secured to the ends of coaxial cable and intermated to provide a continuous transmission path between cable halves;

FIGURE 2 is an exploded and partially sectioned view of the connector of FIGURE 1, showing the details of each connector half;

FIGURE 3 is a longitudinal section of the assembly of FIGURE 1 taken along lines **3—3**;

FIGURE 4 is a schematic diagram showing the novel clamping sleeve construction of the assembly of the invention before and after use in terminating the cable with a connector half;

FIGURE *4a* is an end-on view of the sleeve of FIGURE 4;

FIGURE 5 is a schematic diagram showing approximately, exemplary stress conditions present in the novel locking sleeve of the invention in use; and

FIGURES 6 and 7 are longitudinal sections of further embodiments of the invention.

The foregoing objects are attained in the present invention through the combination of a novel locking sleeve securing each half of a coaxial connector to the cable to be connected and, additionally, improved construction and arrangement of conductor contact members—to provide superior electrical characteristics. The improved construction further permits attachment of terminal portions of the connector directly to the cable in a manner whereby no additional adaptor sections are necessary, and where tolerance deviations of both cable and connector parts are inherently accommodated.

Referring now to the characteristics of typical cable served by the invention, FIGURE 1 shows an interconnection wherein separate halves of a coaxial cable **10** are mechanically and electrically joined by a connector **18** to provide a signal path between electrical or electronic components. Cable **10** includes an outer conductor **12** and a coaxially spaced center conductor **14** separated by a dielectric **16**. Cable of this type is manufactured in ranges of from one eighth to three and one half inches in outer diameter for a wide variety of uses in handling signals ranging from D.C. up to ranges overlapping with wave guide frequencies. Typically such cables are found linking components in radar, television and radio communication equipment, wherein signal frequencies range from a few thousand kilocycles up to and above ten thousand megacycles. Cables for such use come in a variety of constructions including that of **10** having a solid outer conductor formed of aluminum tubing with a solid inner conductor formed of copper rod surrounded and held by a foamed polyethylene dielectric, or a construction wherein the center conductor is a solid copper rod surrounded by nylon beneath an outer conductor of metallic woven braid. Other cable constructions include inner and outer conductors similar to that shown with the dielectric therebetween being formed by air and a thin spiral Teflon ribbon adapted to support the center conductor. Yet other cable forms include transversely oriented thin discs of plastic dielectric material placed at intervals along the cable length to support the center conductor.

The particular cable shown to exemplify the embodiment of the invention includes a center conductor of solid copper rod approximately 243 thousandths of an inch in diameter, a tubular aluminum sleeve forming the outer conductor and a solid foamed polyethylene dielectric sleeve disposed therebetween. The aluminum tubing is approximately 37 thousandths of an inch in thickness and has an outer diameter of approximately 750 thousandths of an inch. The foamed polyethylene dielectric sleeve has an approximate dielectric constant of $K=1.5$.

Interconnection of cables of the above mentioned types has heretofore proven to be a difficult task and the prior art has evolved about a connector construction wherein the cable outer conductor must be externally threaded or gripped by serrated surfaces for each conductor half with a number of connector parts thereafter threaded onto the cable and fitted to separate intermating adaptor sections. This approach requires that the cable be stripped with a portion of the central conductor left protruding for attachment with the connector parts accommodating the central conductor connection. Due to the complexities of the mechanical interconnection achieved by following this approach, various compensating adaptor sections have necessarily been introduced in an attempt to match the connector to the cable with respect to characteristic impedance Nevertheless since flat compensation can only be accomplished at a given frequency the connectors made in accordance with the prior art have not provided a particularly satisfactory VSWR over a broad range of signal frequencies The connector of the invention eliminates the need for compensation as well as simplifying cable preparation and assembly of connector halves thereon

Interconnecting cables **10** is the connector assembly of the invention **18** comprised of halves **20** and **80** adapted to be intermated for completion of the electrical paths formed by the outer conductor shell **12** and the inner conductor shell **14** As shown in FIGURES 2 and 3 half **20** includes female portions adapted to cooperate with male portions of half **80** to form such paths As will be further apparent from FIGURES 2 and 3, the outer end portions of halves **20** and **80** are electrically and mechanically identical with the inner and mating portions being similar but modified to an extent to permit mechanical engagement.

