

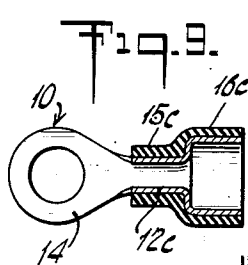
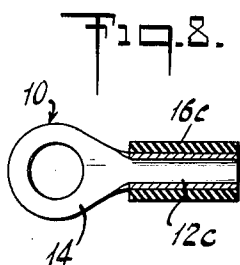
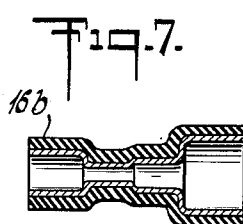
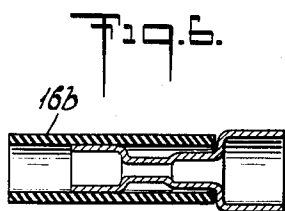
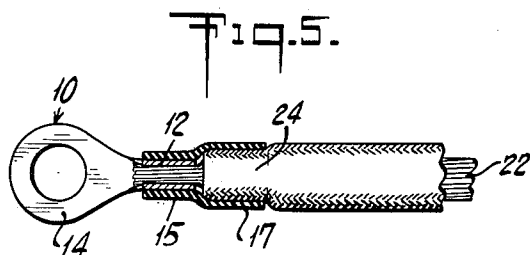
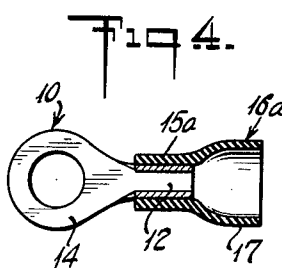
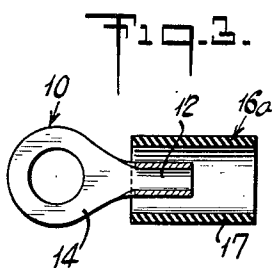
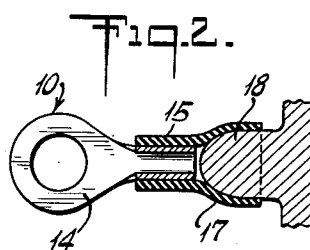
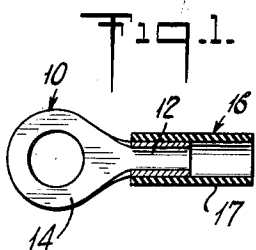
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ELECTRICAL CONNECTOR

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2,671,889

ELECTRICAL CONNECTOR

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2 Claims. (Cl. 339-213)

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This invention relates to insulating terminals of the type broadly described and claimed in an application of William S. Watts, Serial No. 782,469, filed October 28, 1947, now Re. 23,688, and particularly to connectors and connections and methods of making the same wherein the insulating sleeve on the exterior of the connector is expanded to receive an insulation of larger diameter than the exterior diameter of a metal ferrule on which the insulating sleeve is mounted. As heretofore made, these insulated connectors have proven highly satisfactory where the insulation was no larger than the exterior of the metal ferrule so that it could be inserted into the insulating sleeve on the connector, e. g. as shown in said patent. It has also been the practice to stretch these sleeves to a moderate extent in order to receive somewhat larger insulation. However, because of the requirements of the insulating sleeve and particularly the necessity of having a very tough plastic resistant to cold plastic flow so that it can transmit without failure sufficient pressure to crimp the metal ferrule securely onto a wire, there has been a limit to the amount of stretching or expansion which can be effected without breakage of the insulating sleeves. Thus, it had been found that this could be made only in limited sizes with lightly or moderately insulated wire and more expensive types of connectors have been required for heavily insulated wire.

