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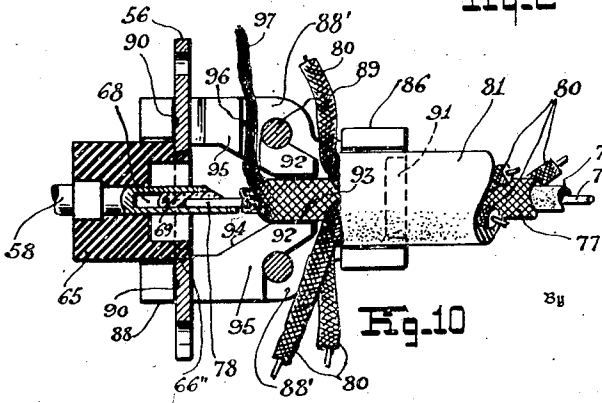
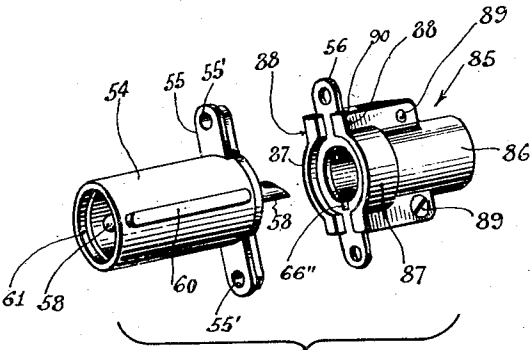
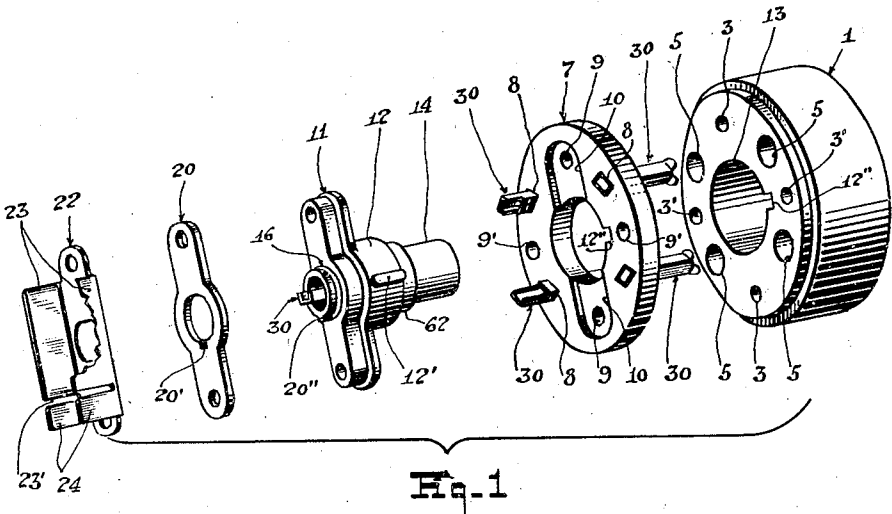
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2,450,271

