July 21, 1964 E. W. FORNEY, JR 3,141,924

COAXIAL CABLE SHIELD BRAID TERMINATORS

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Fig. 1

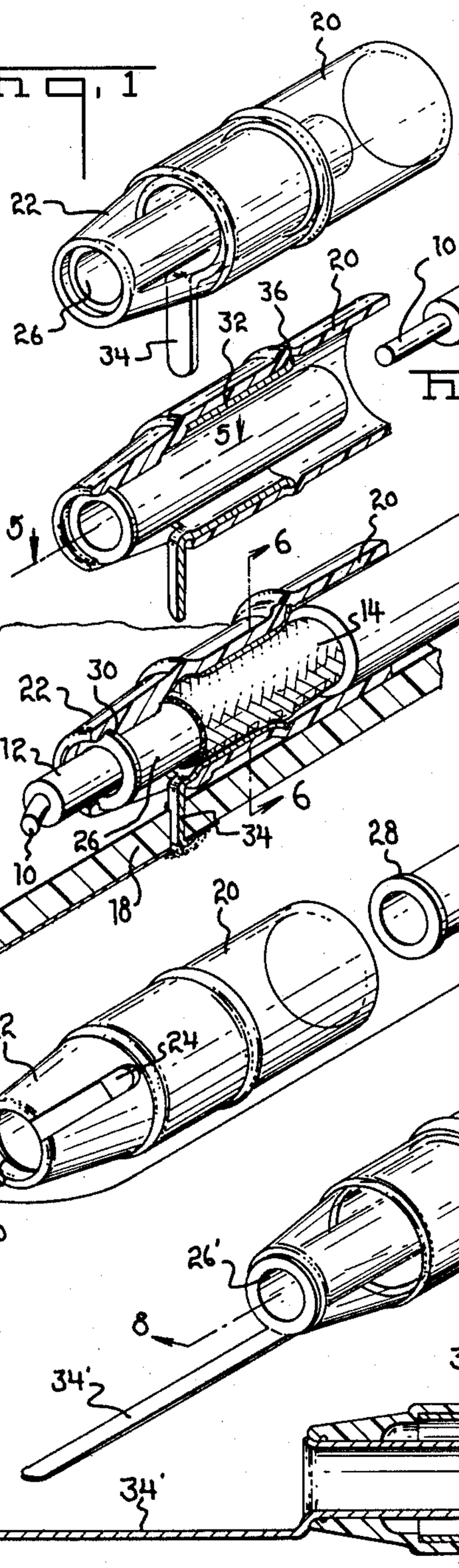

Fig. 2

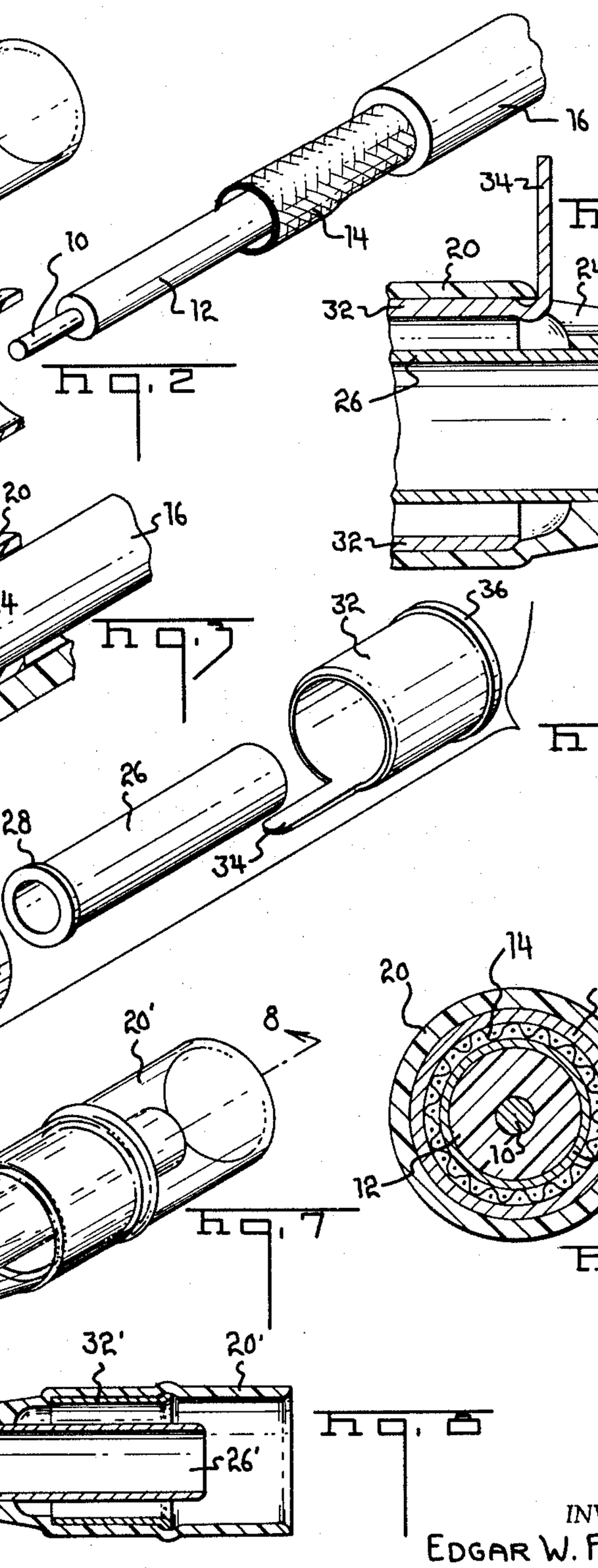