In connector half **20**, there is included a five piece assembly comprised of a central metallic sleeve **22**, an intermating metallic sleeve **44** fitted thereover, a metallic locking sleeve or ring **72**, a central, coaxially disposed contact metallic plug **60**, and a tubular dielectric insert **56**. Half **80** is comprised of a four piece assembly including a metallic sleeve **82**, a metallic locking ring **110**, a central contact plug **98**, and a tubular dielectric insert **96**. Assembly **18** includes an additional piece in the form of a resilient seal **78** adapted to be fitted in between the connector halves **20** and **80**. The ten pieces forming assembly **18** compares with twenty or more pieces of connectors of the prior art having a similar function.

Referring now to FIGURES 2 and 3 and to half **20** in more detail, the central sleeve **22** is an integrally formed shell having a relatively thin sleeve extension **24** tapered as at **28** and a forward and thicker portion **30** joining **24** at a radially disposed transverse face **32**. Portion **30** further includes as an integral extension a radially extending flange **34** abutting **30** to define a transverse face **36** and a forward transverse face **40**. Sleeve **22** includes two longitudinal bores **26** and **42** each of a constant diameter. Bore **26** extends through portion **30** and sleeve extension **24**, and is of a diameter approximating D, the inner diameter of cable conductor **12** such that the maximum deviation of cable and sleeve tolerance will still permit the insertion of the cable dielectric **16** within the bore. Bore **42** extends for a very short portion within portion **34** to provide a cylindrical surface adapted to intermate and engage a corresponding portion of connector half **80** fitted therein, to maintain axial alignment of the connector halves.

Fitted over the outside of **22** is sleeve **44** having a rear portion **50** with an internal rim **51** adapted to lock against face **36** of **34** to limit axial movement of **44** from end **22**. Sleeve **44** further includes an internal bore **52** threaded as indicated to cooperate with complementary threading on half **80**. At the end of the threading of bore **52** is a smooth portion provided to cooperate with the outer surface of **34** and a further bore **55** adapted to fit over the outside surface of section **30**. Overlying portion **50** of sleeve **44** are flats **45**, better shown in FIGURE 1, adapted to provide a gripping surface for forced rotation of **44** during connector assembly.

The central plug or contact pin member **60** includes an end portion **62** of reduced diameter threaded about its periphery as at **64**, and adapted to fit within a complementary threading formed in the end of conductor **14**. The outer diameter of **60** is *d*, that of conductor **14**. In practice conductor **14** is first drilled, then tapped and threaded to a depth such that **60** may be threaded therein with the surface **61** thereof drawn snugly against the end face of the conductor **14**. The forward portion of **60** is comprised of four resilient spring finger members **66**. Finger members **66** are formed by a bore provided in the end of **60** with symmetrically placed slots **68** made through the outside wall thereof. The spring members formed thereby are preferably maintained as thin as is possible with the fingers having a substantial spring action. The purpose of this will be explained more fully hereinafter.

As a further part of half **20**, the locking sleeve or ring **72** is adapted to be fitted over the outside of conductor **12** of cable **10** to interconnect the cable with the connector half through a permanent residual stress achieved between cable and ring. Ring **72** is of a length to extend over extension **24** to provide additional support against cable loads being imparted to the connector parts.

As a most important point, ring **72** is formed of a tapered shell having one end of an internal diameter very slightly larger than the longest tolerable outer diameter of the cable and the other end slightly larger than the largest tolerable outer diameter of extension **24** plus twice the maximum thickness of the material of conductor **12**. Because of this the above-mentioned stress is achieved to lock half **20** to the cable. The features and operation of ring **72** will be described more completely in the description of connector assembly hereinafter to follow as related to FIGURES 4 and 5.