We have now found that it is possible to introduce any required amount of expansion and stretch into the extended portion of the insulation without loosening the insulation on the metal ferrule of the connector by heating this extended portion of the ferrule substantially to a temperature at which it is softened sufficiently to be stretched without danger of cracking. At this temperature, however, the stretched condition is not retained but the plastic returns rapidly to a smaller diameter and therefore, upon initial trial, this method appears to have no promise. According to the present invention it has been found that if the sleeve is cooled the rate of return is gradually decreased and, if cooled to atmospheric temperatures, the expanded form is, for practical purposes, stable, although it retains its elastic memory and the sleeve will shrink again upon heating to a temperature at which softening begins. This condition of elastic memory may be desirable in many cases since it makes possible the gripping of the insulation on a wire merely by application of heat, e. g. with radiant infra red lamps or by passing through a blast of hot gas or into a high frequency field. It also

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facilitates mechanical crimping or pressure forming of the expanded portion of the sleeve onto the insulated portion of the wire.

Where this stretching is undesirable for any reason, it has been found that according to the present invention the sleeve may be initially formed with a diameter sufficiently large to receive the insulation, and the portion over the metal ferrule of the connector may be cold molded by pressure so as to grip the ferrule while the extended end is left uncompressed and therefore capable of receiving the insulating portion of the wire.

In the accompanying drawings Fig. 1 is a longitudinal section through a terminal connector provided with an insulating sleeve of tough plastic material.

Fig. 2 is a similar axial section showing the extended portion of the sleeve expanded by means of an anvil or pin which is shown in its final position within the sleeve.

Fig. 3 is a similar axial section showing a connector and insulating sleeve in preliminary assembled relation.

Fig. 4 is a corresponding view of the same showing the sleeve of Fig. 3 compressed onto the ferrule.

Fig. 5 shows a complete connection made by use of either of the connectors of Fig. 2 or Fig. 4.

Fig. 6 shows another type of splicing connector with an insulating sleeve in process of being applied.

Fig. 7 is a view of the same after application is complete.

Fig. 8 is a similar cross-sectional view of another terminal connector with the insulating sleeve initially positioned thereon; and

Fig. 9 is a similar view of the same after expansion of the insulating supporting portion.

Referring first to Figures 1 and 2, the metal portion of the terminal 10, as there shown, may be made by any of the manufacturing methods as well understood in this art, e. g. from copper tubing by flattening and expanding one end, or from sheet metal by stamping and rolling the lateral portions into a cylindrical ferrule or by deep drawing methods. In any case, the ferrule forming portion 12 is made adjacent the tongue portion 14 and over this ferrule forming portion a plastic sleeve 16 is applied.

In a preferred example the sleeve as applied may be a standard vinylite tubing consisting for example of vinyl chloride vinyl acetate copolymer having about 3-5% acetate and plasticized to a flexible and stretchable condition. In this condition the tubing may be applied over the ferrule

much as a rubber hose would be applied over a nipple with a slight constrictive fit so that it can readily be slid in place for subsequent operation. The tubing is then cut off at a distance beyond the end of the metal ferrule portion 12, e. g. as shown in Fig. 1.

The terminal is then baked in an oven with forced convection whereby the plasticizer is volatilized and removed from the sleeve leaving the latter in a very tough and stiff condition. While still hot, after removal from the oven, or after re-heating, e. g. by exposure to infra red radiation, these terminals are driven onto an expanding mandril or pin 18 as shown in Fig. 2, so that it enters into the extended portion 17, and thus the desired expansion of the interior bore of the tube is obtained.

The pin 18 is cooled sufficiently during and/or between the stretching operations so that while it is pushed into the sleeve it quickly extracts heat from the sleeve and after a few seconds, e. g. $\frac{1}{4}$ to $\frac{1}{2}$ minute, the connector may be discharged from the pin in a sufficiently cooled condition to hold its expanded condition. Advantageously, upon discharge from the pins the terminals are immersed in cold water so as to assure that they are well below the temperature at which elastic memory would result in objectionable return toward the smaller diameter.

Instead of pre-heating the extended portion 17 of the insulating sleeve and forming it on a cold pin, one may practice the invention by using a heated pin and driving it more slowly into the extended end of the plastic sleeve so that its heat may be transmitted into the plastic as it is expanded or the plastic may be spun to the larger diameter using a heated iron to work the plastic outward or exposing it and heating externally or internally in other manner while the spinning progresses.