ELECTRICAL CONNECTOR

Filed March 7, 1945

2 Sheets-Sheet 1



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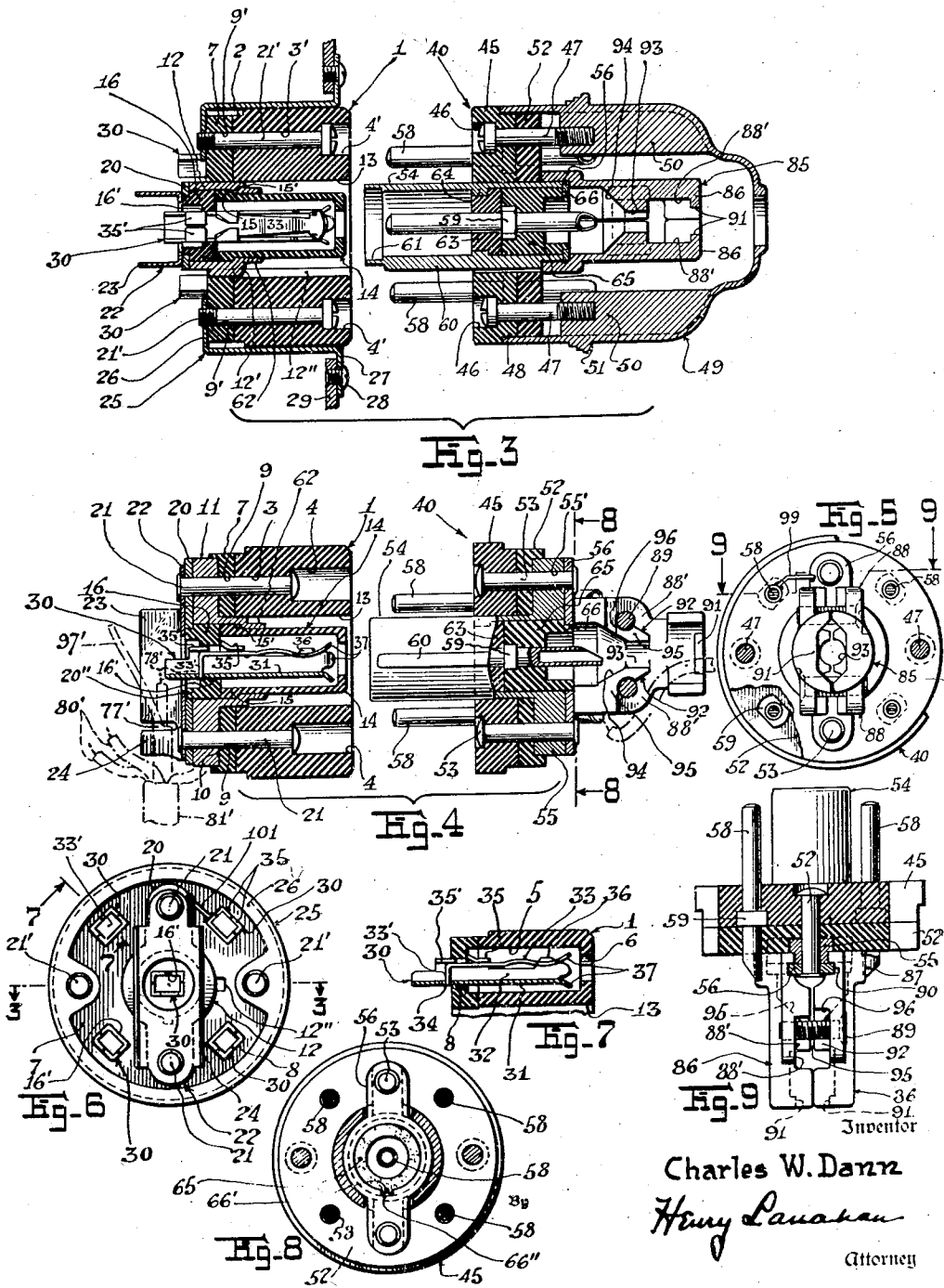
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2 Sheets-Sheet 2



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UNITED STATES PATENT OFFICE

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ELECTRICAL CONNECTOR

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This invention relates to electrical connectors and more particularly to multi-wire cable connectors of the so-called plug-in type. It relates more specifically to an electrical receptacle and plug as well as to the combination of plug and receptacle. The invention is particularly useful for plugs and receptacles and combinations thereof used for sound reproduction and/or recording.

In this art a shielded conductor has been used extending from the transmitting to the amplifying station, as well as conductors for controlling a phonograph. While various means have heretofore been suggested for coupling leads to a phonograph for the operation of the same, they have all failed for one reason or another to accomplish these purposes efficiently. By the present invention new plugs and receptacles and new combinations of them are provided in such a way that they are particularly useful and convenient.

With this invention a novel receptacle can be readily produced which provides excellent shielding for one or more of the leads carried thereby as well as the contact connected to said lead or leads.

Other objects of this invention are: to provide a novel plug which may be readily produced and which provides excellent shielding for one or more of the leads carried thereby and the contact connected to said lead or leads; to provide a novel combination of plug and receptacle; and to provide a novel combination of plug and receptacle wherein a pair of cooperating contacts are well shielded in a very efficient and simple manner.

