

[54] **SHIELDED CABLE CONNECTOR AND METHOD OF MAKING THE SAME**

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 [58] Field of Search **339/98, 99, 136, 142, 143, 339/177 R, 177 E, 182, 183, 217 S, 218, 276 R, 276 SF, 276 T, 276 C, 217 R, 223; 29/629**

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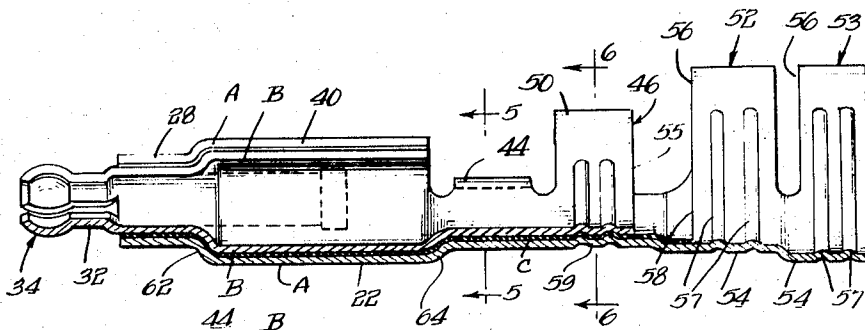
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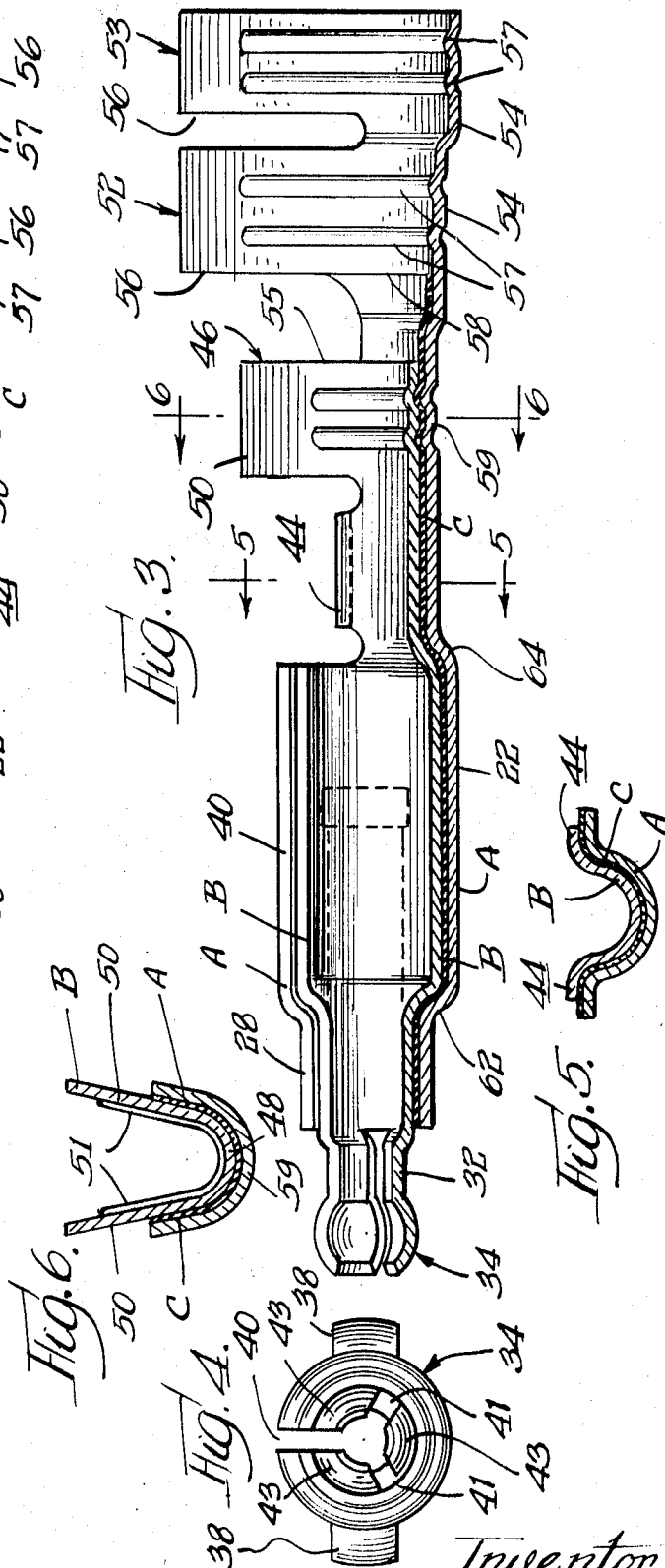
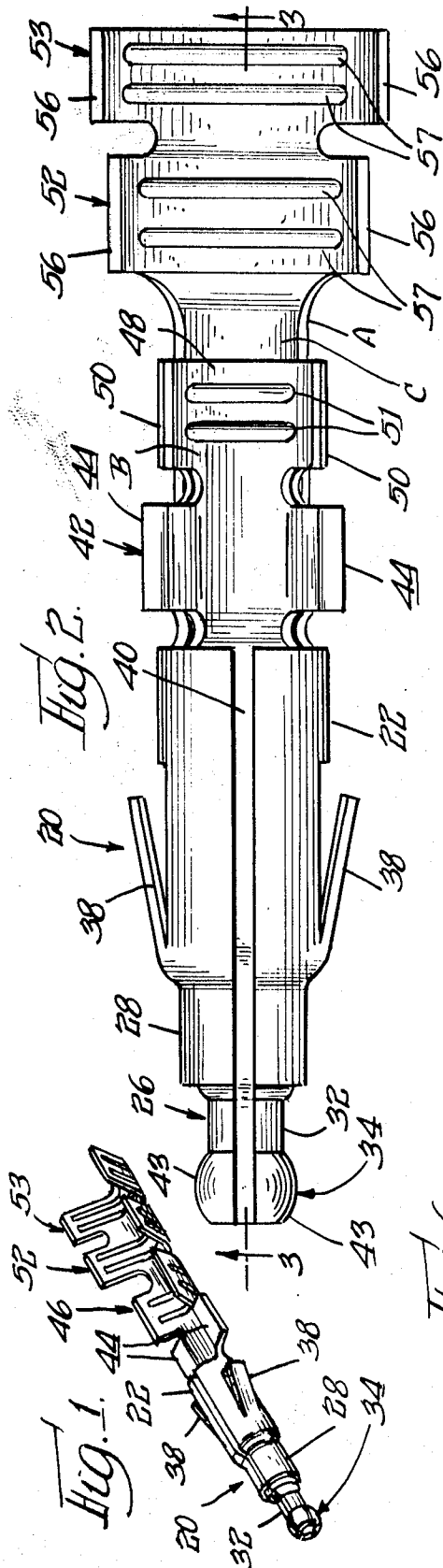
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[57] **ABSTRACT**