Fig. 3

Fig. 4

Fig. 5

Fig. 6

Fig. 7

Fig. 8

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COAXIAL CABLE SHIELD BRAID TERMINATORS

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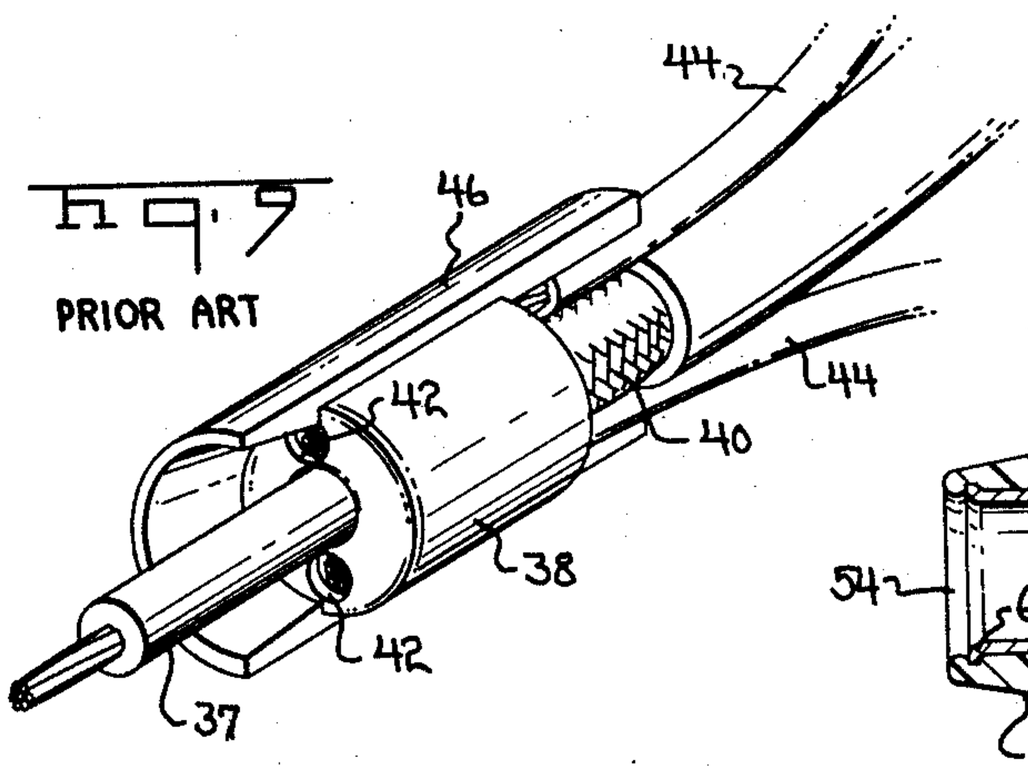