The dielectric insert includes an interior bore **58** of constant diameter larger than the exterior diameter of pin **60**, such as to provide an air space between the outer surface of **60** and the inner surface of the dielectric. Insert **56** is preferably wedge-fitted within bore **26** under portion **30** of **22** to define an outer diameter equal to D. The length of insert **56** is such that the outside end is flush with the face defined between bores **42** and **26** and the inside end is disposed immediately under face **32**. When assembled, half **20** is arranged such that the dielectric **16** of cable **10** abuts the end face of insert **56**.

Turning now to the complementary connector half **80**, sleeve **82** is relieved to define a face **90** and extending axially therefrom, a portion **92** having an externally threaded portion **93** adapted to fit within the internal threading of sleeve **44**. The forward end of **82** includes a transverse surface **94** complementary to face **40** of half **20**. Extending beyond surface **94** and of a lesser outer diameter, is a sleeve extension **95**, adapted to fit within bore **42** against bore face **40** of half **20**. The transverse face of the sleeve extension **95** is adapted to be disposed opposite to a corresponding face between bores **42** and **26** of half **20**. Flats **83**, as shown in FIGURE 1, are included on the outer surface of 82, serve to permit half 80 to be held for assembly.

The rear portion of sleeve 82 includes a sleeve extension 86, having a bore 84 extending the full length thereof and of constant diameter slightly larger than the diameter D of cable dielectric 16. The centrally disposed contact pin or plug member 98 includes an extension 100 threaded as at 102 to fit within conductor 14, suitably drill tapped and threaded to receive 100 as in the manner heretofore described. Pin 98 includes a portion 104 of the diameter D extending forwardly and a portion 106 of reduced diameter having a tapered end 108 adapted to fit within the spring fingers 66 of 60. The diameter of portion 106 is made such as to provide a frictional fit within fingers 66 to accomplish a stable electrical innerface therewith. The provision of a sliding engagement readily accommodates any slight differences in connector parts due to manufacturing tolerances and due to differential thermal expansion of inner and outer conductor materials.

The dielectric insert 96 in bore 84 of half 80 extends along the length of the bore from a portion wherein sleeve extension 86 joins the body of 82 to the opposite end thereof. Insert 96 has an outer diameter D and includes a bore 97 of a diameter considerably larger than the diameter of section 104 of pin 98. The dielectric insert is wedged within bore 84.

The locking ring 110 of half 80 is similar in construction to ring 72 described with respect to half 20 and operates to secure half 80 to the cable in the same manner.

The connector halves 20 and 80, after being attached to the cable in the manner to be hereinafter described, appear generally as shown in FIGURE 2. The interconnection of the halves may be accomplished by merely inserting the forward end of 80 into the forward end of 20, whereby the pin portion 108 is fitted within spring fingers 66 of pin 60, which tend to align and hold half 20 while sleeve 44 is rotated to thread over the threading of 80 and thereafter during use. As the final turns are made, seal 78 is caught between faces 40 and 94 of the connector halves, respectively and deformed in compression to provide a seal of the connector against environment. The positioning of 78 is such as to provide sealing against entry of moisture and/or corrosive gases at the only possible point of entry other than through the cable or around the connector locking rings 72 and 110. Additionally, if desired, the connector construction permits use with gas filled cable, in which event, seal 78 operates to contain the gas.

Thus the construction of the connector of the invention provides a single seal in place of prior art uses of four to six seals to accomplish the same function.