These as well as other objects of this invention will be apparent from the following description in connection with the accompanying drawings, in which

Figure 1 is a detail exploded perspective view of some of the parts of the receptacle;

Figure 2 is a similar view of parts of the plug;

Figure 3 is a longitudinal cross-sectional view of the plug and receptacle along line 3—3 of Fig. 6.

Figure 4 is a longitudinal cross-sectional view of the plug and receptacle, with the housing of the plug and receptacle omitted, this view being taken on a plane about 90° from the plane of the section shown in Figure 3;

Figure 5 is a view of the outer end of the plug shown in Figure 4;

Figure 6 is an outer end view of the receptacle shown in Figure 4;

Figure 7 is a sectional view along line 7—7 of Fig. 6;

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Figure 8 is a sectional view along line 8—8 of Fig. 4;

Figure 9 is a sectional view along line 9—9 of Fig. 5;

Figure 10 is an enlarged side view partly in section showing how the multi-wire cable is connected to the combined clamp, strain relief, and electric static shield of this invention.

A short cylinder 1 of insulating material is provided having a thick wall. This cylinder, with its associated parts, constitutes a socket. A projecting cylindrical portion 2 (Fig. 3) of cylinder 1 is of slightly less diameter than the cylinder. Four longitudinal parallel holes, comprising the pairs of holes 3 and 3' disposed at right angles, extend through the cylinder 1 parallel to the axis of this cylinder. Enlarged ends 4 and 4' of the holes 3 and 3', respectively, are provided, as shown in Figs. 3 and 4. Four larger holes 5 (Figs. 1 and 7) extend through the cylinder 1 parallel to the holes 3. One end of each of the holes 5 is reduced as shown at 6 in Fig. 7.

A disk 7 of insulating material (Fig. 1) of the same diameter as the projection 2 is provided having rectangular holes 8 therethrough for contacts or plugs aligned with the holes 5. Holes 9 and 9' are provided through the disk 7 so that they can be aligned with the holes 3 and 3' in cylinder 1. A transverse or diametrical slot 10 is provided along the outer face of the disk 7. A metal support or cross-piece 11 is to be located in the slot 10. A cylindrical projection 12 which is a part of an electrical shield is provided on the support 11 and is adapted to project through the disk 7 and into the central opening 13 of the cylinder 1. A lug 12' is provided on cylinder 12 and corresponding slots 12'' in disk 7 and cylinder 1 in order to insure assembly of these parts in a predetermined proper angular position with relation to each other.

A thimble 14 (Figs. 3 and 4) of insulating material is located in the opening 13 of cylinder 1. It has an annular shoulder 15 cooperating with a shoulder 15' on the projection 12 of cross-piece 11 to keep this thimble 14 from moving in one direction. A ring 16 of insulating material is provided to bear against the other end of the thimble 14 to keep it from moving in the other direction. A metal strap 20 (Figs. 1 and 4) is kept in place on the cross-piece 11 by rivets 21 which extend through openings 3 and 9 in the parts 1 and 7 and corresponding openings in said strap and cross-piece. The radial arms of strap 20 are slightly wider than and therefore overlap the reduced portions of the radial arms of the cross-piece

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on which they bear. Strap 20 has a slot 20' which is engaged by a key or lug 20'' on ring 16 to prevent the latter from turning. This strap 20 extends along the outer face of cross-piece 11. The bolts 21' (Fig. 3) in holes 3' and 9' may be provided to attach the cylinder 1 to a support.

A metal strap 22 is kept by means of rivets 21 in assembled position with strap 20, cylinder 1, and disk 7. Shielding wings 23 are provided on the strap 22, these wings having slots 23' thereacross to provide lugs 24 for convenience in clamping a cable to said strap.

A support for cylinder 1 may, for example, be provided comprising a metal cylinder 25 (Fig. 3), having a flange 26 at one end bearing against the disk 7 and having a flange 27 at its other end by which it can be attached in place, as indicated in Fig. 3, by bolts 28 to a support 29. However, either the plug or socket of this invention may be fixed in place and the other connected thereto, or they can be connected to the ends of separate leads and then connected together.

