

Dec. 6, 1966

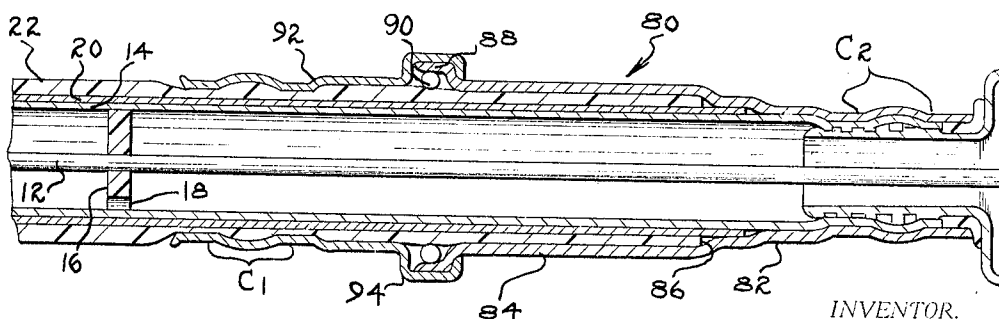
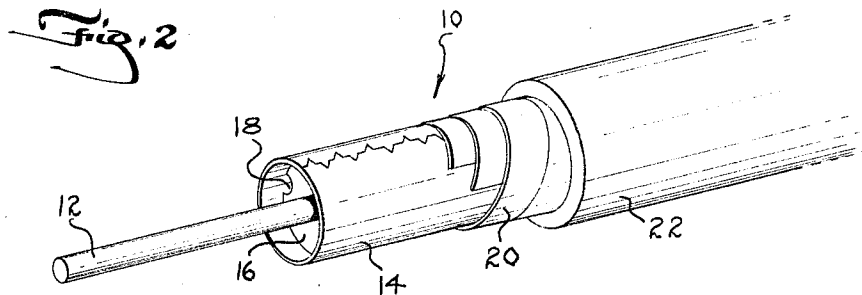
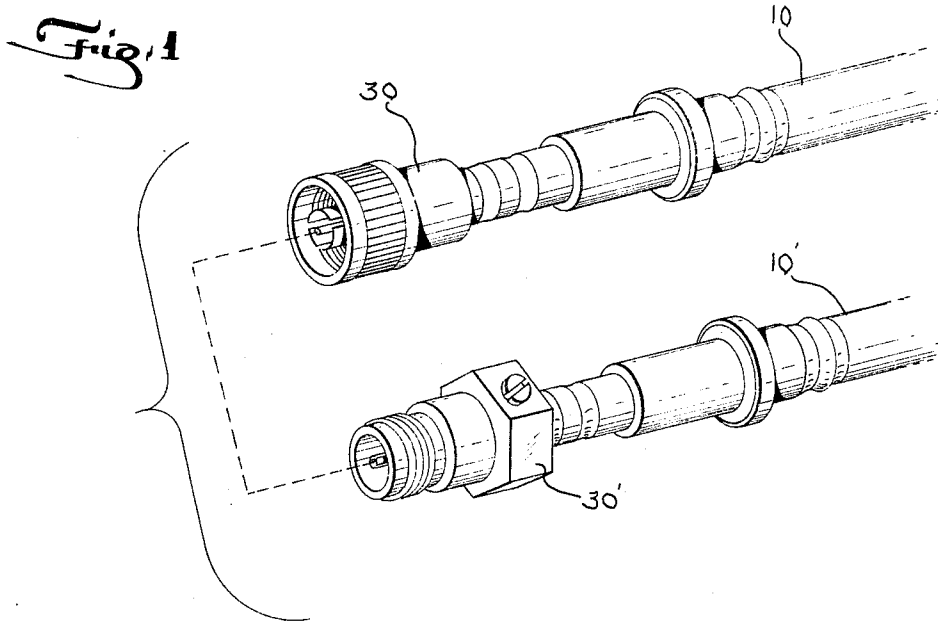
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3,290,640