Considering further the installation of the connector of the invention with respect to the assembly of half 20, FIGURES 4, 4*a* and 5 show an important aspect of the operation of the locking sleeve fitted over the outside of the cable. Preparatory to installation the cable should be cut in a plane transverse to the longitudinal axis of the cable with some care being taken to provide a flat, even surface. The use of a fine hacksaw blade is adequate when employed with reasonable care. It is to be noted that no stripping procedure is required as in the manner of the prior art, wherein separate portions of inner conductor 14, dielectric 16 and outer conductor 12 must be separately cut to different lengths. After the initial cutting step, the center conductor may be drilled and tapped by any suitable means to a length as indicated in FIGURE 3, sufficient to receive the threading of portion 62 of central pin 60. Thereafter, the connector portion 22 may be forced into position by inserting sleeve 24 between the O.D. of dielectric 16 and the I.D. of outer conductor 12. The provision of a tapered edge 28 at the end of sleeve 24 greatly facilitates this insertion. A taper of approximately 30° has been found satisfactory for this purpose. At the same time sleeve 24 is wedged within the cable, ring 72 is held in position and thereby formed by being partially expanded to lock the connector to cable 10. As shown in FIGURES 4 and 4*a*, the preassembled configuration of ring 72 is that of a smooth taper extending from a larger I.D. at one end to a smaller I.D. at the other end. The larger I.D. is made to be slightly smaller than the O.D. of portion 30, and is made slightly larger than the O.D. of the cable plus twice the thickness of 12. It has been found useful to provide a difference in material thickness along the length of ring 72 with the thinnest portion at the larger diameter and the thickest portion at the zone of maximum stress.

FIGURE 5 shows a length stress diagram of ring 72 as fitted in position on the connector assembly. The abscissa of FIGURE 5 represents the length of ring 72 and the ordinate represents the stresses existing in the ring along given lengths. By providing the taper above described, the ring 72 is stressed such that in the left portion 76 there is a gradual increase of stress from approximately zero up to a maximum in the zone wherein the ring overlies the end 28 of 24 with a sudden reduction to substantially zero stress for the remainder 74 of the ring length. The particular stress pattern existent in the sleeve series two useful purposes, the first of which is that regardless of tolerance variation in either the O.D. of the cable or in the I.D. of ring 72 of the connector assembly there will exist, at some point along the ring, a stress condition absolutely securing the connector to the cable. By assuring that the stress condition occurs in the central area as indicated in FIGURE 5, overside cable or undersize ring conditions as shown by curve A will nevertheless provide a connection between cable and connector far in excess of that required. A condition of undersize cable or oversize ring within standard manufacturing tolerances will produce a stress condition as shown in curve B, still far in excess of that necessary to adequately connect the connector of the cable. As further indicated from FIGURE 5, the stress curves A and B will permit destructive pull test greater than that of the cable. This same advantage works with deviations of diameter in sleeve 24.

As indicated in FIGURE 4, the central portion of the ring 72 is tightly stressed against the cable outer conductor overlying the end 28 of the sleeve 24. It has been found as a second advantage that in the process of assembling the connector, the particular configuration shown provides an excellent inner-face between the sleeve 24 outer surface and that of the connector cable with respect to electrical continuity. It is thought that actual cold welding occurs due to the contact of surfaces wherein the surface of oxidation products has been broken. The connection between sleeve extension and cable has been found to be so tight as to force the cable to fail mechanically before relative slippage will occur responsive to cable torque.

