Jan. 3, 1956 F. L. PIERCE 2,729,695

ELECTRICAL CONNECTORS

Filed April 27, 1951

Fig. 1.

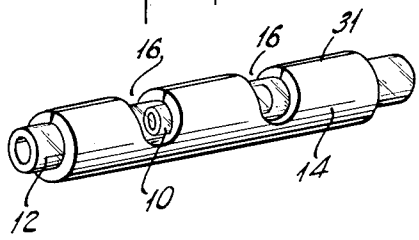



Fig. 2.

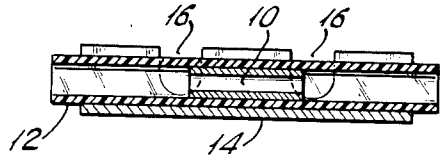



Fig. 3.

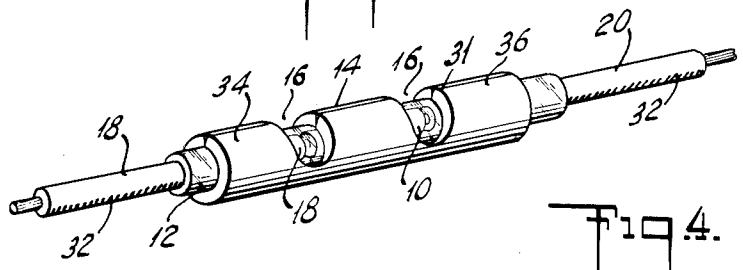



Fig. 4.

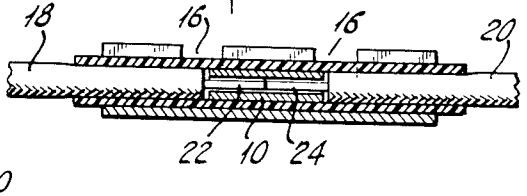



Fig. 5.

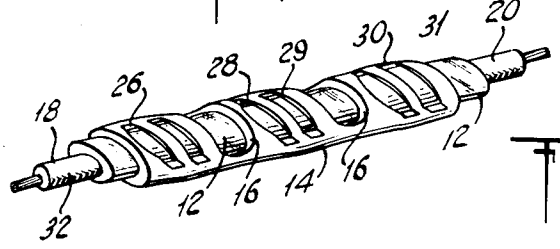



Fig. 6.

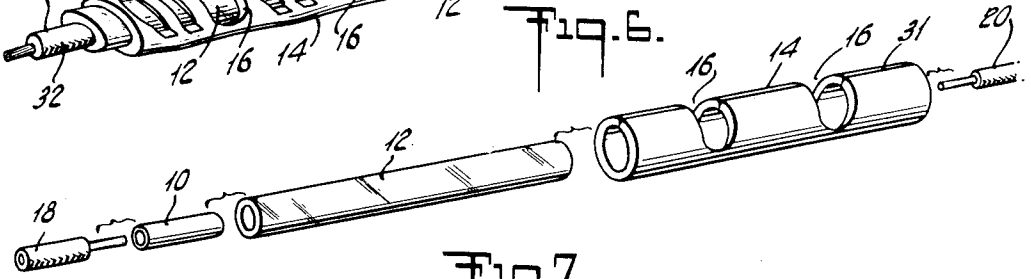
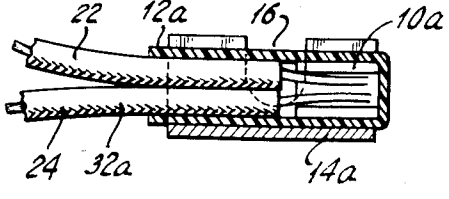



Fig. 7.




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2,729,695

# ELECTRICAL CONNECTORS

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5 Claims. (Cl. 174—84)

This invention relates to electrical connectors and more particularly to a corrosion-proof connector of the type adapted for crimping on a wire.

There are many instances where it is required that the ends of two wires be permanently bonded together. Since the connection is permanent, it should be of maximum life and minimum resistance to current flow with as constant a resistance value as possible. In order to maintain such high quality mechanical and electrical connection, it has heretofore been found that the connection must be protected from the entrance of moisture and other foreign substances.

Accordingly in my present invention, I provide a protective sheath for the connection sealed against entrance of water and air. In part this invention may be said to be an improvement upon that of William F. Broske, Patent No. 2,478,082.

It is a primary object of my invention to provide an electrical connector terminal adapted for sealing onto the wire and its insulation by pressure-forming.