Fig. 9
PRIOR ART

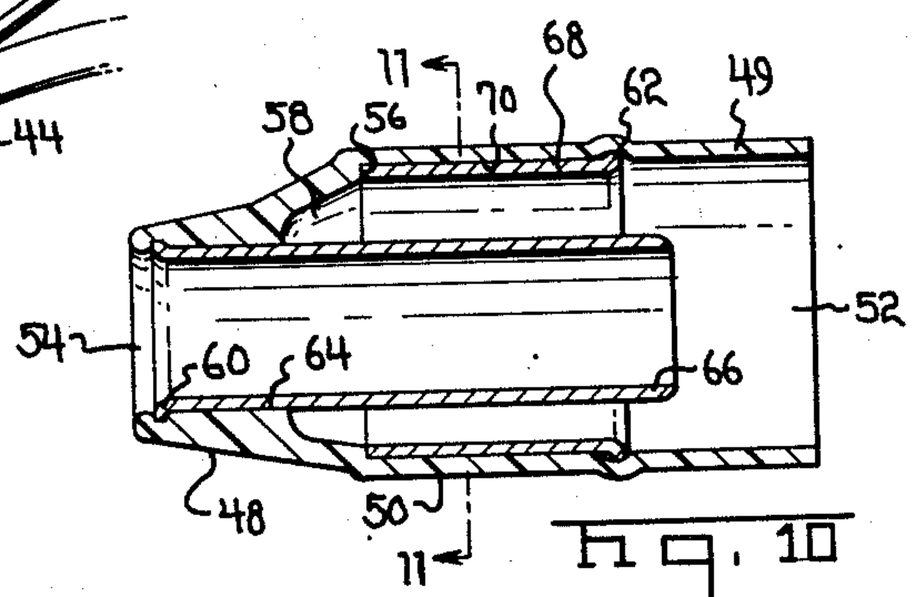


Fig. 10

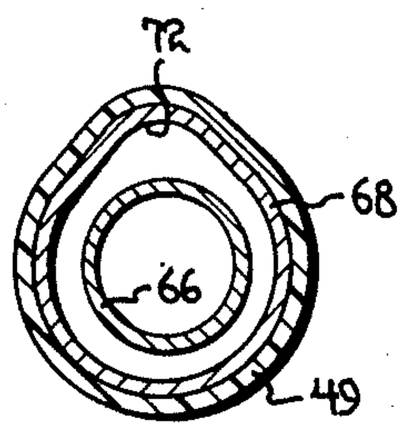


Fig. 11

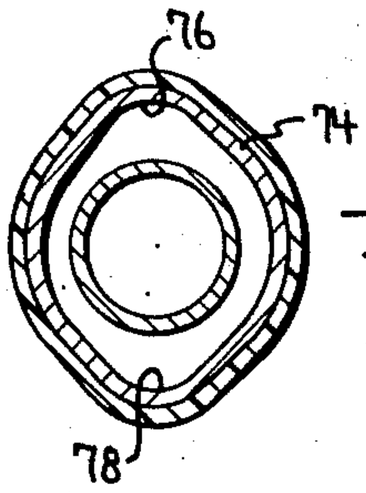
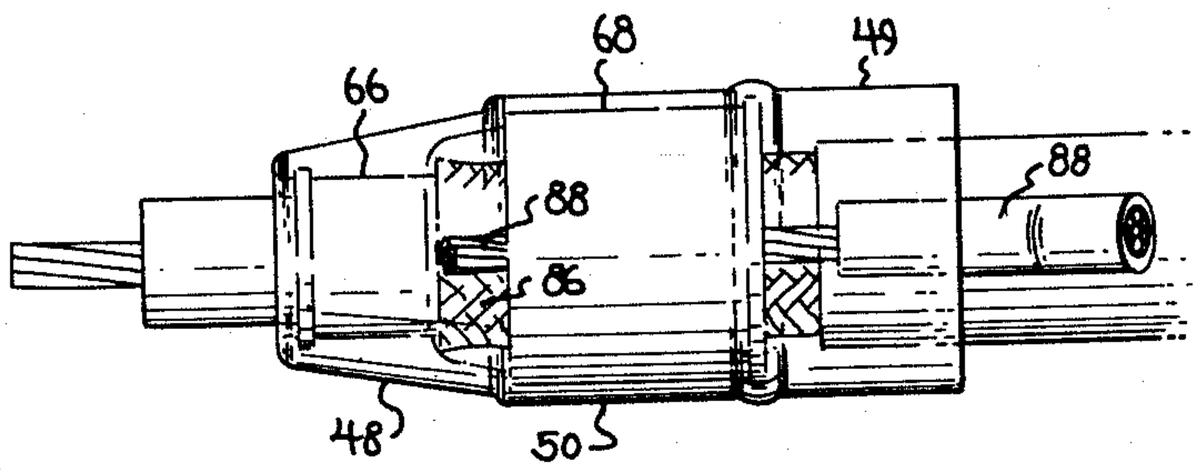


