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INSULATED ELECTRIC CONNECTOR

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Fig. 1.

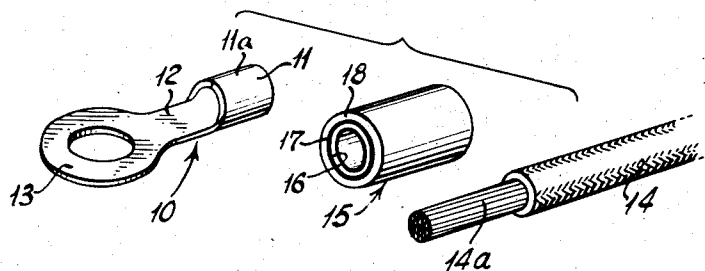


Fig. 2.

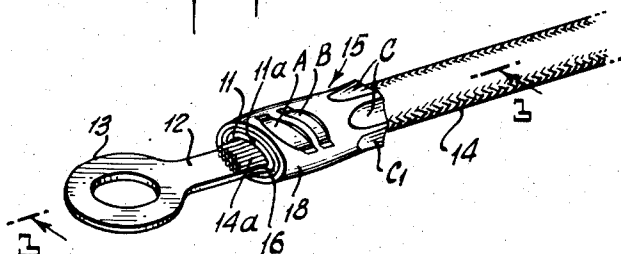
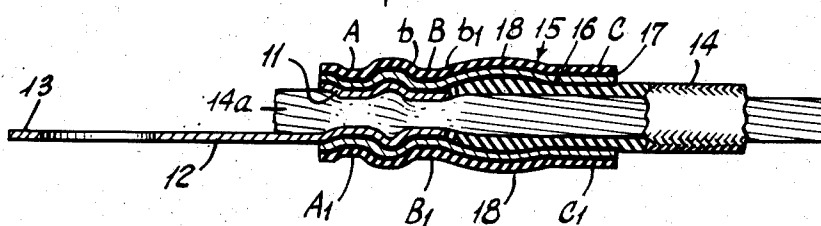


Fig. 3.



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INSULATED ELECTRIC CONNECTOR

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4 Claims. (Cl. 339-213)

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This invention relates to an insulated electric connector and the method of attaching the same to a conductor end.

In the manufacture of electric connectors of the type adapted to be connected to the end of a conductor, it is often advantageous or desirable to insulate a portion of the connector, e. g. the ferrule of the connector which is attached to the conductor end. The connector is often attached to the conductor end by a crimping operation which not only assures a tight connection, but also one characterized by low resistance of excellent stability by reason of intimate pressure contact between the metal of the connector and that of the conductor. As it is desirable to insulate the portion of the connector which is crimped onto the conductor ends, problems arise in effecting a satisfactory and efficient insulation, it being expensive to insulate the connector after its attachment to the conductor. It had been suggested before my invention to cover the ferrule of such a connector with a sleeve of insulating plastic prior to the crimping operation by which the connector and conductor are compressed together as disclosed in Patent No. 2,410,321 of W. S. Watts; but because of the extremely high and localized pressures under the crimping dies, it may happen that portions of the insulating material are pierced or objectionably reduced in thickness by the jaws of the crimping tool when the crimps are made.

It is accordingly among the objects of my invention to provide a laminated electrical connection which is sturdy, durable and capable of application to a wire or other electrical conductor by compressive forging therewith and of safe and efficient use after such application. Another object is to provide a connector of the crimped ferrule type wherein a portion which would be exposed to possible short circuits is protected therefrom by ample insulation. Another object is to provide a simple, practical and efficient method of attaching an insulated connector to a conductor end in a manner which assures a tight connection of low stable resistance without damage to the unstripped insulation on the connector. Other objects will be in part apparent and in part pointed out hereinafter.