An important aspect of the connector assembly of the invention is the electrical characteristics wherein the connector is enabled to pass a wide range of signal frequencies with minimum distortion, signal reflection and other loss-causing phenomena. This is achieved in the embodiment of FIGURES 1–3 by maintaining the characteristic impedance at any incremental length throughout the connector from end 28 to end 88, substantially that of the characteristic impedance of the cable to be connected. In the sectional length between end 28 and the end of the cable dielectric within the connector half 20, the distance between the outer surface of the inner conductor 14 and the inner surface of the bore 26 of the connector is constant. The provision of the tapered end 28 in conjunction with the operation in assembling the device assure that no substantial air gap will be present to cause an unwanted discontinuity at such point. The characteristic impedance meausred from the end of the cable dielectric to the end of the dielectric 56 is made to be equal to the characteristic impedance of the line. This is facilitated by maintaining the outer surface of end **60** of the same diameter as that of the central conductor **14**. The space between the outer surface of pin **60** and the inner surface of **32** is also of the same diameter as that of the preceding length of cable. The combined dielectric constant of the air spaces surrounding **60** and the insert **56** is made to equal that of the preceding dielectric material of the cable of an appropriate choice of the dielectric material used for **56**. Continuing on through the connector, the same spacing is maintained between the outer surface of pin **98** and the inner surface of **82** as that of the preceding sections and that of the cable. The combination of the air space about pin **98** and the dielectric material **96** is made such as to provide a characteristic impedance equal to that of the cable and the preceding section. Finally the characteristic impedance of the section from the end of cable in half **80** extending out beyond the end of ring **110** is the same as the characteristic impedance of the line.

In the foregoing description a preferred embodiment of the invention has been described with respect to connector halves directly engageable. As FIGURE 1 indicates, no separate interposed adaptor sections are necessary in applications wherein the requirement is one of joining two similar coaxial cables. It is contemplated that the connector assemblies, as shown, may be utilized with adaptors if such is required. For example, certain applications dictate that cable of the type shown in FIGURE 1 be terminated into equipment through type N or type BNC connectors having characteristics in accordance with military specifications. Alternatively, it may be desirable to interconnect a cable of a given size through type N or type BNC connectors, into a cable of the type shown in FIGURE 1. In either event, the appropriate half, such as **20** or **80**, may be utilized in conjunction with an adaptor including at one end the type N or BNC structure and, as an integral part, an intermating assembly adapted to fit with the connector half of the invention. For example, the structure **80**, as shown in FIGURES 1–3, might be modified to include at the opposite end portions receiving the male part, a type N or BNC connector interconnected to other sizes of cables. This assembly could then be fitted into half **20**. As a further example, a cable such as **10** interconnected to a half such as **80** might be intermated to a connector having a type N or BNC forward portion, with a rear portion similar to **20** adapted to intermate with the half **80**. The simplicity and arrangement of the outer and particularly the inner conductive path portions of the connector assembly of the invention makes this possible. As an important advantage relative to the above, the provision of a threaded center contact pin member permits a conversion of the assembly to intermate with adaptors with only the center contact being replaced and the remaining portions used direcly without requiring the cable to be severed and re-terminated. In such use the center contact member is removed and replaced by a center contact member of greater length suitable to accommodate the length of the adaptor section.

Turning now to an alternative embodiment of the invention, FIGURES 6 and 7 show assemblies for interconnecting cables such as **10** with the outer conductive shell **12** of the cable removed, and with only the center contact pins included, the remainder of the connector assemblies being as shown in FIGURE 3.

The alternative embodiment shown in FIGURE 6 may be found preferable in applications for the smaller cable sizes, as for example those having an O.D. of one-half inch. The assembly of FIGURE 6 differs from that above described in that the central conductor **14** of each cable half is left extending from the dielectric **16** as the cable is prepared for assembly. The extending portion is thereafter machined to a smaller O.D., as at **15** with a series of threads thereabout adapted to cooperate with internal threading as at **121** and **123** formed on contact pin members **120** and **122**. The forward and engaging portions of the contact pins are as heretofore described with respect to the pin members **60** and **98** detailed with respect to FIGURE 3.

In the embodiment shown in FIGURE 7, the forward end of the central conductor **14** is prepared as in the embodiment in FIGURE 6, with a reduced diameter and a forward extending portion as at **15** adapted to be fitted within an aperture such as **125** or in the associated pin member such as in **124** and in **126**. A preferred method of doing this constitutes providing a bore line **125** in the end of each contact member approximately the same diameter as the forwarding extending portion **15** of the cable center conductor with an outside preformed pin diameter, forming a bulge as at **127** as shown by the dotted lines, which is deformed inwardly, as by crimping or welding to secure each pin to each conductor **14**.