SEALED R.F. CRIMP TYPE COAXIAL CONNECTOR MEANS

Filed May 22, 1964

3 Sheets-Sheet 1



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SEALED R.F. CRIMP TYPE COAXIAL CONNECTOR MEANS

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3 Sheets-Sheet 3

Fig. 4

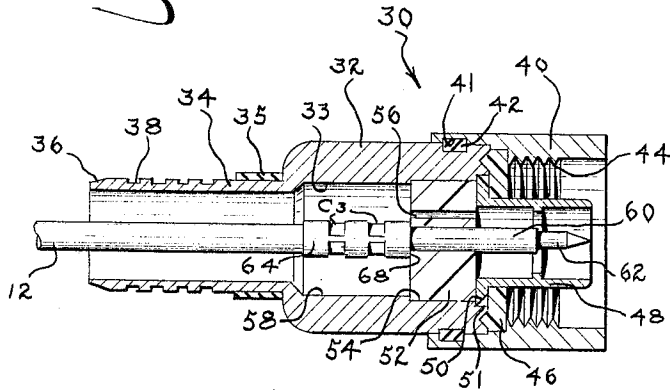


Fig. 5

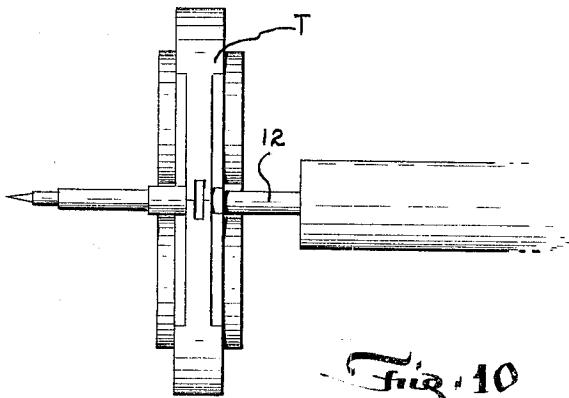
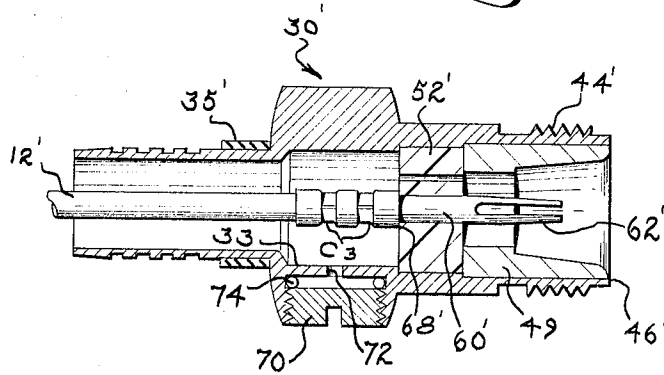


Fig. 10

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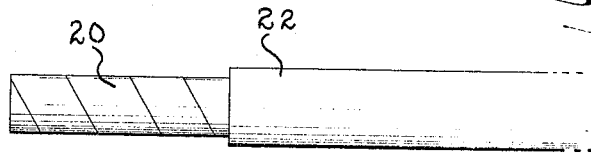