Another object is to provide a connector adapted by simple pressure-forming onto a waterproof-sheathed wire, to give a secure low resistance electrical connection sealed against corrosive attack. Another object is to provide an airtight and waterproof sheathed electrical connection of the crimped type. A further object is to provide a connector adapted to produce a fully corrosion resistant connection. A still further object is to provide a connector adapted for visual inspection of the connection both before and after crimping. These and other and further objects will be in part obvious and in part pointed out as the specification progresses.

In this specification and accompanying drawings I have shown and described a preferred embodiment of my invention and suggested various modifications thereof; but it is to be understood that these are not intended to be exhaustive nor limiting of the invention, but on the contrary 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 and adapt it in various forms, each as may be best suited to the conditions of a particular use. As is apparent, this invention may be incorporated in connector constructions other than that of the straight through and end connectors shown.

In the drawings:

Figure 1 is a perspective view of a straight through connector ready for application to a wire;

Figure 2 is a longitudinal axial section on the seam of the connector shown in Figure 1;

Figure 3 is a perspective view of the connector of Figure 1 with the wires inserted ready for crimping;

Figure 4 is an axial sectional view of the assembly of Figure 3;

Figure 5 is an isometric view of the connection of Figures 3 and 4 after crimping;



Figure 6 is an exploded view of the connector of Figure 1 showing the component parts and their alignment with each other;

Figure 7 is a view in axial section of an end connector according to the present invention in place on two wires.

Referring to Figures 1 and 2, a tough but malleable, highly conductive ferrule **10** is formed for the desired wire size and inserted within a surrounding sleeve of tough, but malleable, and advantageously transparent, insulating material **12**. Ferrule **10** is ordinarily of a soft metal, advantageously annealed pure electrical copper or annealed cartridge brass. The insulating sleeve **12** is advantageously a polyvinylidene chloride commonly sold under the trade name of Saran, or molding nylon or polymers of the vinyl salts and/or esters. This may be as set forth and claimed in the patent of William S. Watts, No. 2,410,321, dated October 29, 1946; but due to the presence of the outer metal sleeve tightly fitted over the insulation, a somewhat softer or more plasticized material may be used.

The ferrule **10** advantageously is cemented to the insulating sleeve **12** which permits the use of a softer insulating material for sleeve **12** without danger or damage to the insulation on crimping. Alternatively with the tougher insulating materials, it may be merely a press fit. The ferrule may be inserted through the extruding nozzle of a tubing machine as the insulating sleeve is extruded or it can be inserted after the insulating sleeve is formed and cut to size.

The assembled inner ferrule and insulating sleeve is then inserted in an outer metal ferrule **14** which extends approximately the same distance on either side of the inner ferrule as does the insulating sleeve. A pair of slots or windows **16** in this outer ferrule is positioned so as to allow visual inspection of the ends of the inner ferrule **10** through the transparent insulating sleeve. This outer ferrule **14** is advantageously also cemented to sleeve **12**, but in any case the assembly is a tight enough fit so it will not come apart with normal handling making it not essential that it be cemented together. Both the inner and outer ferrules may be made of tubing or of rolled and brazed sheet metal.

Wires **18** and **20** are next inserted until the stripped ends **22** and **24** extend the proper distance e. g., about half-way, into the inner ferrule **10** (Figure 4). This can be determined by stripping the insulation from the wire to the proper distance and then pushing the insulation end up against the end of ferrule **10**, which is seen by visual inspection through the windows **16** described above. The whole assembly is then crimped at the four points **26, 28, 29** and **30** (Figure 5). The crimps **28** and **29** compress both outer and inner ferrules **10** and **14** and the intermediate plastic sleeve **12**, thus pressure-forming or cold forging these parts into a tight engagement giving a good electrical and mechanical connection with the stripped ends of the wires. These crimps **26, 28, 29** and **30** are shown as being of the type described and claimed in the application of S. N. Buchanan, Serial No. 559,604, filed October 20, 1944, now U. S. Patent 2,554,813.