Each of the embodiments shown in FIGURES 3, 6 and 7 maintains the diameter *d* of the center conductor **14** along the length of the connector. By holding the inner diameter of the connector bores to be substantially that of the inner diameter D of the cable to be connected and by providing appropriate dielectric insert material, the effective characteristic impedance of the connector may be held to be the same as that of the cable. It is contemplated that in certain instances it may be desirable to have the central pin members of each connector part slightly deviate from the diameter of the central conductor **14**. As is well appreciated by those skilled in the art, such deviations, making the diameter of the central pin members either larger or smaller than the central conductor, will cause discontinuities which affect the efficiency of the connector. As is also generally appreciated, the effective dielectric constant of an incremental length throughout the connector can be altered to compensate for such discontinuities, or the diameter of the outer conductor bore portions of the connector may be increased to accomplish compensation. Alternatively, some compensation may be achieved by diameter change and further compensation achieved by choice of dielectric constant and material. These procedures may be utilized with the connector of the invention if such is desirable due to the particular application encountered. It is preferred, however, that the arrangement shown in FIGURES 3, 6 and 7 be carried out wherever possible. As yet a further alternative, wherein application requirements dictate deviations in conductor diameters final compensation may be achieved in the manner shown in my U.S. patent application, Serial No. 276,712, filed April 30, 1963.

As a final point, the embodiments above described show examples wherein the connector halves are joined by complementary threaded members. It is also contemplated that the connector halves may be joined by other standard arrangements, including those wherein the threaded members as shown would be replaced by members without threading, but including the well known bayonet and slot arrangement. For example, in the embodiment in FIGURES 1–3, the sleeve **44** might be slotted by diagonal slots on either side thereof and the sleeve **82** might be made to include integral post members extending therefrom such that the slots would engage the posts to lock the halves together. As is standard in such assemblies, an additional spring member would be utilized to hold the post members within the slots.

In an actual embodiment constructed in accordance with FIGURES 1–3 for connecting Phelps-Dodge Foamflex cable of the dimensions above given, the connector had the following approximate dimensions in thousandths of an inch:

Sleeve bore I.D.	676
Sleeve extension O.D.	736
Sleeve extension length	750

Ring maximum I.D.	820
Ring length	1060
Ring minimum I.D.	760
Ring thickness	20
Contact pin O.D.	240

The sample connector was pull-tested to cable destruction at approximately 1200 lbs.; the cable tensile rating being 420 lbs. before cable stretch causes excessive signal degradation. The sample connector provided a VSWR below 1.10 from 0 to 6 gh. signal frequency.

Changes in construction will occur to those skilled in the art and various apparently different modifications and embodiments may be made without departing from the scope of the invention. The matter set forth in the foregoing description and accompanying drawings is offered by way of illustration only. The actual scope of the invention is intended to be defined in the following claims when viewed in their proper perspective against the prior art.

I claim:

1. An improved connector for coaxial cable of the type having a center conductor surrounded by dielectric material and an outer conductor including a rigid metallic outer sleeve having an extension slightly larger in outer diameter than the inner diameter of the cable outer conductor, a locking ring of relatively thin expandable material adapted to be fitted over the outer conductor and axially held with said extension being forced within said ring and outer conductor to expand such, said locking ring having a tapered portion in its undeformed state of an inner diameter less than the outer diameter of the portion of the outer conductor expanded by said extension such that the said locking ring is loaded by substantial and residual circumferential stresses along said portion, said connector including within said outer sleeve a center contact member secured to said cable center conductor with the inner diameter of the sleeve and the outer diameter of the contact member being approximately equal to the spacing between the cable center conductor and the cable outer conductor along the interior length of the connector.

2. The connector of claim 1 wherein the said tapered portion of the said locking ring is disposed proximate the center of the length of said locking ring with one end of said locking ring fitted over said extension and said cable outer conductor, and the said one end has an inner diameter larger than the expanded outer diameter of the outer conductor whereby the locking ring has a minimal residual circumferential stress at such end.