Fig. 12

Fig. 13



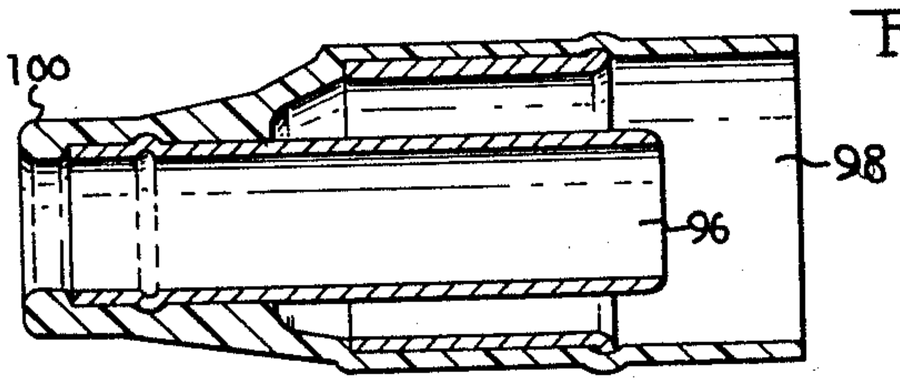


Fig. 14

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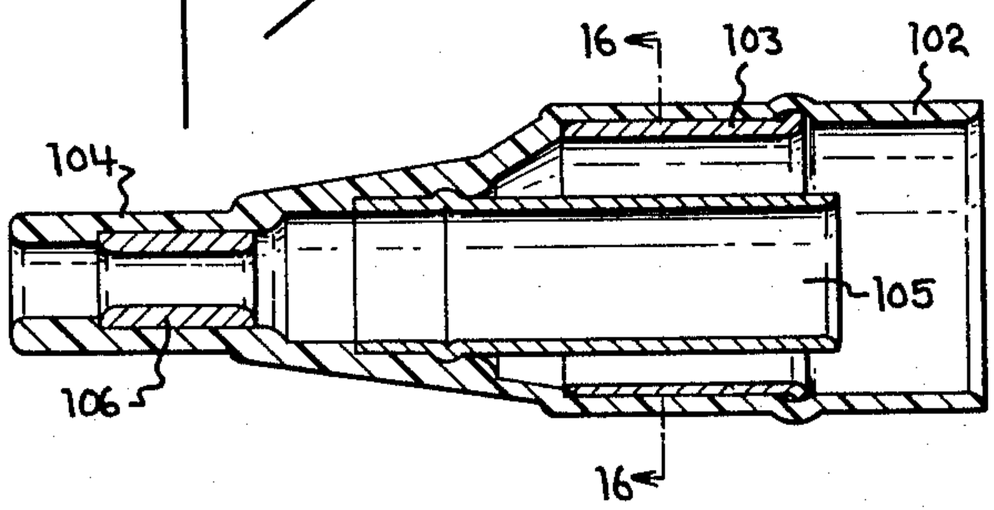
Fig. 15