Fig. 6

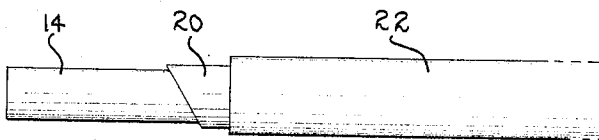


Fig. 7

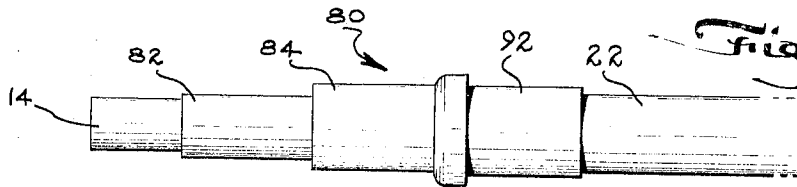


Fig. 8

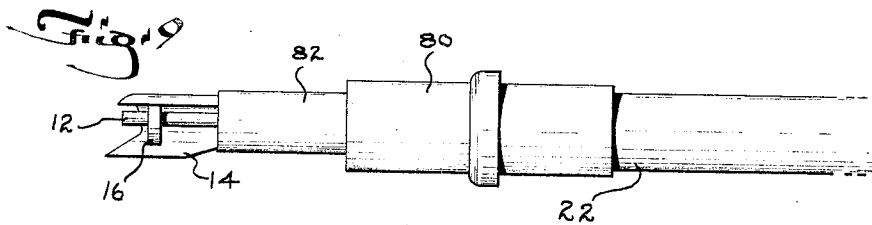


Fig. 9

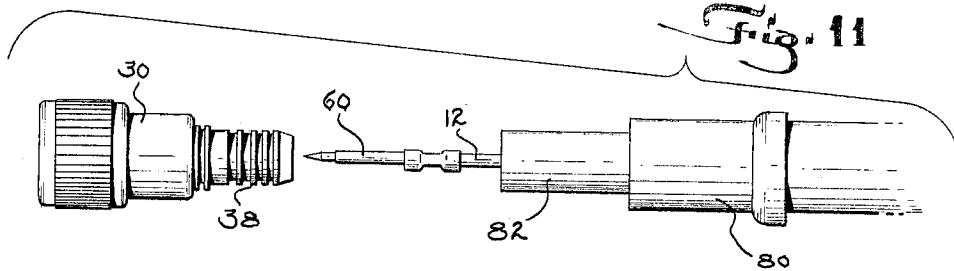


Fig. 11

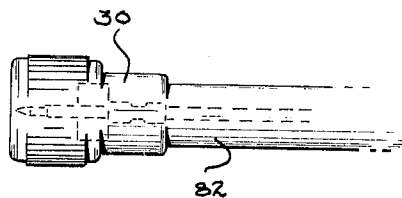


Fig. 12

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SEALED R.F. CRIMP TYPE COAXIAL CONNECTOR MEANS

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Filed May 22, 1964, Ser. No. 369,509
10 Claims. (Cl. 339-177)

This invention relates to RF coaxial connectors of the type which are crimped to coaxial cable.

There has been developed a specialized coaxial cable for carrying RF signals from antenna and distribution points to receivers wherein portions of the cable are exposed to adverse environment. The cable is so constructed as to withstand both the strains of pole mounting and the moisture present in underground installation. A typical application of the cable is that of closed circuit television systems for educational use wherein a single classroom presentation is distributed to the various schools of a given district. Another typical installation is for temporary hookup between numbers of portable transmitters and receivers installed for sports events, political conventions and the like. In such uses the cable may be found swinging freely from extensive overhead spans or barely covered in shallow trenches temporarily and hastily accomplished. In any use the cable must maintain its dimensional integrity to avoid shorting between the spaced coaxial paths or signal distortion which may be caused if there is a displacement of one signal path relative to the other path. For this reason the cable is of a relatively heavy construction having about the outer conductive path several layers of armor made of spiraled metal foil, all over-covered with a thick, tough insulating sheath. The ruggedness of the cable, in conjunction with requirements of low connection cost, have produced a substantial problem with respect to both the design of a connector compatible with the uses to which the cable is put and to a method of connection which involves a minimum of labor for installation.

The prior art approach has produced a connector which employs soldering, crimping and considerable taping. In one example the construction of the connector is such that the cable must be carefully disassembled and then partially reassembled with layers of insulating tape applied in various stages of assembly. The cable as connected with prior art devices must be separately supported to avoid strains applied to the connection, and special care must be taken in practically every point of assembly. To make the connection of the prior art gas tight various liquid sealers are applied at points within the connector, the parts having been scuffed and prepared prior to application of the sealers, with five or ten minutes allowed for drying of the sealers prior to completion of assembly. Prior art approaches have for the foregoing reasons not represented an adequate solution, since the assembly of the connector requires a high degree of skill and considerable time for installation.