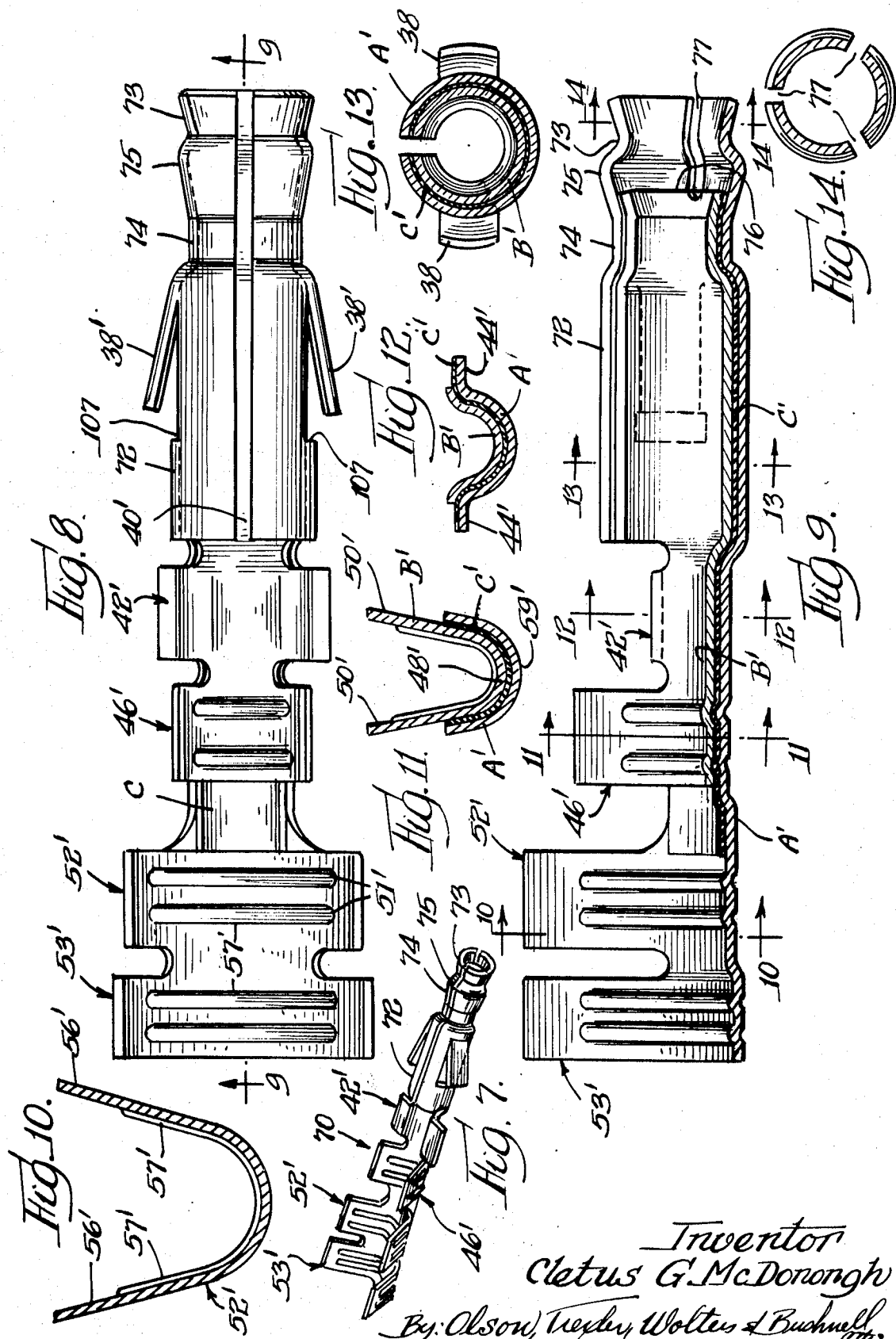
Complementary male and female connectors are provided for shielded cables such as audio cables. Each connector comprises inner and outer sheet metal conductors with a sheet of insulation laminated to the outer conductor and located between the two conductors to insulate the two conductors. Each connector has portions for crimping respectively the center conductor and shield of a shielded cable. A method of making the connector is provided whereby a sheet of metal, a part of which has the insulating sheet laminated thereto, may be blanked and folded to bring together an outer laminated conductor part and an inner non-laminated conductor part so that the insulation is sandwiched between the two conductor parts, following which the inner and outer parts are shaped into a configuration which includes a tubular body having a longitudinal seam.