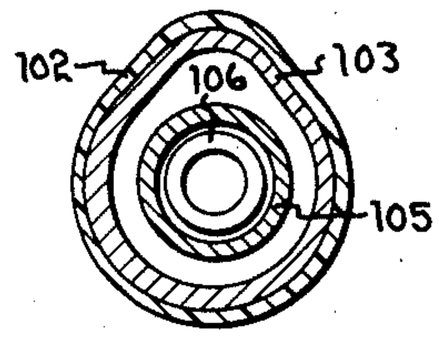


Fig. 16

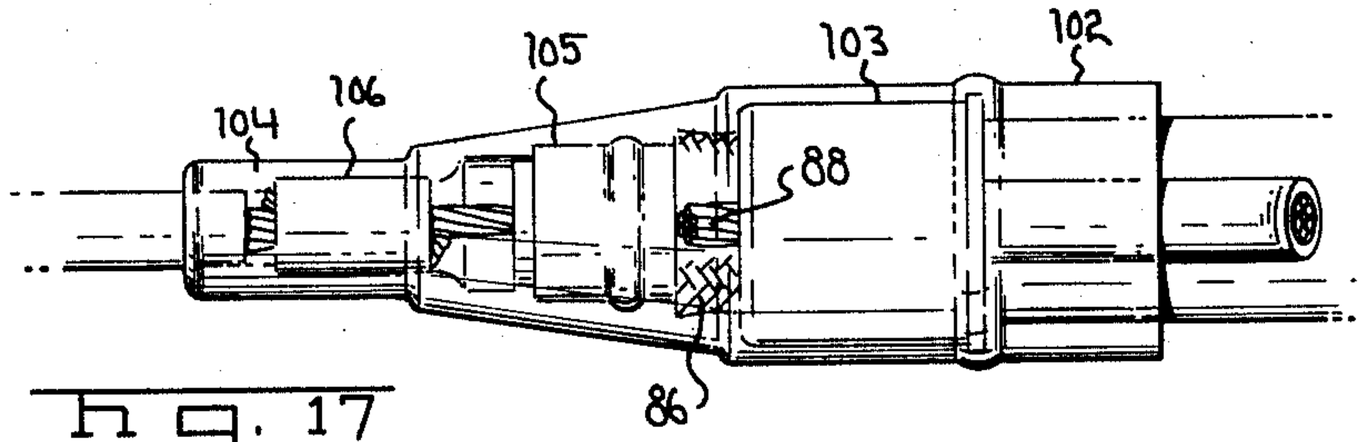


Fig. 17

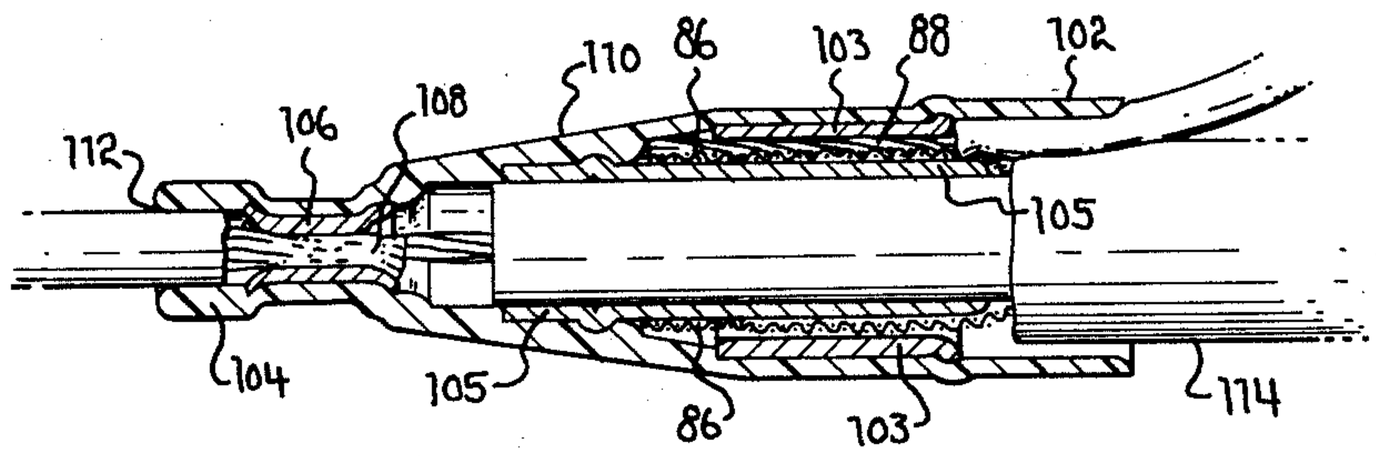


Fig. 18

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COAXIAL CABLE SHIELD BRAID TERMINATORS

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Filed Mar. 16, 1962, Ser. No. 180,236
5 Claims. (Cl. 174—75)

This invention relates to a device for terminating or making connections to electrical conductors.

The present application is based upon the disclosures of U.S. application Serial No. 13,802, filed March 9, 1960, abandoned January 12, 1962, U.S. application Serial No. 34,483, filed June 7, 1960, now abandoned, and U.S. application Serial No. 130,164, filed August 8, 1961, now abandoned, and is a continuation-in-part thereof.

A specialized type of electrical conductor is the shielded wire conductor. Conductors of this class normally have a central core of conductive material surrounded by insulating material and a sheath of metal braid surrounding the insulation to screen a signal on the inner conductor from external interference. These conductors may also have a second insulation coating surrounding the metallic braid. It is an object of this invention to provide a device for making an electrical connection to this metallic braided conductor to provide means for subsequent electrical connections to ground or other circuits.

It is a further object of this invention to provide an electrical connecting device for a shielded braid conductor wherein the electrical connecting member is an inherent part of the device which is crimped onto the conductor. It is also an object of this invention to provide such a device which may be preinsulated and the termination made by crimping through the insulation.

It is still a further object of this invention to decrease assembly time and increase reliability of shielded conductor connections by providing an improved preinsulated connector construction which simplifies conductor assembly and provides visual observation of conductors both before and after crimp.

It is another object of this invention to provide a compact preinsulated connector device for grounding shielded co-axial cables to an auxiliary conductor wherein the cable shielding and the auxiliary conductor contact area is maximized.

It is still another object of this invention to provide a connector device for terminating the shielded braid of a co-axial cable and the central conductor of such cable within a single insulation sleeve by a single crimp with visual observation of both connections before and after crimp.

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 a connector embodying the principles of this invention;

FIGURE 2 is a view similar to FIGURE 1, partially broken away, showing a conductor about to be inserted into the connector;

FIGURE 3 is a view similar to FIGURE 2 showing the connector crimped onto the conductor and the connecting tab soldered to a printed circuit board;

FIGURE 4 is an exploded perspective view of the connector of FIGURE 1;

FIGURE 5 is a fragmentary sectional view taken along lines 5—5 of FIGURE 2;

FIGURE 6 is a sectional view taken along plane 6—6 of FIGURE 3;

FIGURE 7 is another embodiment of a connector illustrating the principles of the invention;

FIGURE 8 is a sectional view taken along lines 8—8 of FIGURE 7;

FIGURE 9 is a perspective view exemplifying known prior art devices;

FIGURE 10 is a longitudinal section of a preferred form of the connector of the invention;

FIGURE 11 is a section of the connector taken along plane 3—3 of FIGURE 2;

FIGURE 12 is a section of an alternate embodiment of the connector of FIGURE 2;

FIGURE 13 is a plan view of the connector of FIGURE 2 as loaded prior to crimp;

FIGURE 14 is a longitudinal section of an alternate embodiment of the connector of FIGURE 2;

FIGURE 15 is a longitudinal section of a further embodiment of the invention;

FIGURE 16 is a cross section of the connector of FIGURE 7 taken along plane 8—8;

FIGURE 17 is a plan view of the connector of FIGURE 7 as loaded prior to crimp; and

FIGURE 18 is a longitudinal section of the connector of FIGURES 7 and 8 after crimp.