Accordingly, it is one object of the present invention to provide an RF connector which permits a simple and rapid installation on armored coaxial cable.

It is a further object of the invention to provide a coaxial connector which is crimped to armored coaxial cable and which is sealed to withstand positive pressure loading by seals carried by the connector parts.

It is another object of the invention to provide an improved coaxial coconnector construction wherein internal seals are eliminated so that gas pressure is maintained in the contact areas of the connector.

It is a further object of the invention to provide an RF connector for armored coaxial cable which is capable of withstanding mechanical loads and the effects of tempera-

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ture, moisture and pressure to a degree approaching that of the cable itself.

In the drawings:

FIGURE 1 is a perspective view of a pair of mating halves which form the connector of the invention both, being positioned and crimped on armored coaxial cable;

FIGURE 2 is a perspective view of the type of armored cable served by the invention;

FIGURE 3 is a longitudinal sectional view showing the sleeve of the connector of the invention positioned and crimped on such cable;

FIGURES 4 and 5 are longitudinal sections of the connector halves of the invention;

FIGURES 6-9 are plan views depicting the preparation of coaxial cable for assembly with the connector of the invention;

FIGURES 10-12 are plan views showing respectively, crimping of the center contact member to the cable, the disposition of cable for assembly to a connector half and final assembly prior to crimping the outer conductor of the cable.

Referring now to FIGURE 1, the coaxial cable is shown as 10 and 10' terminated respectively to coaxial connector halves 30 and 30' which are adapted to be intermated to connect cables 10 and 10'. In FIGURE 2, the general construction of the cable is shown to include a center conductive member 12, an outer conductive member 14 coaxially disposed with respect to 12 and spaced therefrom by a series of insulating plugs 16 (one of which is shown), an outer armor layer 20 and protective insulating shield 22. The center conductor 12 is typically solid copper rod and the outer conductor 14 is typically copper sheet material. The center conductor 12 is positioned and held relative to 14 by the series of spaced plugs 16 of dielectric material such as polyethylene, each of which is apertured as in 18 to permit the passage of gas for maintaining the cable under positive pressure. The armoring layer 20 is typically of steel tape wound in two layers about outer conductor 14. The insulating shield 22 is typically of a flexible high density polyethylene. Cable of this type can be permanently installed upon telephone poles suspended from messenger wire or placed in underground conduit and still maintain its integrity without causing the conductor members to short out or be so displaced as to cause signal distortion. Cable of this type may also be utilized for temporary installation on or slightly below the ground in the presence of moisture and other contaminants for limited periods of time. The connector of the invention serves to provide an all-crimp type connector permitting a quick disconnect between cable halves or between a cable end and some piece of equipment. In the latter use, a member having the general mating characteristics of 30 may be found mounted on some piece of equipment such as an amplifying station with the cable terminated in a half such as 30' which is threaded therein. It is preferred to use the connector half 30' for attachment to the cable and the half 30 for attachment to the equipment so that the gas loading port 70 will be available to the line, without requiring a similar port on both halves.

From FIGURES 1 and 3 it can be seen that the connector of the invention features for each half a forward portion adapted to mechanically and electrically interconnect the inner and outer conductors of the transmission line formed by the cable. The rear portions of each connector half include a ferrule or sleeve member crimped at two points C₁ and C₂ to the cable. Before going into a further description of the sleeve, the crimp and the characteristics thereof, the description of each of the connector halves will be given. Referring to FIGURE 4 and to the plug half of the connector