8 Claims, 17 Drawing Figures





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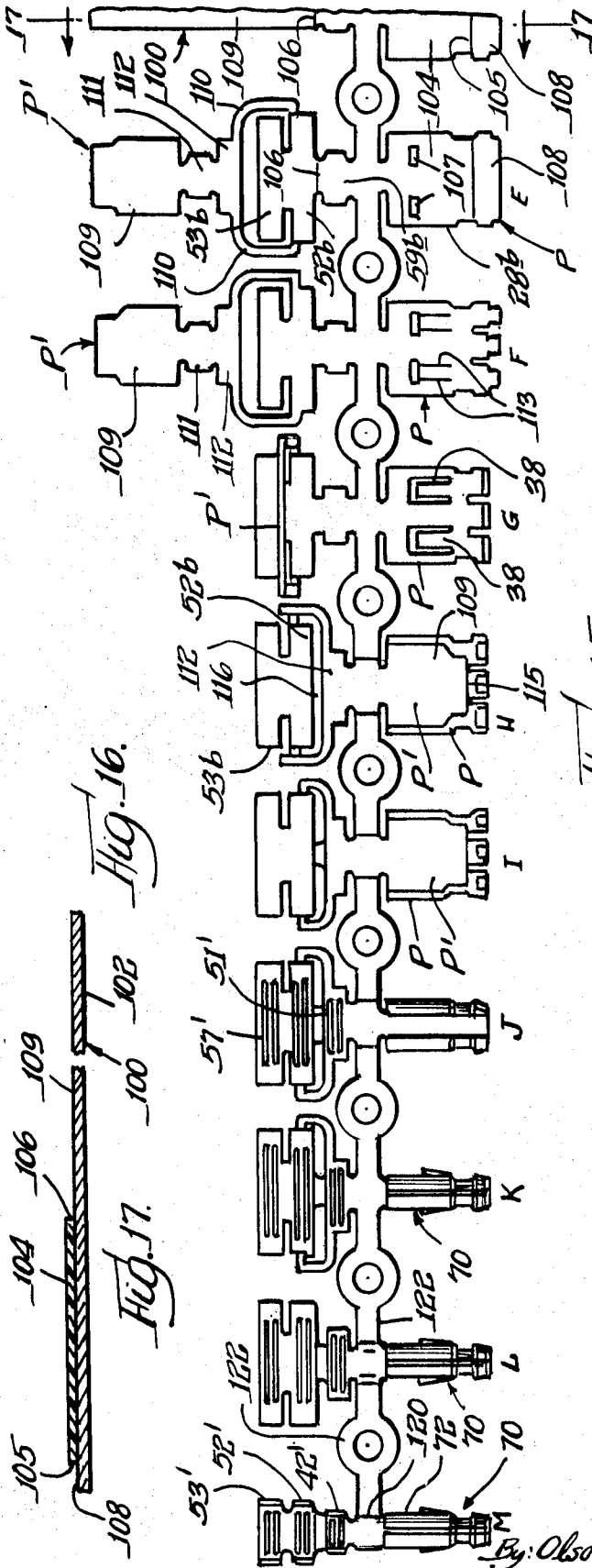
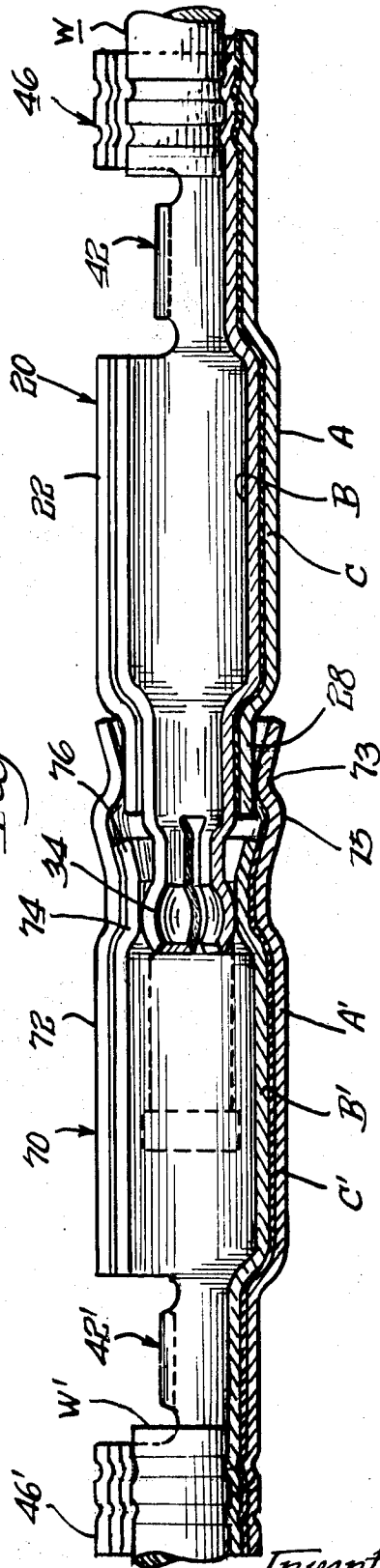


Fig. 15.



