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F. W. KOLLER ET AL

2,798,113

SHIELD CONNECTORS

Filed March 29, 1954

FIG. 1

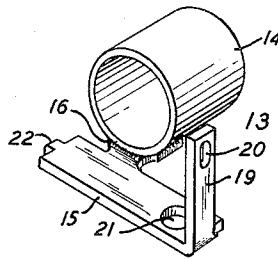


FIG. 2

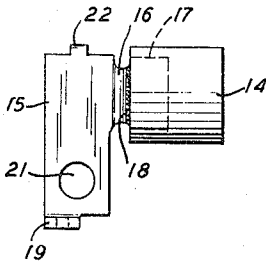


FIG. 3

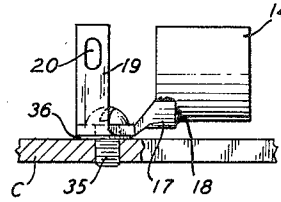


FIG. 4

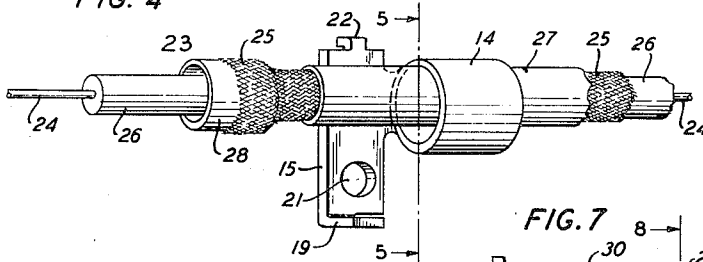


FIG. 5

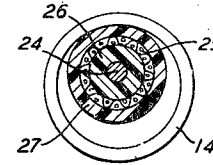


FIG. 6

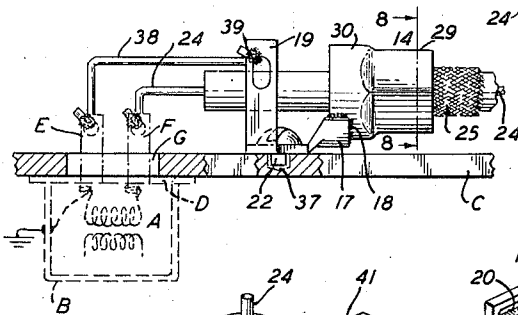


FIG. 7

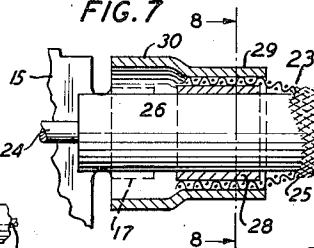


FIG. 8

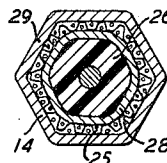


FIG. 9

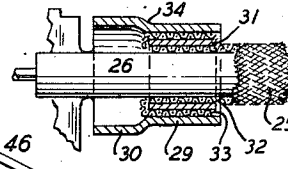


FIG. 10

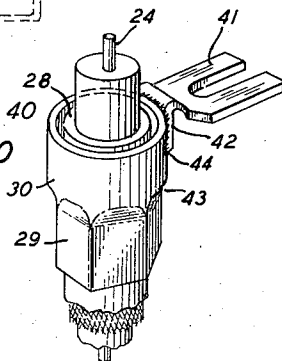
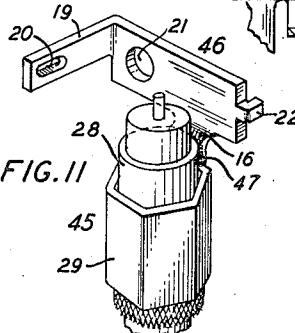


FIG. 11



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SHIELD CONNECTORS

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2 Claims. (Cl. 174—75)

The invention relates in general to a terminal for mounting an electrical cable to a support and specifically relates to a shield connector for use in mounting an end of a shielded cable to a support, and still more specifically relates to a connector for use in mounting and, where required, for grounding the shield at the open end of a coaxial cable or at the open end of a shielded, balanced pair high frequency electric transmission cable.