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shown as 30 there is included the metallic sleeve member 32 having a forward portion which serves to house coaxially disposed therein a central pin member 60, a rearward portion 34 which may be integrally formed therewith and a forward portion shown as 40 which serves to provide the mechanical connection to half 30'. The half 30' is substantially identical in function to 30, but includes reversed portions to provide complementary connecting faces for the central pin member and the outer portions. The sleeve extension 34 is made to be sufficiently strong to withstand the crimping force applied thereto to terminate the cable to the connector half in the manner shown in FIGURE 3 and includes a beveled end shown as 36 to facilitate assembly to the cable. Along the outer surface of 34 are provided a series of annular recesses shown as 38 which operate as the rearward sleeve member is crimped thereover to better grip the copper outer conductor 14 of the cable. Fitted over 34 and adjacent to the body of 32 as shown in FIGURES 3, 4 and 5 is a gasket 35 of insulating and elastic material which is preferably sized so as to be retained in position under a slight elastic deformation to avoid the need for additional loose pieces during shipment and storage of the connector halves prior to installation on a cable. The gasket 35 is preferably flat and relatively thin to permit a use as shown in FIGURE 3 wherein upon the outer sleeve being crimped the gasket is compressed to provide a seal but not crushed as would be the case if it were of greater thickness.

The forward portion 40 includes an internal recess 41 locked by a ring such as 42 to the member 32, the sleeve being internally threaded as at 44 to engage complementary external threading 44' on half 30'. Disposed within 40 and against the end of 32 is a further gasket 46 adapted to be engaged and compressed by the end 46' of half 30' as it is threaded into 30. The central bore shown as 33 in half 30 includes at its forward end offset 50 into which is mounted a metallic insert 48 having an annular radially extending flange 50 locked within 51. Adjacent member 48 at the rearward portion thereof and secured within bore 33 is an insulating spacer 52 preferably of dielectric material such as Teflon seated and held against axial movement in the forward direction by 48 and in the rearward direction by a slight flange shown as 54 formed in the bore 33. The insulating member 52 includes a small aperture therein shown as 56 to permit the passage of gas to provide positive pressure on the contact surfaces. Disposed within and held by 52 is the central pin member of the connector half shown as 60. The central pin member is positioned as indicated in FIGURE 4 and includes a reduced forward portion 62 adapted to aid in the engagement of 60 with the complementary half 60' of half 30'. Rearwardly of the central portion of 60 is a sleeve portion 64 preferably integrally formed therewith a series of crimps indicated as C₃ are applied to terminate 60 to the center conductor 12 of the cable. With 60 mounted as indicated in FIGURE 4 it is held against radial displacement by the insulating member 52. The difference in radius between 64 and the body of the pin provides a face 68 which bears against the rearward surface of 52 to both lock the assembly against axial displacement out of the connector half and to aid in assembly.

The half 30' is substantially identical to the half 30 except that it includes complementary mating portions for the inner and outer conductive paths. Additionally, the half 30' includes a gas access port 72 formed by a threaded plug shown as 70 which leads to a small port entering into the main bore of 30'. An "O" ring or gasket seal 74 is provided between the plug and the inner portion 33' of the connector half such that as plug 70 is threaded into the member the gasket 74 operates to seal against escape of gas. As one further difference, there is included in the forward end of 30' an insert 49 which is adapted to engage the members of the forward portions

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of member 48 of 30 which are preferably provided with spring characteristics so as to be held in contact with the inner surface of 49 when the two halves are engaged.

As should be apparent to those skilled in the art, the halves 30 and 30' serve to provide a mechanical disconnect and holding feature to the connector. The energy transmitted by the connector is carried through the insulating medium along the inner bore of each half, such being air in the rearward portions, dielectric plugs 52 and 52' in the center region and air again in the zone of the inner-mating surfaces.

The assembly procedure with respect to halves 30 and 30' is identical and proceeds as is indicated in FIGURES 6-12. As a first step the cable 10 is stripped as indicated in FIGURE 6 with the sheath 22 being removed for a length to expose the armoring layer 20. The armoring layer is then removed to leave a portion showing as indicated in FIGURE 7. Thereafter, the sleeve member shown as 80 is then positioned on the cable in the manner shown as FIGURE 8, its insertion being exactly positioned by the reason of the diameters of the different parts thereof; i.e., the initial insertion being limited by the change in diameter 86 shown in FIGURE 3, engaging the stripped end of sheath 22. With the sleeve so mounted the remaining portion of the copper jacket 14 extending beyond the portion 82 of the sleeve is removed as indicated in FIGURE 9. The configuration of the sleeve 80 may thus be seen to facilitate assembly by permitting 14 to be torn off against the edge thereof.