Female contacts 30 (Figs. 3, 4, 6 and 7) are located in holes 5 in the socket 1 and are maintained in position by the disk 7 in such manner that they are kept from turning but have some freedom of longitudinal movement. Four of these contacts are spaced in accordance with the holes 5 in cylinder 1 (Fig. 1) and one is located along the center line of this cylinder.

As shown in Figs. 4 and 7, each contact assembly 30 has a bottom wall 31 and side walls 32 with a right-angular contact spring 33 sprung between a slot 34 in the wall 31 and the lugs 35 and 35' which are bent over extensions of the side walls 32. The entrance ends of these contacts can move laterally or float. The lugs 35 are bent up so as to rest against the end of a recess in disk 7 to keep the contacts 30 from coming out. Lugs 35 are provided along the side walls 32 of the contacts 30 to keep the springs 33 positioned. Flared ends 37 of the contacts 30 guide the pins 58 (to be described) into position under springs 33.

The central female contact 30 is located in the thimble 14 (Fig. 4). The lugs 35 on this contact bear against the ring 16 to keep this contact from being pushed out when its mating plug is inserted. The opening of ring 16 has an inner rectangular portion 16' in which said contact loosely fits and whereby the latter is prevented from turning.

The plug 40 (right-hand portions of Figs. 3 and 4) will now be described. It comprises a disk 45 of insulating material having recesses 46 for heads of screw bolts 47. It is provided with an annular seat 48 for the rim of a metal cap 49 which is connected to disk 45 by bolts 47 that are screwed into the threaded lugs 50 on the inside of cap 49. A rim 51 is provided for convenient detachment of the plug 40 by hand. A disk 52 of insulating material is provided having the same diameter as the seat 48. It is attached by rivets 53 (Fig. 4) to the disk 45. A tubular metal shield 54 is kept in fixed position along the axis of the plug 40 by radially-extending projections 55 having holes 55' therein through which the rivets 53 pass. These rivets 53 also pass through holes in disks 45 and 52.

A connector strap 56 (Figs. 2, 4 and 9) is provided and the rivets 53 maintain the same in assembled position, thus keeping the parts 45, 52, 55 and 56 secured together. The strap 56 is identical with the strap 20 of the socket or receptacle, and its arms are slightly wider than and therefore

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overlap the reduced portions of the shield projections 55 against which they bear.

Four male contacts 58 (Figs. 3, 5 and 9) are mounted in the disks 45 and 52 so that they can be plugged into the contacts 30. These contacts are loose or float in their mountings so that their ends have some freedom of lateral movement. Integral enlargements 59 having flat faces are provided on the pins 58 to keep them in place and to prevent them from turning. A longitudinal rib or guide 60 (Fig. 4) is provided on the shield 54. This rib fits into the slot 12'' (Fig. 1) in the cylinder 1. An annular internal recess 61 (Fig. 3) is provided at the outer end of the shield 54. This recess fits loosely over the reduced end 62 of the metal extension 12 in the socket 1.

A cylindrical plug 63 (Fig. 4) of insulating material is provided inside of the shield 54. It has a reduced portion which provides an abutment that rests against an annular shoulder 64 on the inside of shield 54. A cylindrical plug 65 of insulating material of the same diameter as plug 63 rests against the plug 63. The reduced end 66 of plug 65 provides a shoulder which bears against the strap 56. The rib 66' (Fig. 8) coacts with a corresponding slot 66'' in strap 56. The plugs 63 and 65 are thus secured in place and plug 65 and thereby the central contact 58 are prevented from turning.

A voice wire conductor 75 (Fig. 10) which is insulated as indicated at 76 and well shielded by a braided metal shield 77 has the bared end 78 thereof soldered in the hollow end 68 of the central contact 58, as shown at 69. The conductor 75 and other insulated conductors 80 are shown as enclosed in the insulation 81. These conductors 80 are for making the desired connections to a control device or other devices in the known way. They carry heavy currents compared to the current in wire 75.