It has been known in this art to band such cables at their open or terminated ends with a sleeve snugly engaging the outer metallic shield of the cable and to solder or otherwise secure to the sleeve a ground wire for grounding the sleeve and thus the shield onto any conveniently available ground. Any soldering to the shields of most wire or cable is objectionable, among other reasons because it carries the risk of heat transference to the insulation within the sleeve which is apt to soften the insulation and possibly cause it to flow for an undetermined distance back from the point of heat application, thus ruining the insulation and transmission properties of the cable at the point so heated. The connector herein featured is of the solderless type in its engagement with the cable shield and the connector and cable are permanently connected by a crimping operation.

The use of a shield connection in the usual form of a round wire attached to the shield of such cables is objectionable in high frequency equipment such as television, video and microwave radio relay circuits, in that the use of wires even when properly soldered or even crimped onto cable terminals causes a high inductive reactance which limits the circuit performance.

The primary object of the invention is to design a simplified article of manufacture which will in one unit provide both a termination for the shield of a cable and a mounting therefor, which will avoid the above-noted objections and which will be also suitable for use in high frequency electrical circuits.

More specifically defined, the invention has for other objects the providing of a more positive interfacing engagement between the banding sleeve or ferrule and the metallic shield of the cable than has been possible heretofore; the providing of wide areas of electric paths of the least possible ohmic resistance for conducting electric charges away from the banding sleeve; and the providing of mounting features which will remain fixed in place on its support and thus resistant to the usual conditions which tend to displace connectors of the type herein featured from their supporting structures.

Various other objects and advantages of the invention will be in part obvious from an inspection of the accompanying drawings and in part will be more fully set forth in the following particular description of three forms of sheath connector embodying the invention, and the invention also consists in certain new and novel features of construction and combination of parts hereinafter set forth and claimed.

In the accompanying drawings—

Figure 1 is a perspective view of a wire or cable shield

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connector forming a preferred embodiment of the invention;

Figs. 2 and 3 are, respectively, a plan view and a view in side elevation of the connector shown in Fig. 1, and with the connector shown mounted on a support in Fig. 3;

Fig. 4 is a view of the connector of Fig. 1 loose on a coaxial cable, with an inner sleeve loose on the cable with the cable shield distended over the inner sleeve, and showing the assembly before the connector has been shifted into position telescoping the inner sleeve;

Fig. 5 is a transverse sectional view taken on the line 5—5 of Fig. 4, looking in the direction indicated by the arrows;

Fig. 6 is a view in side elevation of the connector crimped onto the coaxial cable, mounted on a support, and with the open end of the cable connected to an instrument shown in ghost outline and to which it is supplying current;

Fig. 7 is a view in axial section of the right end of the connector of Fig. 6 with the braided cable shield distended to fit over the inner sleeve and the connector permanently crimped to the cable;

Fig. 8 is a transverse sectional view taken on the lines 8—8 of Figs. 6 and 7;

Fig. 9 is a view similar to Fig. 7 showing the braided cable sheath underlapping and then bent back upon itself overlapping the inner sleeve, and with the connector permanently crimped to the cable;

Fig. 10 is a view in perspective of a slightly modified form of connector and featuring a tongue welded to an outer ferrule which is crimped onto a coaxial cable banded with an inner sleeve as in Fig. 7 or 9; and

Fig. 11 is a view in perspective of another modified form of connector featuring a flag or tongue welded to the inner sleeve with the outer ferrule hexagonal from end to end.

In the drawings and referring first to the uncrimped connector 13 shown in Figs. 1-3, there is disclosed a one-piece prefabricated unit including a cylindrical barrel or ferrule 14, and a flat mounting flag 15 or terminal tongue connected to one end of the ferrule through a reduced neck 16.

It is a requirement in such devices that the ferrule be made of ductile metal and sufficiently soft and thin so that it can be easily deformed into crimps of hexagonal cross section. On the contrary, it is required that the mounting flag 15 be rigid and for this reason is formed of a gauge of metal somewhat thicker and harder than that used to form the ferrule. The connector as a whole is electro-tin plated and placed on the market as shown in Fig. 1.

In its preferred form the ferrule 14 has a continuous perimeter, is therefore free of slits and seams, and is made of soft tubular copper or commercial bronze, Rockwell F65 with a thickness of .024 inch. The mounting flag is made of brass, Rockwell 870 to 890, having a thickness of .040 inch. The connector illustrated has an all-over length of eleven-sixteenths of an inch.