According to my present invention, a tubular piece of the insulation is adhesively secured to the base of the laminated connector, e. g. a metal ferrule of an electric connector is coated with a cement having such properties as enable it to adhere strongly both to the metal of the ferrule and to the insulating material which is to be

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applied on the ferrule. I have found that by coating the metal ferrule with a suitable cement, and then slipping over and shrinking onto the cement coating a tube formed of a suitable plastic having insulating properties, the tube is so firmly cemented to the ferrule that when the connector is crimped onto the end of a conductor the resistance of the material of the tube to puncture or near puncture at the crimped areas is greatly enhanced.

The present application is an improvement on that of W. S. Watts described and claimed in his Patent No. 2,410,321.

Although in the accompanying drawings I have shown a preferred embodiment of my invention and having described the same and various modifications thereof in this specification, it is to be understood that these are not intended to be either exhaustive or at the ultimate limits of the invention, but, on the contrary, are chosen for the purposes of illustrating the invention in order that others skilled in the art may so fully understand the invention, its principles and the application thereof, that they may embody it and adapt it in numerous forms, each as may be best suited to the requirements of a particular use.

In the drawing, wherein there is shown one form of an insulated electric connector attached to a conductor in accordance with the method of my invention,

Figure 1 is a perspective view of the several elements of the connector, together with the conductor end to which the connector is to be attached;

Figure 2 is a perspective view of the connector attached to the conductor end; and

Figure 3 is an enlarged section taken along the line 3-3 of Figure 2.

Similar reference characters refer to similar parts throughout the views of the drawing.

In general, and with reference to Figure 1, there is shown a connector generally indicated at 10 which comprises a ferrule or base 11 from which extends an integral tongue 12. The outer end of tongue 12 carries a ring 13 which is adapted to be secured to a conventional binding post. As better shown in Figure 2, the stripped end 14a of a conductor 14 is disposed within ferrule 11 wherein it is securely held by a crimping operation which forges the ferrule tightly onto the conductor end. The outer surface of the ferrule is covered with an insulating sleeve, generally indicated at 15, this sleeve also being subjected to the crimping operation so that it tightly grips the ferrule.

More specifically, the metallic portions of connector 10, i. e. the integral ferrule 11, tongue 12 and ring 13 may be stamped from a flat sheet of conductive metal such as copper and the ferrule formed by bending up the sides of one end until the edges thereof abut to form a seam 11a. When the ferrule is so formed, I have found it advantageous to include within insulating sleeve 15, a metal tube 16 which may be formed of any malleable metal and which acts in a reinforcing capacity with respect to both the ferrule 11 and the insulating sleeve 18. Thus when the crimping operation takes place, tube 16 prevents undue parting of the ferrule sides at seam 11a and at the same time supports the sleeve 18 against transverse stretching forces. However, tube 16 may be dispensed with and the insulation applied directly to the ferrule, as will be described.

The metal to which the insulating plastic is to be applied, in this case the tube 16, is according to this invention adhesively secured to the insulating sleeve. As illustrated, this is done by first giving tube 16 a coating 17 of any of the cements known to be strongly adherent to metal and to the particular insulating plastic used, for example, a known composition of vinyl chloride-vinyl acetate copolymer, with a thermosetting phenol-formaldehyde resin, and a glypatal resin in a suitable solvent and usually with suitable plasticizer or softener. This coating will conveniently be by dipping which has advantage as indicated below.

After the tube 16 is thus coated, an outer insulating tube 18 is applied. The tube 18 may comprise any plastic having toughness to withstand the necessary crimping pressure without excessive cold flow. An extrusion of vinyl chloride-vinyl acetate copolymer plus a plasticizer such as tricresyl phosphate, for example, may be slipped over tube 16 after being sufficiently expanded either by any suitable mechanical stretching, or by immersion in an organic solvent. The solvent may include sufficient plasticizer to prevent excessive leaching or even to increase the proportion of plasticizer in the plastic; and it is an advantage of this process that it permits modification of the plastic to give properties most suitable for the crimping operation, even through such properties may be inconsistent with the extrusion process by which the tube is made. This leaching with a solvent as well as a baking hereafter mentioned are the invention of Frank J. Sowa described and claimed in a copending application Serial No. 560,785, now abandoned, filed October 28, 1944.