Next, the central pin member 60 is positioned on conductor 12, plug 16 being removed, the end of 12 being seated within sleeve position 64 thereof.

With pin 60 so positioned it is then crimped to conductor 12 in the manner indicated in FIGURE 10, the crimp being formed by spaced indentations shown as C₃ in FIGURE 4. The type of crimp preferred is that of a square crimp. Alternatively, and in instances where it is desirable to reduce electrical discontinuities within the connector, the technique shown and described in U.S. patent application Ser. No. 268,873, filed Mar. 29, 1963, now Patent No. 3,212,050 in the name of F. B. Stark, may be employed. With the pin member 60 then attached to conductor 12 and with sleeve 80 positioned as indicated in FIGURE 11, the cable is then worked forwardly, pin 60 being fitted within the bore of the member 52 of half 30 to a point wherein the portion 68 stops further insertion of the assembly. At this point the connector sleeve is pushed forward so that it will be properly positioned relative to portion 34, being close to the pin thereof adjacent to 32 and overlying the gasket 35 as indicated in FIGURE 12. So positioned, the sleeve 80 is then preferably crimped at two spaced points in the manner indicated in FIGURE 3. At each of the crimps shown as C₁ and C₂ it is preferred that an "O" type crimp be applied at spaced points with the indentation being limited to deform the outer conductive sleeve 14 as little as possible and still maintain a tight connection. As shown in FIGURE 3 the rear indentations C₁ formed by crimping are down against the armoring of the cable which serves to resist deformation of the inner member 14 by distributing the forces of crimping. The forward crimp C₂ is directly over the outer conductive member 14 and against the sleeve 34 which itself serves to prevent inward displacement of the outer conductor 14 to cause signal distortion or even shorting between the outer conductor 14 and the inner conductor 12. Preferably, the end of 14 is abutted against the body of 32 so that the innermost crimp of C₂ compresses the gasket to seal the connection against entry of contaminants. The bore of 34 is held to be as close to the inner diameter spacing between 12 and 14 as is feasible with sufficient strength left in the sleeve to resist crushing during the crimping operation.

Turning now to a description of sleeve 80, reference to FIGURE 3 will show the sleeve to include sections of two diameters, the sections being formed of portions 84 and

92 substantially of the same diameter and the section 82 of a substantially smaller diameter. The sections 84 and 92 are approximately the outer diameter of the cable including the sheath 22 and the portion 82 is of a diameter approximating the maximum expected production diameter of the outer conductive member 14. The length of the portions are such that 84 and 92 extend outwardly over substantial portion of the cable to provide mechanical support for the cable and the portion 82 extends the length of member 34 plus an additional length before the transition point 86 is reached. The sleeve 80 is preferably of the construction shown being formed in two pieces for ease of manufacture. The portions 82 and 84 are formed in one piece and the portion 92 is formed of a separate piece, the different pieces being joined in the manner indicated by reason of an outwardly flared portion 88 of 84 which is locked and held by an outwardly flared portion 94 of 92. Within the cavity formed by portions 88 and 94 there is provided an "O" ring or gasket 90 of a relaxed diameter to rest within the cavity and extend inwardly to a diameter slightly less than that of the sheath 22. Upon insertion of the cable as prepared in the manner above described the gasket 90 is loaded in compression to effectively seal against entry of contaminants either from the portions of the path between 88 and 94 or from a point on the opposite side of the crimps C₁. The rear part of the connector of the invention thus then has only two gaskets and both are normally carried in the position of use so as to avoid a separate loose piece requirement.