A combined shield and strain reliever 85 (Figs. 2, 3, 4, 5, 9 and 10) is provided. It comprises two semi-cylindrical mating clamping members 86 each having an enlarged semi-circular portion 87 at one end thereof. Each one is provided with oppositely extending flanges 88 (Fig. 2) terminating short of the outer end thereof. These portions 86 can be clamped together by threaded bolts 89 passing through holes in the flanges 88. The flanges 88 are cut away at their face portions as indicated at 88' to provide outwardly extending passageways for the three leads 80 as shown in Figs. 9 and 10. Slots 90 (Figs. 9 and 10) are provided in the flanges 88 to receive the edges of the strap 56. Inwardly extending integral projections 91 (Figs. 4, 5 and 10) are provided at the outer ends of semi-circular clamps 86. The edges thereof are adapted to bite into the insulated cable. Inwardly projecting portions 92 of members 86 have semi-circular recesses 93 thereacross to provide a passageway and a fairly snug fit for the braided shield 77. This passageway is enlarged inwardly as indicated at 94 (Fig. 10). The faces 95 of the portions 92 bear against each other when the parts are assembled. A radially extending slot 96 is provided across one of these lugs for passage of a lead 97 formed of twisted strands of the braided metal shield 77.

The bare braided lead 97 (Fig. 10) is connected by soldering to the upper left-hand prong 58 (Figs. 5 and 9). One of the leads 80, which passes through the corresponding passageway 88' is similarly connected to the right upper prong 58 (Figs. 5 and 9). The other two leads 80 which extend through the lower passageway 88' are connected

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in a similar manner to the other two prongs 58 (Fig. 5). This electrically connects all of the leads to the plug.

As will be understood from the above description, one of the prongs 58 of the plug, the upper left one in Fig. 5, has the ground lead 97 secured thereto. But since the combined strain reliever and shield 85 (Fig. 2) must be at the same ground potential as the braided shield 77, and mere contact between them at the passageway provided by the recesses 93 is not to be relied upon, electrical connection is made between the strap 56 (Fig. 5) and the prong 58 to which the lead 97 is soldered, by means of a short wire 99. Also in order effectively to ground the shielding parts 11, 20 and 22 of the socket or receptacle, and thereby avoid relying upon the uncertain electrical connection between the strap 22 and the braided shield 77' of cable 81' when the latter is clamped to said strap by bending over the lugs 24 thereof, the female contact 30 into which the upper left hand male contact 58 (Fig. 5) enters, namely, the upper right hand contact 30 (Fig. 6), is electrically connected by a short lead 101 to the strap 20. All of the said shielding portions of the plug and receptacle are thus maintained at the same ground potential as the braided shields 77 and 77' of the cables 81 and 81'.

Fig. 4 illustrates in broken lines the case where a cable 81', similar to cable 81, is attached to the receptacle or socket. The ground lead 97', formed by twisted strands of the braided shield 77' for the voice wire 78' of cable 81', is connected by soldering to the female contact 30 (Fig. 6) to which lead 101 is connected. The bared end of wire 78' is soldered to the central female contact 30, and bared ends of the control wires 80' are respectively soldered to the other three female contacts 30 which are adapted to receive the respective prongs 58 of the plug to which the bared ends of the corresponding leads 80 of cable 81 are respectively soldered. When the soldered connection between the voice wire 78' and the central contact 30 has been made, a piece of insulating material is placed over said connection and the wings 23 of strap 22 are then bent down over the lead 78' so as to effectively shield the latter.

It is to be noted that the short leg 33' of the spring 33 in each of the female contacts 30 not only serves to anchor said spring but also coacts with the outer end portions of the bottom and side walls and lugs 35' of the contact, to form a confining pocket for the solder used in securing one of the leads to the contact; and constitutes a limit stop for the end of said lead.

It will be obvious that instead of fixing the socket or receptacle of my improved connector to a wall or other support as shown at 27, 28 and 29 (Fig. 3) and pushing the plug 40 thereinto, the plug may be fixed to a support and the socket pushed thereon, or the plug and socket may be respectively attached to free ends of cable sections and then connected together. When the plug 40 is the fixed part of the connector and the socket or receptacle is connected to the free end of a cable section, the cap 49 and combined shield and strain relief 85 of the plug are respectively replaced by the support or cylinder 25 and strap 22 of the receptacle (or by like parts), and the said support and strap of the receptacle are respectively replaced by the cap 49 and the shield and strain relief 85 of the plug (or by like parts). This can readily be done as the construction and dimensions of the plug and recep-