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SHIELDED CABLE CONNECTOR AND METHOD OF MAKING THE SAME

BACKGROUND OF THE INVENTION

The present invention is concerned with terminals for inter-connecting cables of the type having an inner conductor and an outer shielding conductor and is an improvement on the invention described and claims in my copending application Ser. No. 16,346, filed Mar. 4, 1970. Such cables are commonly used for transmitting audio frequencies since the grounded outer shield tends to prevent stray hum and noise from being picked up by the cable.

OBJECTS OF THE INVENTION

It is an object of this invention to provide a crimp type connector for a shielded cable wherein the connector has a tubular body with a longitudinal seam and made up of two conductive sheet metal members, one within the other, and with an interposed sheet of plastic dielectric that is laminated to only one of the conductive sheets to insulate electrically the two sheets, and with the other conductive sheet being mechanically locked to the laminate so that the connectors form a functionally one-piece construction.

It is a further object of this invention to provide a connector of the type stated in which there is a wire-crimp portion and shield-crimp portion axially spaced apart and formed from the respective two conductive members, the insulating or dielectric sheet separating the two conductive members at the wire-grip portion, and the member having the shield-crimp portion being free of the insulation.

It is also an object of this invention to provide a method of making an electrical connector of the type stated which can be carried out using known sheet metal stamping and forming equipment, and wherein the two sheet metal conductor members may be fabricated in assembled relation rather than being separately fabricated and then assembled.

It is a more specific object of this invention to provide a method of the type stated which includes the provision of a blank having a sheet of conductor material with a layer of insulation laminated over only a portion thereof, folding the blank so that part of the sheet that is free of the insulation is brought face-to-face against a part of the sheet that contains the insulation layer and with the insulation layer being sandwiched between the conductive sheet portions, and then shaping the two portions and insulating sheet into a connector having a generally tubular body in which the conductors are electrically insulated from each other.

IN THE DRAWINGS

FIG. 1 is a perspective view of a male terminal constructed in accordance with and embodying the present invention;

FIG. 2 is a top plan view of the male terminal;

FIG. 3 is a sectional view taken along line 3—3 of FIG. 2;

FIG. 4 is a front elevational view of the terminal of FIG. 3;

FIGS. 5 and 6 are sectional views taken along lines 5—5 and 6—6 respectively, of FIG. 3;

FIG. 7 is a perspective view of a female terminal constructed in accordance with the present invention;

FIG. 8 is a top plan view of the female terminal;

FIG. 9 is a sectional view taken along line 9—9 of FIG. 8;

FIGS. 10, 11, 12, 13 and 14 are sectional views taken along lines 10—10, 11—11, 12—12, 13—13 and 14—14 respectively, of FIG. 9;

FIG. 15 is a fragmentary longitudinal sectional view showing the male and female terminals connected together;

FIG. 16 is a top plan view showing the progression followed in the method of forming the female terminal according to the present invention; and

FIG. 17 is a sectional view taken along line 17—17 of FIG. 16.

Referring now in more detail to the drawings and particularly to FIGS. 1—6, there is shown a male terminal 20 which is of the pin-terminal type with a plurality thereof designed to be

housed in bores in a plastic or the like housing. The male terminal 20 is formed of sheet material and includes a generally tubular barrel or body 22 of predetermined diameter tapering at the left as seen in FIGS. 2 and 4 into a front or entering end 26. The front or entering end 26 of the body includes an intermediate barrel portion 28 of predetermined intermediate outside diameter somewhat less than that of the body 22. The barrel portion 28 tapers and merges into a restricted neck 32, and at the extreme entering end there is a bulbous tip 34 of somewhat less outside diameter than the barrel portion 28.