The relative lengths of the portions making up 80 are such as to facilitate preparation of the cable, a comparison being made during stripping with these lengths and, as mentioned in assembly, with the insertion of the cable within the sleeve being controlled by 86. The relatively long length of the sleeve combined with the placement of the crimps C₁ and C₂ at the ends thereof serves to quite adequately support the connector on the cable against either axial, radial or torsional loading. It has been found in actual practice that the connector tensile crimped as indicated approaches that of the cable itself. It has been found in actual use that the cable prepared in accordance with the invention may be loaded under positive pressure with a gas and placed under tensional strains to the same extent as if the cable were terminated in the more laborious fashion of the prior art.

While the invention is particularly directed to armored coaxial cable of the type utilized to transmit RF communication signals and other type having the construction shown, it should be appreciated that it is contemplated that the technique employed and the features of the invention may be used with many of the specialized cables being developed having the same general characteristics as the cable shown. For example, the connector may be utilized with conductors having continuous dielectric material rather than the spaced insulating plugs as shown and/or with cable having a different type of outer conductor such as braiding or the like. It is also contemplated that the invention may be used directly with fixed connections wherein the rear components of the connectors of the invention including the sleeve such as 34 and the shell such as 80 are as shown, and the forward outer innermating portions are of one piece. In such case the inner portions including the pins 60 and 60' will be substantially as shown to fit within insulating plug members similar to 52 and 52' which are carried in an integral construction joining the two. The sleeve construction of the invention has been found to be particularly useful in terminating a relatively large cable to a relatively small cable or connector.

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 75

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.

5 What is claimed is:

1. In a coaxial connector for cable of the type having an inner conductor surrounded by dielectric material and an outer conductor further surrounded by a protective sheath, the combination including a pair of connector halves having conductive outer shell portions and conductive center pin members each supported by a dielectric plug member within the shell member, the outer shell and inner contact pin member of the halves being intermatable, each connector half including a rear extension and a sleeve member adapted to be crimped thereover to mechanically join the cable to the connector half, the rear extension being of a diameter to fit within the outer conductor of the cable and the sleeve member including a forward portion adapted to be fitted over the cable outer conductor and crimped inwardly to common the outer conductor to the extension, the sleeve member further including a rear portion of greater inner diameter sized to fit over the outer protective sheath of the cable and to be crimped inwardly to grip the cable at a point spaced from the first mentioned crimp, the sleeve including intermediate the two crimps an internal recess carrying a gasket member of a diameter less than that of the outer diameter of the cable sheath such as to be held in compression when said sleeve is mounted on said cable to terminate each said connector half.

2. The connector of claim 1 wherein there is further included a gasket disposed on each connector half rear extension proximate the forward end of said sleeve overlying said extension and said first mentioned crimp serves to compress said gasket inwardly against said sleeve to seal against ingress or egress of gas or contaminants within said connector half.

3. The connector of claim 1 wherein the supporting plug members include ports wherein the innermating contact surfaces of the center conductive pin members are maintained under positive pressure when said cable is loaded with gas.

4. The connector of claim 3 wherein one of said connector halves includes a sealable gas port adapted to permit said connector and thus said cable to be loaded under positive gas pressure.

5. An improved means for connecting coaxial cable to a coaxial connector half wherein the cable is of a type having a center conductor surrounded by dielectric material and an outer conductor in turn surrounded by a layer of protective armor and an insulating sheath, said means including a sleeve member having a forward portion of reduced diameter adapted to be fitted over a connector back-up extension and crimped inwardly over the cable outer conductor and said extension to terminate the outer conductive path of said cable to the connector half, a further portion of an internal diameter approximating that of sheathing of said cable and adapted to be crimped at the end thereof opposite to said forward portion inwardly against the cable sheath and the protective armor to mechanically link said sleeve member to said cable and thereby said cable to said connector half, an intermediate portion of larger diameter than said second mentioned portion including an internal recess having therein a gasket held in compression against the sheathing of said cable to seal against egress or ingress of gas vapor or the like.

6. The means of claim 5 wherein forward and further portions are joined at the intermediate portion by a mechanical joint with the forward portion crimped to the cable sheath extending over and around an end of the further portion crimped to the connector extension and the said gasket is disposed within said last mentioned end.