In the embodiment shown in FIGURE 2, a shielded braid wire may have an inner core **10** of conductive material e.g. a copper stranded conductor, a surrounding insulation sleeve **12**, a metallic member **14** (known as "shielding") surrounding the insulation **12**, and an outer coating of insulation **16**. The device of the present invention is designed to ground the braid wire **14** to a printed circuit board, note FIGURE 3.

The device for terminating the shielding member **14** includes an outer insulation sleeve **20** (FIGURES 2 and 4), which is generally cylindrical and tapers to a nose portion at one end **22**. A slot **24** extends rearwardly from the nose portion. A cylindrical metal portion **26** is disposed concentrically of the insulation sleeve **20**. A flange **28** on one end of the sleeve **26** is fitted into a detent **30** in the nose portion of the insulation sleeve (FIGURE 5).

A second metallic ferrule **32** (FIGURE 4) is adapted to be inserted into the insulation sleeve **20** and is concentric with the inner metal ferrule **26**. A tab **34** projects from the front end of the ferrule **32** and fits into the slot **24**. A flange **36** on the rear end of the ferrule **32** extends outwardly so that it may be force-fit into the insulation sleeve **20**. The constriction of the insulation sleeve holds the ferrule **32** coaxially with the ferrule **26**.

In assembly, the tab **34** on the ferrule **32** is aligned with the slot **24** and the ferrule **32** is positioned within the sleeve **20**. The front of the ferrule **32** is spaced from the reduced diameter portion of the sleeve **20** so that the shield **14** may be observed. The tab **34** is then bent outwardly through the slot **24** so that the tab extends from the ferrule **32** to the exterior surface of the insulation sleeve **20**. The inside surface of the nose of the insulation **22** supports the ferrule **26** and retains the ferrule coaxially with the outer ferrule **32** (FIGURE 5). A clear plastic insulation may be used to permit visual inspection of the assembly thus assuring that it is properly inserted onto the shielding.

When it is desired to connect the braided shield **14**, the conductor is properly stripped as shown in FIGURE 2.

The terminator is inserted over the wire so that the ferrule 26 slides under the braid conductor 14 and the ferrule 32 slides over the braid conductor 14. A pair of crimping dies (not shown) are brought to bear upon the insulation sleeve 20, and the ferrules 32 and 26 are crimped together to grasp the shielded conductor 14 therebetween. The insulation sleeve extends back over the insulation 16 on the conductor so that none of the shielded braid is exposed. The tab 34 may then be soldered or otherwise secured to a printed circuit board 18 or a similar type connection. The inner core conductor 10, of course, is free to be connected to the desired circuit.

The embodiment illustrated in FIGURES 7 and 8 includes an outer insulation sleeve 20', an inner metal ferrule 26' and an intermediate ferrule 32', all corresponding with the parts of the device shown in FIGURES 1–6. A tab 34' is secured to the nose of the ferrule 26' and may be connected to a printed circuit board, or otherwise grounded. The connector illustrated in FIGURES 7 and 8 may be secured to a shielded wire in the same manner as the connector described in FIGURES 1–6. The difference between the embodiments is that the connector shown in FIGURES 1–6 has the tab secured to the outer ferrule and the connector shown in FIGURES 7 and 8 has the tab secured to the inner ferrule.

In the foregoing embodiments the particular objective embraced a grounding connection effected by a metallic tab portion of a ferrule in contact with metallic braid. In many instances it is desirable to achieve a similar grounding connection with a separate conductor or pig-tail lead.

Typical of the specialized connectors developed for this purpose is the solderless preinsulated and preassembled connector shown in FIGURE 9 of the drawings. The assembly procedure of this prior art device requires that the central insulated conductor 37 be inserted through the center of the ferrule 42 and at the same time the metallic braid 40 slowly rotated and worked within the ferrule until the braid ends can be observed through the peep holes 42. The ground pig-tail 44 is then inserted between the ferrule 42 and the braid 40 and the connector is crimped through the insulation cover 46. Keeping in mind the small size of the connector and the peep holes 42, it can be readily appreciated that termination with this connector requires considerable care and is time consuming. Moreover, it is apparent that no positive observation of the ends of both the braid and the pig-tail lead can be made. In fact, only a very small segment of the braid ends can be viewed and such observation requires that the connector be turned up or otherwise manipulated to permit inspection of proper braid insertion. In mass termination, the total time consumed in the assembly procedure outlined above is considerable and the overall reliability of the connector is reduced by non-positive observation of conductor assembly.