It is to be understood, however, that these particular crimps are not esential to the obtaining of very good performance, and that other types of crimps may be used within the scope of my invention. In particular, the type described in the Carlson Patent No. 2,359,083, dated September 26, 1944, may be used at **26** and **30**; if the seam **31** is brazed, the twin longitudinal indent crimp of Freedom Patent No. 2,535,013, dated December 19, 1950, can be used with advantage at **28** and **29**; and the staggered transverse indent crimp of Macy application, Serial No. 580,841, filed March 8, 1945, now U. S. Patent 2,639,754, or the laterally confined crimp of the Holz-

apple application, Serial No. 73,946, filed February 1, 1949, can be used with advantage for any of the crimps 26, 28, 29 and 30. Crimps 26 and 30 force the insulating sleeve 12 into tight compressive engagement with the wire insulation 32. This crimping tends to extrude the sleeve 12 axially beyond the ferrule portions 34 and 36 in both directions and set up a substantial axial restoring force, particularly where the wire insulation is cotton or glass fiber insulation. Since any extrusion of the sleeve 12 is axial and since the tough plastics of the type specified exhibit susbtantial recovery or "creep back" after deformation, the provision of the outer metal sleeve tends to cause this axial restoring force to crowd the plastic under the crimped metal sheath 14 thereby producing a radial force which tends to seal the crimp tighter and take up any spring back of the metal from its tightly crimped form. To ensure this sealing, it is necessary that the insulating sleeve be thick enough to be extruded sufficiently to permit enough "creep back" to take up the spring back of the metal ferrule.

As the insulating sleeve is waterproof and gas proof, a water-tight, gas-tight connection is obtained when the insulating sleeve 12 is thus sealed to the wire insulation on each side of the electrical connection.

The quality of the connection can be checked after crimping by visual observation through the window 16. If an insufficient length of stripped wire is caught in the crimp for any reason, it is made evident by excessive length of stripped wire visible through the window. Defective connections thus are easily detected and rejected.

In Figure 7 the present invention is shown applied to an end connector with corresponding parts similarly numbered. With this end connector, since the wires 22 and 24 are side by side, the inner ferrule 10*a* may be omitted and the outer end of the sleeve 12*a* and ferrule 14*a* made smaller, so that the wires are compressed against each other when that end of the connector is crimped.

I claim:

1. An electrical connector comprising a highly conductive cylindrical malleable metal sleeve portion, a plurality of insulated wires with bare ends positioned in the bore thereof, a tough sleeve of insulating plastic material of the type having a tendency to return to its original shape upon deformation surrounding said metal sleeve and extending a substantial length over the insulation of said wires, an outer malleable metal sleeve, surrounding said plastic insulating sleeve over the insulation of said wires, said connector being crimped near the middle onto said bare ends of the wires and on each side of the inner metal sleeve within the extremities of the plastic sleeve onto the insulated wires to cause deformation of the plastic sleeve, whereby the connection is characterized by good electrical and mechanical connections sealed at each end.

2. An electrical connector of the type intended to be permanently fastened to a plurality of electrical conductors by pressure forming, comprising an inner malleable metal sleeve for forming a low resistance contact with said plurality of electrical conductors, each of which has one end positioned in the bore of said sleeve, a tough insulating plastic sleeve of the type having a tendency to return to its original shape upon deformation adapted to receive said conductive sleeve and the ends of said electrical conductors, an outer malleable metal sleeve adapted to be pressure-formed within the extremities of the plastic tube to cause longitudinal extrusion of said insulating plastic sleeve and to effect a compressive engagement of said outer metal sleeve and said conductors, said three sleeves tightly interfitting each other and said outer metal sleeve being of sufficient rigidity to maintain, upon crimping, a constant radial pressure on said conductors as said insulating tube tends to creep back and crowd under the crimp.

3. A moistureproof electrical connector of a type which is to be pressure formed onto a plurality of insulated conductors having uninsulated extremities to connect said conductors, said connector including a pair of malleable concentric cylindrical metal sleeves, an intermediate sleeve made of a plastic having a tendency to return to its original configuration when deformed, said plastic sleeve being longer than either of the other sleeves and so positioned that it overlaps the extremities of the other sleeves so that when the connector is crimped onto the conductors the plastic sleeve will be partially deformed and will form a moistureproof seal due to its tendency to return to its original shape.

4. The device of claim 3 including means for insuring proper positioning of the conductors in the device.

5. A moisturetight electrical connector of a type which is to be crimped onto a plurality of insulated conductors having uninsulated extremities including: a malleable metal cylindrical sleeve adapted to receive the insulation free portion of a conductor in each end, a plastic sleeve surrounding the metal sleeve and being of such length as to enclose the metal sleeve and a portion of the insulation of each of the conductors therein, a second malleable metal cylindrical sleeve surrounding the plastic sleeve and being shorter than said sleeve so that a section of the plastic sleeve protrudes from each end of the second metal sleeve, whereby crimping the connector onto the conductors causes the protruding sections of the plastic sleeve to be slightly extruded with the consequent formation of a moistureproof seal between the insulation and the plastic due to the tendency of the plastic to attempt to regain its original shape.

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