The body 22 has lances or legs 38 of a resilient nature which are struck from the material of the body and extend diagonally outwardly and rearwardly from the body 22. As will be understood by those skilled in the present art, when the terminal 20 is inserted front end first into a housing, the lances 38 will snap over shoulders in the housing to latch the terminal against undesired or unauthorized withdrawal. A longitudinal seam 40 runs the full length of the tubular body 22 to enhance resiliency to the terminal allowing it to be compressed diametrically. Furthermore, the tip 34 and neck 32 have additional splits or seams 41, 41 120° apart so that the tip and neck are divided into three sections 43, 43, 43.

Rearwardly of the cylindrical body 22 is a terminal retaining section 42 including oppositely extending wings or flanges 44 lying substantially in a common diametrical plane at right angles to the diametrical plane of the lances 38. As will be seen, the distance across the wings 44 is greater than the maximum external diameter of body 22 whereby the wings may engage against shoulders of a housing to limit inserting of the terminal into a housing.

Rearwardly spaced from the terminal retaining section 42 is a wire-gripping section 46, of generally V-shaped cross-section as may be seen in FIG. 6, including a bight 48 and upwardly and diagonally outwardly diverging flanges 50, the bight and flanges having inwardly directed ribs 51, 51. A suitable tool or machine crimps the flanges 50 down against a wire (constituting the center conductor of a shielded cable) inserted in the wire-gripping section 46.

Rearwardly spaced from the wire-gripping section 46, there are provided shield-gripping sections 52, 53 of greater diameter and having bights 54, 54 and upwardly and outwardly diverging legs 56, 56 designed for crimping about the braid or other shield of a shielded cable or wire. The sections 52, 53 have inwardly impressed ribs 57.

The male pin terminal 20 is of sheet material construction of a resilient nature. The sheet material construction comprises an outer metal conductor A and an inner metal conductor B and an intermediate dielectric plastic C that is laminated to the outer sheet A. The plastic material may be a polyester such as Mylar, or it may be a highly plasticized polyvinyl chloride formulation. A plastic sheet thickness on the order of 0.005 inch is contemplated, and the metal sheets may be of the same or greater thickness, preferably being material that has both resiliency and good electrical contact characteristics. Brass, beryllium-copper, or phosphor bronze are preferred examples, but other metals are satisfactory. The metal of the conductor A may be heat or pressure sensitive bonded to the plastic layer C or they may be otherwise adhesively secured together.

The male terminal 20 thus comprises a tubular body with inner and outer tubular conductive members A, B and with there being a tubular insulating layer C between the conductors A, B. As best seen in FIG. 3, inner tubular member B extends rearwardly to the rear edge of the wire gripping section 46 and forwardly beyond the outer conductor A to provide the neck 32 and tip 34. The outer conductor A extends from the forward edge of the barrel portion 28 rearwardly beyond the wire-gripping section 46 to constitute the shield gripping portions 52, 53. The insulating sheet is coextensive with the inner conductor B and in addition extends rearwardly of the rear edge 55 of the wire-gripping portion approximately to the forward edge 58 of the shield gripping portion 52. The part 59 of the outer conductor A that embraces the lower portion of the

flanges 50 and the bight 48 constitutes a backing at the wire-gripping portion 46.

Due to the shaping of metal and plastic layers together, as will hereafter be described, the inner conductor B is mechanically locked to the laminate consisting of the conductor A and insulation C. Thus, for example, the ribs 51 is one region in which the laminate and inner conductor B are locked together since the ribs 51 are struck in both the laminate and in the conductor B. Even in the absence of the ribs 51, the generally V-shape of the inner conductor B and the laminate at the wire-gripping section 42 prevents relative rotation of the inner conductor B and laminate. The radial deformations 62, 64 at the opposite axial ends of the body also prevent axial separation of the laminate and inner conductor B. It should be noted that the lances 38 are struck out from only the laminate and do not include the inner conductor B, as will be later described.