The embodiment of FIGURE 10 comprises a generally tubular unitary transparent plastic sleeve 49 having a rear opening 52 and a forward opening 54 separated by a pointed or tapered forward portion 58 of thickened wall section and a middle or rearward portion 50. Carried within the plastic sleeve is an inner ferrule 66 and an outer ferrule 68. The inner ferrule 66 is captivated and supported by reason of flange 60 and a tight fit with the sleeve forward portion. It is to be noted that the inner ferrule bearing area 64 is relatively large to provide rigidity of the inner ferrule with respect to the plastic sleeve. This rigidity is of material assistance in assembly of the shielded conductors because a proper spacing is maintained between the inner ferrule and the sleeve for easy insertion of the shield. The outer ferrule 62 is rear seated and secured by reason of offset 56, the bearing area 70 with sleeve and the flange 62. This construction provides a unitary assembly of ferrule and insulation which inherently simplifies termination procedure.

Problems with aligning loose ferrules, as in certain prior art devices, are avoided.

It will be noted that the inner ferrule 66 extends rearwardly beyond the outer ferrule 68. This extension facilitates threading the metallic braid of co-axial cable over the outside of the ferrule 66 during assembly. It will be further noted that the inner ferrule 66 extends forwardly beyond the end of the outer ferrule 68 and that the two ferrules are shown as completely separated parts. The sleeve 49 is so formed that complete insertion of the ferrule 68 terminates at inner shoulder 56, leaving a space or cavity 58 defined by the inner ferrule 66, the inner wall of the sleeve and the forward edge of the ferrule 68. This cavity, as is apparent from FIGURE 11, extends around the periphery of the inner ferrule 66. The cavity has the function of accommodating the end of the metallic shield of a co-axial conductor and the end of any auxiliary lead connected to such shield. The staggered relationship of inner and outer ferrule in conjunction with the cavity 58 permits visual observation of the conductor ends and thereby assures proper assembly. A significant advantage of the sleeve of the invention is that all shielding and conductors are completely entrapped and possible shorts due to the protrusion of shield or conductor wires are eliminated. This overcomes a substantial shortcoming of known prior art devices. The sectional view of the assembly of FIGURE 10, as shown in FIGURE 11, indicates that the outer ferrule 68 has a raised portion 72 extending the length of the ferrule body. This portion facilitates loading of pig-tail ground wires or auxiliary conductors.

An alternate embodiment of the connector of FIGURE 10 is shown only in section in FIGURE 12, wherein the outer ferrule 74 has a raised portion on two sides as indicated by numerals 76 and 78. This embodiment will accommodate two ground conductors. It is to be understood that the outer ferrule 74 would be symmetrical along the length as in the embodiment of FIGURES 10 and 11.

It will be apparent that the structure shown above forms a compact mechanically unitary connector of flexible utility having separated inner and outer ferrules rigidly aligned for ease of loading. The beveled or tapered nose portion of the outer sleeve of the connector permits close connection to equipment and thereby provides better shielding.

In assembly, the conductors are properly prepared by stripping a portion of the outer insulation and removing a length of metallic braid from the insulated central conductor. The central conductor and its insulating covering are inserted through the inner ferrule with the metallic braiding slidingly inserted over the outside of the inner ferrule and within the inner diameter of the outer ferrule. Contrary to the procedure of the prior art device as discussed above, the central conductor and the metallic braid may be rapidly worked into the connector to a point wherein the end of the metallic braid may be observed through the transparent sleeve in the cavity as described. The connector need not be turned up nor is it necessary to rotate the connector for this observation due to the fact that the cavity extends fully around the sleeve. Following the insertion of the braid and the central conductor the pig-tail ground lead or another auxiliary conductor may be inserted within the raised portion shown in FIGURE 11 until its end is observed in space 58 as shown in FIGURE 13. It will be apparent that with the connector of the invention the auxiliary conductor 88 and the metallic braid 86, are in contact along their entire exposed length and can be observed in a manner precluding improper alignment. The assembly may now be crimped and again visually inspected to determine if the braid and the pig-tail ground are properly assembled.

The embodiment of FIGURE 14 shows a modification of the outer sleeve of the connector of FIGURE 10 wherein the inner ferrule 96 is backloaded through the rear opening 98. The forward edge of the sleeve in this em-

bodiment includes an extension **100**, which has its internal diameter sized to fit closely to the insulated conductor, thereby providing an added measure of protection against accidental ground between ferrule **96** and equipment in installations requiring a close fit between connector and equipment housing.