3. The connector of claim 2 wherein the other end of said locking ring has an inner diameter approximately that of the outer conductor of the cable, whereby the residual circumferential stress at such other end is minimal.

4. An improved connector for coaxial cable of the type having a central conductor, a surrounding dielectric material and a surrounding outer conductor comprising in combination, intermating outer sleeve members for each half of the connector with means disposed on the forward portion of each member to lock said members together, an extension of relatively thin rigid metal on the other end of each sleeve member adapted to be fitted beneath the outer conductor of the cable, the said extension having an outer diameter larger than the inner diameter of the outer conductor of the cable so as to expand said outer conductor, a tapered ring member of relatively thin expandable metal adapted to be fitted over said cable outer conductor and having portions of its inner diameter in its unstressed condition less in diameter than the expanded diameter of the outer conductor when positioned over said extension, said tapered ring member as fitted over said outer conductor and said extension being adapted to be forced axially together to position said extension within said outer conductor and said tapered ring member to drive the outer conductor of the cable inwardly against the extension and lock said sleeve members to the cable through a substantial and residual circumferential stress developed in said ring member by an outward expansion thereof, a central connector contact for each sleeve member adapted to be secured to the central conductor of a cable half with the forward portion of one central contact adapted to engage the forward portion of the other central contact and both central contacts having a maximum diameter substantially the same as that of the central conductor of the cable.

5. An improved means for interconnecting a coaxial connector half to a coaxial cable of the type having an inner conductor surrounded by dielectric material and an outer conductor of metallic tubing, the said means comprising a sleeve extension of rigid metallic construction adapted to resist deformation, said extension having an inner diameter approximately equal to the outer diameter of the dielectric material and an outer diameter greater than the inner diameter of the cable outer conductor, a ring member of a length greater than that of the said extension with its smallest diameter approximating the outer diameter of the cable outer conductor and adapted to be fitted over the cable outer conductor, the said ring member being comprised of an expandable metallic construction having characteristics such that said ring member as fitted over said cable outer conductor may be axially held with said extension being axially driven within said outer conductor and ring member to expand such and develop a substantial residual circumferential stress in said ring member locking said cable to said half.

6. An improved means for locking an electrical connector assembly to a coaxial cable comprising in combination a sleeve extension of rigid metallic construction having an outer diameter larger than the inner diameter of the cable outer conductor, a ring member adapted to be fitted over the cable outer conductor with the said extension being axially driven relative to said ring member to expand said outer conductor and said ring member radially, the said ring member having a tapered configuration prior to expansion and material characteristics of yield strength to preclude buckling due to axial loading whereby to develop substantial residual circumferential stresses locking the outer conductor to the said extension.

7. The means of claim 6 wherein said ring member has a material wall thickness greater at longitudinal center portions than at end portions.

8. An improved coaxial device for connecting the ends of coaxial cable of the type having an inner conductor surrounded by a dielectric material and an outer conductor, including in combination a pair of oppositely oriented sleeves of rigid metallic construction each having an extension, a ring member for each extension of a metallic construction having a yield strength to prevent buckling, each ring member being of a length greater than that of the said extension and having an end portion approximating in inner diameter the outer diameter of the cable outer conductor with the ring member being adapted to be fitted over the cable outer diameter and with the said extension being driven axially relative to the said ring member as fitted over said outer conductor whereby said outer conductor and ring member are expanded radially to develop residual inwardly directed radial forces locking said outer conductor to said extension and whereby said end of such ring member supports said cable axially outward of said extension.

9. The device of claim 8 wherein said sleeves include an interior bore equal to the inner diameter of the cable outer conductor and each said ring member includes an inner diameter proximate the outer end of each extension as fitted thereover to hold said outer conductor inwardly at the end of said extension to minimize the outer conductor deformation at such outer end.

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