If the tube 18 is mechanically expanded, it is subsequently shrunk on inner tube 16 by normal recovery with or without application of heat to hasten such recovery. If the tube has been swelled in a solvent, it shrinks onto the inner tube as soon as the solvent evaporates. In either case the inner and outer tubes are tightly bonded by the coating 17 of cement which adheres to both. With the assembly as shown, the terminal is advantageously subjected to a heat treatment by which the cement coating 17 is more securely bonded between the tube 16 and the insulation 18. Thus the assembly may be baked or cured at a temperature of 250° F.-300° F. for five to seven hours. I have also obtained satisfactory results by baking at a somewhat higher temperature for a somewhat shorter period of time. I believe that by so treating the assembly the plasticizer is substantially removed from the plastic sleeve, thus

toughening it against flow or puncture during the crimping operation.

Of course, where inner tube 16 is not used, the coating 17 of cement is applied directly to ferrule 11, and the outer tube 18 is secured thereon in the manner described.

As shown, the sleeves 16 and 18 are longer than the ferrule 11 so that, after insulating sleeve 15, either with or without inner tube 16, has been slipped onto ferrule 11 and the end 14a of conductor 14 is threaded into the ferrule a substantial portion of the insulated part of the conductor lies within the ferrule, as shown in Figure 3. The filled ferrule is then placed between juxtaposed crimping dies which are closed with high pressure against opposite sides of sleeve 15. As the dies engage the insulation 18, crimps A, B and C are formed on one side, complementary crimps A₁, B₁ and C₁ being formed on the opposite side. As shown in Figures 2 and 3, the plastic, the metal sleeve 16, the ferrule 11 and the wire 14a are all forged together under the die so that all hold the impress of the die, but the insulating sleeve 18 is not punctured.

However, because of the tight bond between the insulation 18 and tube 16, provided by cement 17, and because of the use of a plastic having a tough leathery nature at ordinary temperatures the insulating plastic 18 is not excessively extruded out from under the crimping dies nor is it sheared at the edges thereof, but rather completely covers the surface of the crimp so as to leave no portion thereof exposed. If any shearing of the insulating plastic should occur, it would be due to use of too sharp corners on the die or a plastic which is too soft so that it is easily extruded; these conditions can be corrected. Even then a film of insulation ordinarily remains and if the die should cut through to the metal, it would only be at the edges of the die, e. g. at points b and b₁ of crimp B, where exposure of the metal would be relatively harmless in low voltage circuits. The bottom of the crimp would, of course, be completely insulated because the insulating plastic in that area would be tightly bonded to the metal tube or ferrule, as the case might be, and thus securely held against extrusion by the pressure of the crimping die.

As noted above, metal tube 16 preferably forms a part of sleeve 15 when ferrule 11 is seamed, as at 11a. It may now be seen that the combination of the plastic sleeve 15 and the tube 16, is well able to resist and prevent spreading apart of the edges in ferrule 11 at seam 11a. It is possible, however, to select an insulating sleeve sufficiently tough to serve this purpose without use of the metal tube 16.

Thus I have provided an article of manufacture and a fabricating method therefor which attains the several objects hereinabove set forth in a thoroughly practical and efficient manner.

I claim:

1. An insulated electrical connector of the type which is to be applied to a wire by severe deformation and plastic flow of the wire and of the connector including its insulation which comprises a ferrule of soft highly conductive metal, a tube of tough and stiffly flexible insulating plastic fitted over the outer surface of said ferrule and an intermediate cementing layer bonding the outer surface of said ferrule to the inner surface of said tube.

2. An insulated electrical connector as defined in claim 1 wherein the tube is composed of a tough vinyl chloride-vinyl acetate copolymer plasticized

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to an extent sufficient to accommodate the deformation without fracture.

3. An insulated electrical connector as defined in claim 1 wherein the ferrule is composed of soft pure electrical copper.

4. An insulated electrical connector as defined in claim 1 wherein the ferrule is composed of an inner metal tube adapted to fit over the wire and an outer metal tube fitting over said inner tube.

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