The embodiment shown in FIGURE 15 is a modification using principles of the invention but providing additional adaptability. This embodiment is of similar construction to the unit of FIGURE 10 with a molded transparent plastic sleeve **102** housing an outer ferrule **103** and an inner ferrule **105** and including an extension **104** of the tapered nose portion of the sleeve. A third ferrule **106** is disposed within the inner surface of the extension **104**. FIGURE 16 is a cross section of the connector of FIGURE 15 taken along plane **16—16** to show the arrangement of the ferrules. It is to be understood that the connector of FIGURE 15 can be made to include an outer ferrule having a double raised portion similar to the outer ferrule as shown in FIGURE 12 for the purpose of accommodating dual pig-tail leads.

The embodiment of FIGURE 15 has a special utility in termination situations wherein, in addition to a ground or pig-tail conductor connection to co-axial cable shielding, it is desirable to connect the center conductor to an unshielded conductor. Among the principle advantages of this embodiment are visibility of conductor alignment before and after crimp and increased strength of termination due to a one piece construction captivating all conductor connections. The assembly of this embodiment provides, in a single unit, a connector function requiring at least two units in prior art devices with incident savings in labor and material and increased reliability.

FIGURE 17, representing a plan view of the assembly prior to crimp, shows how positive conductor connection can be assured through visual observation of the ends of the conductors. In FIGURE 18, it will be noted that any tendency of the connector to bend will be borne principally at points **112** and **114** through the conductor insulation and that point **108** will receive a reduced bending load due to the sleeve being continuous throughout the portion **110**. This feature is of importance throughout the life of the connector to avoid bending strains of the wire at **108**. Additionally, this construction is of particular importance in situations wherein the central signal conductor of a co-axial cable is either of a very fine diameter or of copper weld material for the reason that standard wire-wrap or butt-block termination technique is complicated by the use of such conductors.

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. A device for terminating the shielding of a co-axial conductor including in combination a transparent outer insulation sleeve having a tapered portion at one end and a nontapered portion at the other end, a first metal ferrule fitted within the insulation sleeve in a nontapered portion thereof, a second metal ferrule fitted within the insulation sleeve in the tapered portion thereof and radially disposed with respect to said first ferrule, the second ferrule having a smaller cross sectional diameter than the first ferrule to form a space therebetween adapted to receive shielding, the second ferrule having one end longitudinally disposed from the same relative end of the first ferrule, and the sleeve having a relieved inner diameter in the tapered portion extending from the same relative end of the first ferrule toward the said one end of the second ferrule to form a cavity capable of receiving the end of the shielding and permitting its observation through the transparent sleeve.

2. A device for terminating shielded wire braid including an outer insulation sleeve having a tapered nose at one end, a first metal ferrule fitted within said insulation sleeve in the nontapered portion, a slot in the tapered nose, an electrical connecting means integral with said first ferrule extending outwardly through said slot, a second metal ferrule smaller in diameter than said first ferrule concentrically disposed to said first ferrule and said sleeve, a flange on one end of said second ferrule, and a groove on the inside surface of the tapered portion of the insulation sleeve, said flange on said second ferrule located within the groove of the nose to retain the ferrule within the insulation sleeve.

3. The device of claim 2 wherein said nose section of the insulation sleeve is thicker than the rest of the sleeve, the diameter of the inside surface of the nose portion being substantially equal to the outside diameter of the surface of the second metal ferrule, whereby the thickened portion of the insulation sleeve holds the second ferrule concentrically within the first ferrule.

4. A device for electrically joining shielded braid conductors including an outer insulation sleeve tapered at one end, a first metal ferrule with a circular flange at one end, a slot around the inside circumference of the tapered portion of the sleeve with said flange extending into the slot, a second ferrule having an outside diameter slightly larger than the inside diameter of the insulation sleeve to form a force-fit therewith, a flange on one end of said second metal ferrule so that the friction-fit between the insulation sleeve and the flange retains the second ferrule therein, and a tab extending outwardly from said second ferrule through said insulation sleeve.

5. A device for terminating coaxial cable of the type having a central conductor surrounded by insulating material and metallic braid, comprising in combination an outer insulating sleeve having three integral portions including a first sleeve portion, a first ferrule secured in said first sleeve portion, a second sleeve portion tapered along its outside diameter, a second ferrule smaller in diameter than the first ferrule and secured in said second sleeve portion, and a third sleeve portion, a third ferrule smaller in diameter than said second ferrule secured in said third sleeve portion; the first ferrule being held in a concentric relationship about the second ferrule by said insulating sleeve to define a space for metallic braid, the third ferrule being longitudinally disposed from the said second ferrule to define a space therebetween, the said second sleeve portion tapered along its outside diameter having a relieved inner diameter proximate the near end of the first ferrule to define a space accommodating the end of the braid and a thickened wall section along the length thereof to resist bending moments between said second and third ferrules.

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