Referring now to FIGS. 7-13, there is shown a complementary female terminal 50 of similar construction and in which like reference numerals followed by a "prime" indicate the parts of the female connector that are the same as those of the male connector, previously described. Suffice it to say further, however, that in the female terminal 70 the tubular body 72 tapers at its forward end to a reduced barrel 74 and then conically tapers reversely to an enlarged section 75, and from there forwardly to a restricted neck 73 with a flared open end. As seen in FIG. 9, the outer conductive member A' extends forwardly of the inner conductive member B' from the terminus 76 of the inner conductor B that is in the section 75 and the terminus 76 is flared to complement the section 75. Furthermore, the outer conductor may have splits 77, 77' extending forwardly of the terminus 76.

FIG. 15 shows the male connector 20 plugged into the female connector 70 and with a wire W crimped by the wire gripper 46 and a wire W' crimped by the wire gripper 46'. The wires W, W' (which may be solid or stranded) are center conductors of a shielded cable, and the shield (not shown) for each cable is crimped to the respective shield grippers 52, 53, 52', 53'. These are not shown in FIG. 15, as this arrangement will be understood from the previous description. As shown, there is a conductive path from the wire W through inner conductor B to the resilient tip 34, which snugly contacts the inner conductor B' at the reduced barrel 74 of the female connector 70. The inner conductor B' at reduced barrel 74 is, of course, in integral conductive connection with the wire gripper 46' and thus the wire W'. The outer conductors A, A', which are in integral conductive connections respectively with the shield grippers 52, 53, 52', 53', are electrically connected through the contact made by the barrel portion 28 of the male connector and the restricted neck 75 in the outer conductor A' of the female member.

In FIGS. 16 and 17, there is shown a method of making the female connector 70, but it will be understood that the male connector 20 is made in a like manner. The progression of the steps of the process is illustrated, but not the machinery used, since the latter is of a type known in the art and can be readily adapted to carry out the method.

A sheet of material 100 has a metal layer 102 that ultimately will be used to form the outer conductor A' to which is laminated the dielectric plastic insulation 104, which ultimately will be used to form the insulating layer C'. The plastic 104 is laminated only over a part of the sheet from 105 to 106, which leaves uncoated a region 108 from which the sections 76, 73 will be formed and a region 109 from which the shield grippers portion and inner conductor will be formed.

In the working station or step E, there is blanked in the sheet a form that includes, in a first part P, an outer body blank portion 28b that includes the shield-gripping blank portions 52b, 53b and a blank portion 59b constituting ultimately the backing 59'. In the aforesaid first part, the insulation 104 will extend to the line 106 at the forward edge of the shield-gripping blank portion 52 to what will be the rear end of the section 75. Also holes 107, 107 are punched in the portion 28b at which the lances 38 are struck. Also formed is a second

part P', having an inner body blank portion 109 that is attached to the section 52b by the thin members 110, 110 and includes a wire-gripping blank portion 111 and a retaining section blank portion 112.

In the working step F slits 113, 113 are formed for each lance and material is cut away at the forward end of the body blank portion 28b for further formation of that portion of the connector.

In the working step G the lances 38, 38 are struck from the laminate and the forward edge portion is bent upwardly to further progress the shaping of the front end of the connector 70. Also the part P' is bent up 90° around the junction of the thin members 110, 110 and the shield gripper blank portion 52b.

In the working step H the forward edge portion is further shaped and the part P' is further bent 90° into flush engagement with the part P whereby the insulation 104 is between the part P' and the metal of the part P. The forward edge 115 of the part P will correspond substantially to the terminus 76 and the rear edge 116 of the part P will correspond to the rear edge of the to-be-formed wire-gripper section 42' of the connector. The portion 111 is wider than the portion 59b and will overlie the portion 59b and the portion 112 will overlie a portion of the connector strip 122, which joins successive piece parts together as they progress through the various forming stations.

In the steps or stations I, J, K, L, the body portion 72 is progressively formed into a generally tubular shape and the ribs 51', 57' are formed in the shield-gripper blank portions and in the wire-gripper blank portions. The tubular body is readily formed, and this is facilitated by the fact that the inner sheet metal part P is not bonded to the plastic insulation. At the step L, the thin members 110, 110 are cut off, which removes the electrical connection between the inner and outer sheet metal conductors, leaving them fully insulated by the insulating sheet. At the station M, the wire- and shield-gripping blank portions are bent into their generally V-shapes and the piece is cut off the strip 122.