The mounting flag 15 is in a plane offset from the ferrule by reason of the fact that the neck is bent Z-shape in side elevation, as shown in Fig. 3. The outer or free end 17 of the neck forms an arcuate saddle in which the adjacent curved end of the ferrule 14 fits more or less. The lapping portions of the saddle 17 and ferrule are brazed together as shown at 18 in Figs. 3 and 6. In this way the two parts 14 and 15, even when formed of different materials as herein featured, are integrally connected to form the connector as a somewhat rigid unitary one-piece article of manufacture.

The originally thick, flat plate forming the mounting flag 15 is provided at one of its narrow ends with a long, narrow tongue 19. The tongue is bent upwardly from the

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plane of the mounting flag, that is, in the direction towards the ferrule to form a ground terminal 19, and is provided with a slot 20 for attaching thereto a ground wire or other circuit component. Adjacent the terminal 19 the flag 15 is provided with a clearance screw hole 21 for receiving a screw for anchoring the connector to a support. At its other narrow end the mounting flag is provided with a small down-turned extension 22 forming a lip hereinafter referred to as a "no-turn lug," for engaging in a recess provided therefor in the support. While the tongue 19 is illustrated as extending at right angles to the plane of the flag 15, it may be otherwise disposed in that position best suited to receive the ground wire 38 hereinafter mentioned.

The connector 13 is particularly designed for use with a coaxial cable 23, but may equally be used with a shielded pair of electrical transmission cables and in either case the parts may be connected together permanently without any soldering operation. These cables while considered to be rigid actually have a considerable degree of flexibility. In the form illustrated the cable is of relatively very small size, say, $\frac{3}{8}$ inch diameter, with an inner or central copper wire conductor 24, sometimes referred to as the core conductor, and outer conductor 25, with the conductors separated by a layer of insulation 26 of a thermoplastic type. There is also disclosed in Fig. 4 an outer cable insulation 27, usually of a coated plastic material. The outer conductor 25 is made of a hollow readily expandable, stranded and braided metal, hereinafter sometimes referred to as braid, but the use of equivalent types of outer flexible or semi-flexible or even more or less rigid conductors is within the scope of this disclosure.

The insulating layer 26 forms a tube which is quite apt to have a very small cross section of material and thus is liable to be perforated or otherwise damaged unless care is exercised in banding the cable. The present disclosure calls for protecting this insulation from any break-throughs or from otherwise interfering with its rated insulation, and this is attained by using within the ferrule a relatively semi-rigid inner shielding sleeve 28 of highly conductive metal.

The requirement that the inner sleeve be used to protect the part of the cable encircled thereby would indicate that the inner sleeve be rigid. However, in the instant case the inner sleeve is utilized in becoming deformed to bind itself on the cable as an incident of crimping the ferrule, as hereinafter described. This requirement calls for an inner sleeve which is sufficiently ductile to be deformed into a crimping engagement with the cable by conventional hand-powered crimping apparatus. The inner sleeve 28 initially is of cylindrical form as shown in Fig. 4, and is designed as a compromise between these two requirements of rigidity and ductility. In the case illustrated the inner sleeve 28 is formed of brass or bronze, Rockwell 70-90, and possesses a rigidity sufficient to resist such extent of deformation thereof as might cause it to damage the cable insulation therein, and sufficiently ductile and pliable to permit it to take such slight deformation (see Fig. 8) as may be imposed on it by reason of the deformation of the ferrule 14 into the hexagonal crimp herein shown.

In preparing the assembly of connector and cable, it is understood that the cable insulation is stripped back to expose the wire conductor 24 and the braid 25 is cut back still a little farther, as shown in Fig. 4. The inner sleeve 28 is slipped onto the exposed end of the plastic insulation 26 with a freely sliding fit. The connector 13 is initially located in position on the cable end so stripped with its ferrule end clear of the inner sleeve and in a convenient position to be manipulated, such as shown in Fig. 4. The free end of the braid 25 is expanded slightly and while so held expanded is drawn over the inner sleeve 28 and released into position to cover the sleeve by virtue of its own resiliency, as best shown in Fig. 7. When the

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braid is thus set over the inner sleeve as shown at the left of Fig. 4, the connector as a whole is then shifted right to left of the showing until the ferrule 14 is in position telescoping the inner sleeve 28 and thus overlapping the distended end of the braid 25 so drawn over the inner sleeve. The right end of the ferrule 14 beyond the weld at 18 is then deformed radially by some form of hand crimping tool or by means of a power-actuated crimping machine, into a crimping engagement with the braid 25. By a squeeze pressure therethrough the inner sleeve for its entire length is deformed radially and at least slightly into a binding engagement with the portion of the insulation 26 encircled thereby as shown in Fig. 8. In binding the inner sleeve onto the insulation 26, care is exercised to avoid as far as possible any material deformation of the insulation for any such deformation would be quite apt to affect the rated impedance of the coaxial cable and this would be most objectionable in circuits leading to sensitive instruments.