7. An improved means for connecting coaxial cable having an inner conductor surrounded by dielectric material, an outer conductor and an insulating protective sheath

with said cable stripped to expose axial segments of the inner and outer conductors, a forward connector portion having outer and inner conductive means to connect with complementary portions of a further connector half, a rear extension attached to said forward portion and adapted to receive the cable outer conductor thereover, a sleeve member of conductive metal, said sleeve member including first and second portions of an inner diameter slightly larger than the outer diameter of the cable and a third portion of an inner diameter slightly greater than the cable outer conductor and adapted to be fitted thereover and over the extension and crimped thereagainst, the first portion of said sleeve member being adapted to be crimped against the cable outer surface whereby said cable is mechanically and electrically connected to said cable, the said sleeve member including between said first and second portions a compressible seal having a relaxed inner diameter less than the outer diameter of the cable whereby to seal said connector half connection to said cable.

8. An improved ferrule construction for crimp type connectors including a first member of an inner diameter approximately equal to the cable outer diameter, a second member having a first portion of an inner diameter approximately equal to the cable outer conductor diameter and a second portion approximately equal to the cable outer diameter, the members being of a malleable material adapted to be crimped over a cable end to terminate said cable to a connector, the said members being joined with the ends thereof defining an outwardly extending inner space, a compressible gasket of a configuration to be held in said space with a surface extending inwardly to a diameter less than the inner diameter of the said first member.

9. An improved means for connecting coaxial cable having an inner conductor surrounded by dielectric material, an outer conductor and an insulating protective sheath, a connector half including a forward connector portion having outer and inner conductive means to connect with complementary portions of a further connector half, a rear extension attached to said forward portion and adapted to receive the cable outer conductor thereover and a sleeve member of conductive metal, said sleeve member including first and second portions of an inner diameter slightly larger than the cable outer diameter and a third portion of an inner diameter slightly greater than the cable outer conductor and less than the outer diameter of the cable, the second and third portions of said sleeve member being joined together to include an interior radial face operable upon the said sleeve members being fitted over said cable and forced axially such that the interior radial face properly positions said sleeve member on said cable by engagement with the end of said protective sheath whereby the third portion may be fitted over said extension and outer conductor and crimped inwardly to mechanically and electrically connect such to the said connector half and the first portion may be crimped inwardly

against said protective sheath to mechanically connect and seal said cable to said connector half.

10. In a means for connecting a coaxial cable of the type having an inner conductor surrounded by dielectric material, an outer conductor and a protective insulating sheath with said cable being stripped to expose a length of the inner conductor and a length of said outer conductor axially extending from the end of said protective sheath, a connector half including a forward portion having outer and inner conductive means to connect with complementary portions of a further connector half, said forward portion including a rear extension having an outer diameter to fit within the cable outer conductor, a bore extending through said outer conductive means including said rear extension, a dielectric plug fitted within the bore in the forward portion of said connector half, said plug having an aperture centrally disposed therein of a given diameter and having a rear face positioned at a given point axially removed from the forward end of the forward portion, the inner conductive means being comprised of a member having a forward contact portion of a diameter to fit within the aperture of said plug and be supported coaxially of said outer conductive means and adjacent to said contact portion a further portion of a diameter larger than the said given diameter to define a transverse face, the said inner conductive means being crimped to the inner conductor of said cable and inserted through said rear extension until said transverse face is in engagement with said plug, a malleable sleeve member including a rear portion of one diameter and a forward portion of lesser diameter joined to define an interior radial face, the rear portion having an inner diameter being approximately equal to that of the protective sheath of said cable so as to fit thereover and the forward portion inner diameter being slightly larger than the outer diameter of said rear extension so as to fit thereover, the said radial face serving to engage said end of said protective sheath to position said member thereon and on said rear extension whereby the sleeve member may be crimped on the rear and forward portions to mechanically and electrically join said connector half to said cable.

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