In the finished piece the portion of the retaining section 44' that comprises the conductor A and insulation C will be wider than the superimposed portion that contains the conductor B, as shown in FIG. 12. However, in the wire-gripper portion 42', the inner conductor member B will be wider than the subjacent laminate consisting of the conductor member A and insulation C, so that the superposed conductor B part will have the flanges projecting upwardly from the edges of the laminate, as shown in FIG. 11.

The principles of the invention are being shown and described but it will be understood that various modifications may be made, and all those coming within the scope of the appended claims are to be considered as part of the invention.

What is claimed is:

1. An electric connector for a coaxial cable having an inner conductor and an outer conductor shielding said inner conductor, said connector having a generally tubular body with a longitudinal seam and comprising two conductive members of sheet material, one member being within the other, an intermediate member of sheet material that insulates one conductive member from the other, the intermediate member being bonded to only one of the conductive members to form a laminate therewith, means forming a mechanical lock between the other conductive member and the laminate, first means for gripping the shielding conductor of the coaxial cable, and second means for gripping the inner conductor of the coaxial cable.

2. A connector according to claim 1 wherein the laminate surrounds said one conductive member.

3. An electric connector having a generally tubular body with a longitudinal seam and comprising two conductive members of sheet material, one member being within the other, an intermediate member of sheet material that insulates one conductive member from the other, the intermediate member being bonded to only one of the conductive members to form

a laminate therewith, and means forming a mechanical lock between the other conductive member and the laminate, one of the conductive members extending longitudinally beyond an adjacent longitudinal end of the intermediate member, said longitudinal seam extending through said laminate and said other conductor.

4. An electric connector having a generally tubular body with a longitudinal seam and comprising two conductive members of sheet material, one member being within the other, an intermediate member of sheet material that insulates one conductive member from the other, the intermediate member being bonded to only one of the conductive members to form a laminate therewith, means forming a mechanical lock between the other conductive member and the laminate, first means for gripping the shielding conductor of a cable having an inner conductor shielded by the shield, and second means for gripping the inner conductor, one of such conductive members extending to said first means and being in conductive connection therewith, the other of said conductive members extending to said second means and being in conductive connection therewith, the two means being axially spaced along the length of said connector.

5. An electric connector for a cable that has an inner wire conductor and an outer conductive shield for the wire, said connector having a generally tubular body with a longitudinal seam and comprising inner and outer conductive members, said connector having an end with a shield-gripping crimp portion, a part of said connector between said shield gripping crimp portion and the body having a wire-gripping crimp portion, the inner conductive member extending to said wire-gripping crimp portion and being in conductive connection therewith, the outer conductive member extending longitudi-

dinally beyond said inner conductive member to said shield-gripping crimp portion and being in conductive connection therewith, and an insulating sheet between said inner and outer conductive members and longitudinally terminating short of said end of the connector a sufficient distance to insure electrical insulation of the two members at said wire-crimp portion but insufficient to insulate said shield-gripping crimp portion from electrically conductive crimping engagement with the outer conductive shield of said cable, said insulating sheet being bonded to only one of said conductive members.

6. A connector according to claim 5 having an opposite end at which one of said conductive members extends longitudinally beyond the other member and wherein the extended part of the extending member also extends beyond the adjacent end of the insulating sheet.

7. A connector according to claim 5 in which the outer conductive member is the conductive member that is bonded to said insulating sheet and the inner conductive member is otherwise mechanically locked to the laminate that is comprised of said outer conductive member and said insulating sheet.

8. An electric connector comprising a body having telescoped generally tubular inner and outer conductor members, an insulating generally tubular member interposed between said inner and outer conductors, means rigidly securing the members together, and a lance struck outwardly from the body and including the outer conductor member and the insulating member but excluding the inner conductor member.

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