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tacle are such that the parts 25 and 49 and also the parts 22 and 85 are interchangeable. In this connection it may be noted that the cylinder 25 is of such internal diameter as to fit telescopically over the disk 45 of the plug, and that the larger end portion of cap 49 is of such internal diameter as to fit telescopically over the disk 7 and the reduced portion 2 of cylinder 1 of the receptacle; and also that the slotted flanges 88 of the shield and strain relief 85, are adapted to be applied to the strap 20 (a duplicate of strap 56) of the receptacle with the edge portions of said strap seated in the slots 90 of said flanges. When the plug and receptacle are to be respectively connected to the free ends of two cable sections, no change is made in the plug, but the support 25 and strap 22 of the receptacle are respectively replaced by substantial duplicates of the cap 49 and combined shield and strain relief 85 of the plug.

I claim:

1. In an electrical connecting device for a multi-wire cable having a single wire thereof provided with metallic shielding: the combination of a socket-type connector comprising contact members for said shielding and cable wires respectively, an insulating housing carrying said contact members and exposing the same at an end of the housing, a first shield member for a single one of said contact members and electrically connected to another of said contact members, said housing having insulating means positioned about said single contact member and extending beyond the end thereof, said insulating means being arranged to provide a locating opening in said housing at said single contact member; and a plug-type connector adapted for coupling to said socket-type connector and comprising an insulating body, connector pins carried by said body and projecting from an end thereof for connection with said contact members respectively, a second shield member for the connector pin corresponding to said single contact member and projecting from said insulating body, said second shield member being engageable with said locating opening in only one angular relation of said connectors to each other and being electrically connected to the connector pin corresponding to said other contact member to cause said shield members to be positively electrically connected together when said connectors are in coupled relation to each other.

2. In an electrical connecting device for a multi-wire cable having a single wire thereof provided with metallic shielding: the combination of a socket-type connector comprising contact members for said shielding and cable wires respectively, an insulating housing carrying said contact members and having openings in an end face thereof to expose the ends of said contact members, said housing having a recess extending from said end face and surrounding that one of said contact members corresponding to the shielded wire of said cable, and a first shield member in said recess around said one contact member, said first shield member being electrically connected to another of said contact members; and a plug-type connector adapted to be joined to said socket-type connector in one relation only, said plug-type connector comprising an insulating body, connector pins carried by said body and projecting from an end face thereof for connection with said contact members respectively, a second shield member surrounding the connector pin corresponding to said one contact

member and projecting from said insulating body to engage said recess as said connectors are joined together, said second shield member being electrically connected to the connector pin corresponding to said other contact member to cause said first and second shield members to be positively electrically connected together by said other contact member and corresponding connector pin when said connectors are joined together.

3. The combination set forth in claim 2, wherein said second shield member projects beyond said connector pins and is adapted to engage said recess in only one relation of said connectors to each other.

4. In an electrical connecting device for a multiwire cable having a single central wire thereof provided with metallic shielding: the combination of a socket-type connector comprising contact members for said shielding and cable wires respectively, an insulating housing carrying said contact members and exposing the same at an end of the housing, the one contact member corresponding to said shielded cable wire being at the axis of said housing, a first shield member surrounding only said one contact member and electrically connected to another of said contact members, said housing having insulating means positioned about said one contact member and extending beyond the end of said one member, said insulating means being arranged to provide a locating opening in said housing about said one member; a plug-type connector comprising an insulating body, connector pins carried by said body and projecting from an end thereof for connection with said contact members respectively, a second shield member surrounding the connector pin corresponding to

said one contact member and projecting from said insulating body, said second shield member being engageable with said locating opening in only one angular relation of said connectors to each other, said cable wires and shielding being electrically connected to said connector pins respectively with the central wire of said cable being connected to the connector pin corresponding to said one contact member and the shielding of said central wire being electrically connected to the connector pin corresponding to said other contact member so that said shield members are positively electrically connected to each other when said connectors are joined together; and a clamping device secured to the outer end portion of said second shield member, said clamping device having an outer portion for said cable as a whole and an inner restricted portion for only said centrally-located shielded wire.

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