It has been found experimentally that the best form of crimp, especially for the small size connectors herein illustrated, is a form of crimp hexagonal in cross section and extending for a material length of the ferrule. In crimping the connector onto the cable it is preferred to limit the crimped portion 29 to the end of the ferrule opposite the end from which the flag extends, leaving the uncrimped inner end 30 of the ferrule in its original cylindrical form. Confining the crimp to the right end of the ferrule avoids any possibility of the deforming crimps interfering with the bond or braze at 18.

In the case illustrated the crimping was done by a hand tool of the pliers type, each of whose squeeze jaws is provided with a half-hexagonal recess coating when the jaws are in contact to form the hexagonal crimp.

When the crimp is formed the outer sleeve forming the ferrule takes the long-faced hexagonal contour shown in Figs. 6, 10 and 11, and the inner sleeve 28 takes a form in cross section somewhat of that of a cylinder, but more nearly hexagonal with rounded corners, as shown in Fig. 8.

In the showing in Fig. 9, where the braid overlaps as well as underlaps the inner sleeve, the inner sleeve 31 has an internal diameter slightly larger than that of the inner sleeve 28 of the preceding figures, so that sleeve 31 can be slid along the braid while the braid remains in position adhering to the insulation 26. The braid is left to extend beyond the sleeve 31 a little longer than in Fig. 7, and the part thereof which thus initially projects beyond the sleeve 31 is distended and folded sharply back upon itself over the inner sleeve, so that the inner sleeve is sandwiched between the two connected layers of the braid and thus forms an inner layer 32 and an outer layer 33 of the braid in overlapping relation. Likewise, in Fig. 9 the ferrule 34, corresponding to the ferrule 14, is of sufficiently larger internal diameter to be slid over the thus enlarged outer layer 33 of braid. In this way, when the ferrule 34 is crimped into the hexagonal form herein featured, it squeezes the outer layer 33 between itself and the inner sleeve 31, likewise into a form more or less approaching that of a hexagon in cross section and in turn squeezing the inner layer 32 more snugly into engagement with the insulation 26 than it was originally.

Crimping the ferrule into the hexagonal form herein featured has the advantage of providing six long, wide, flat areas of contact with the braid encircled thereby. The bearing surfaces provided by the crimp 29 are thus arranged in three opposing pairs of flat surfaces, between each pair of which the braid is squeezed. This insures an intimate contact between the ferrule and the braid for an accumulated extensively large area of interface.

With the connector secured to the cable shield as thus described there is produced as a single, unitary article of manufacture a cable having a terminal secured thereto at its end designed to be attached to apparatus or instruments usually connected to such cables.

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For an illustration of one such situation where the instant terminal has proven satisfactory, reference is made to Fig. 6 wherein an instrument A, such as a coil or transformer, is housed in a grounded casing B secured to the under side of a chassis or other support C. The top closure plate D of the instrument casing B is provided with a pair of terminals E and F which project from opposite sides of the instrument through an opening G in the support C.

The mounting flag 15 is intended to lie flat or almost flat on the support C and is secured thereto by a screw 35 passed through the hole 21 and threaded into the support, preferably with a thin soft copper washer 36 located between the flag and the support and outlining the hole 21, as shown in Fig. 3, or with a toothed lock washer under the head of the screw.

In those cases where the support C is of conductive material and grounded, for instance, on the building water pipe system, as is usual, there will be formed a grounding path between the mounting flag 15 and the support C through the copper washer 36. It is suggested that a more extensive area of grounding interface, and thus a better ground, between the connector 13 and its support C might be formed where the washer is omitted and the flag 15 directly and flatly engages the support C for the entire area of the flag, as shown in Fig. 6.

It is a feature of this disclosure that the mounting and conductive flag 15 is a flat plate of considerable exposed area in contrast with round wires used heretofore in grounding similar banding ferrules crimped onto the cables.

Considering the portion of the flag which lies between the ferrule 14 and the tongue 19, and even including the tongue 19, it is seen that it forms a conductive path whose exposed surfaces are wide and flat and thus distinguishes from the round wire ground heretofore above referred to as being soldered to a similar form of ferrule. These flat surfaces, particularly in the main flat portion of the flag, are rigidly fixed relative to the ferrule and in this respect also define away from the wire type ground which could be moved especially in the free end parts thereof remote from the ferrule. Fixing the conductive path in the portion of the fitting beyond the ferrule has the effect of reducing the imposing of inductive factors into the system. The inductive reactance of the illustrated forms of connector even at high frequencies is made low by reason of the shape, and more particularly by the large dimensional area, of the connector, considering in the total area thereof both its ferrule and its mounting flag.

In order to defeat any possibility of the flag rotating about the screw 33, the no-turn lug 22 is located in a recess 37 therefor, drilled into the support or therethrough if desired. In this way loosening of the connector mounting is prevented even when the cable is pulled or shifted laterally while being installed or subsequently while in use.

A loose connection on the cable shield can cause open circuit, poor circuit operation and circuit noise. In actual practice, when these troubles develop, it is very difficult and expensive to run down the cause.

As shown in Fig. 6 the inner wire conductor 24 of the cable is connected conventionally to one side of the instrument A through terminal F. A ground wire 38 connects the other side of the instrument through terminal E with the ground terminal 19 preferably by soldering the connector at 39. It is suggested that at least for temporary installation the ground wire may be secured by means of any suitable form of releasable clamp adjustable in the slot 20. In either of these ways a good metallic ground return to the cable shield is had independent of the chassis or other support.

Referring to the modified forms of connector shown in Figs. 10 and 11, it is understood that the coaxial cable, the inner sleeve and the crimped ferrule there shown are exactly as described in connection with the preceding fig-

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ures except that in Fig. 11 the crimping of the ferrule extends for its full length. In the Fig. 10 form of the device a connector 40 includes a terminal prong 41 of the slotted type which in general takes the place of the flag in the preceding figures and likewise is intended to have a ground wire such as ground wire 38 secured thereto as the instant situation may indicate. The prong 41 has its inner end 42 downturned and welded to the top of the ferrule 43, as indicated at 44, before the ferrule is crimped onto the inner sleeve and cable as above described for the preferred form.

In the form of the device shown in Fig. 11 there is disclosed a connector 45 with a flag 46 somewhat resembling the flag 15 with its screw hole 21, no-turn lug 22 and bent ground terminal post 19. In this case the neck 16 of the flag 46 overlaps and in its overlapped position is welded to the outer face of the inner sleeve 28, as indicated at 47. However, it is obviously within the scope of the disclosure to weld the flag 46 to the outer ferrule, as suggested for the prong 41 in Fig. 10, and to weld the prong 41 to the inner sleeve, as suggested for the flag 46 in Fig. 11. The slotted prong 41 and the flag 46 are intended to function in mounting the same on a support therefor exactly as has been described for the preferred form in Figs. 1-9.

By using the forms of connector herein disclosed there is avoided any necessity of using the extra mounting parts required by other similar forms of connector; a more positive engagement between the connector and the braid is attained than has been possible heretofore; the inductive reactance even at high frequency is low; a metallic ground return to the cable shield independent of the chassis or support is had; and the "no-turn" lug prevents loosening of the connector mounting when the cable is pulled or moved.

We claim:

1. An electrical connector for grounding the high-frequency shield of an electric cable, comprising a first hollow cylindrical metallic member having an internal diameter greater than the diameter of said cable whereby to slide loosely thereover, a second hollow cylindrical metallic member mounted directly under a flared end portion of said cable shield, the overlying cable portions being removed to expose said cable shield, the diameter of said flared end portion being slightly less than the internal diameter of said first cylindrical member, whereby said first member may be moved freely over said flared end portion, said first cylindrical member being slightly more ductile than said second member, whereby when said first member is crimped by applying a radial squeeze pressure thereto, the less ductile second member prevents substantial deformation of the underlying portions of said cable, a metallic supporting lug integral with said first cylindrical member adjacent one end thereof and including a flat portion for mounting said connector on a supporting surface, said flat portion including an aperture for the reception of a fastening member for securing said connector to said supporting surface, and a second portion of said lug extending perpendicularly to said flat portion from one end thereof, whereby said second portion serves as a soldering tab for effecting a direct, independent ground return.

2. The connector according to claim 1, wherein said flat portion of said supporting lug comprises a lip at the opposite end thereof, extending from said lug into a depression formed in the supporting surface, whereby the connector is prevented from being pivoted about said fastening member.

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