In the case illustrated in Figures 3 and 4 the insulating sleeve 16a is of larger diameter than the ferrule forming portion 12 and instead of expanding portion 17 and the portion 15a over the ferrule, portion 12 is compressed from its normal diameter as shown in Fig. 3 to a smaller diameter as shown in Fig. 4 wherein it grips the ferrule portion 12.

Since the plastic can be more severely deformed under compression than under tension without failure, this compression can often be done as a cold molding operation. It can be done in confined compression dies or it can be done by spinning. In the latter case, however, heating the tool or the sleeve will facilitate the compression. This compression of the sleeve onto the ferrule portion may also be combined with a stretching of the extended portion and this in particular enables one to effect the necessary deformation of the sleeve without heat since the limited expansion which may be safely permitted as cold deformation may be given to the extended portion 17 while the portion 15 is compressing a limited safe amount to engage the ferrule portion 12.

In any case the terminal may be applied to an insulated wire as shown in Figure 5. The end of the wire is first bared by stripping part of the insulation from the wire and the bared end of the central connector 22 is inserted into the ferrule portion 12 while the end of the insulation 24 is inserted into the expanded portion 17 of the insulating sleeve. Both portions 17 and 15 are then compressed, advantageously in a fully confined compression die, so that the plastic sleeve

and the ferrule portion are tightly pressed into permanent engagement with the wire and the wire itself is compressed and to some extent extruded to give a solid and low resistance connection.

In Figures 6 and 7, I have shown a splice connector of the type used to connect wires of different sizes. In this case the metal portion of the connector is formed with ferrules of four different sizes, two to receive the insulation of the two different sized wires and two central ferrule portions for receiving the bared wires. In this case an insulating sleeve has been used of inside diameter approximating the outside diameter of the smaller of the insulation supporting sleeves and the insulating sleeve 16b is then driven over the larger sleeve either with or without heat, depending upon the extent of expansion required. Subsequently the intermediate portion of the sleeve 16b is pressed, as in the case described in connection with Figures 3 and 4, so as to substantially fit the exterior of the central wire-receiving ferrules as illustrated in Figure 7. It is not necessary that the interior metal connector member have ferrules for the insulation support portions of the connector and in such case, if only the central ferrules are used the sleeve 16b may be made to fit the larger of the two ferrules. In this case a cold expansion may be sufficient with the smaller insulation support and this may be effected at the same time that the compression to the smaller wire receiving ferrule is made. In this case, however, expansion with the larger insulation support end of the sleeve would probably be too great for cold expansion, and therefore the heating and chilling as described above in connection with Figures 1 and 2 should be resorted to. The smaller insulation supporting end may also be expanded at the same time in the same manner by such heating, but in that case such expansion is most advantageously effected before the compression onto the smaller ferrule.

It should be understood that the selection and use of suitable plastic sleeves for insulating connectors of this type and their treatment by baking or other methods to produce the desired stiffness and toughness, and the materials and form of the connector and particularly of the ferrule forming portion whether completely cylindrical or partially cylindrical or U-shaped, etc., are all matters previously invented and disclosed to the art, and may be varied as desired without departing from the scope of the present invention.

What is claimed is:

1. An electrical connector of the type adapted to be crimped onto a bared portion of an insulated wire which comprises a malleable metal ferrule adapted to have said bared wire portion inserted therein; and a tough malleable extruded plastic insulating sleeve tightly fitted around the outside of said ferrule; said plastic sleeve also extending for a substantial distance beyond an end of said ferrule; said sleeve being composed of a stiffly flexible plastic which is a copolymer of vinyl chloride and vinyl acetate and as originally extruded, being of uniform bore throughout, said extended portion of said sleeve being expanded after extrusion to an internal bore substantially greater than the bore of said sleeve portion fitted over the ferrule whereby to snugly encompass the insulation of said wire adjacent to the bared wire portion; said expanded portion of said sleeve having been formed by

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stretching an end part of said sleeve while it is maintained at an elevated temperature over a forming pin, thereafter cooling said end part while still stretched over the pin and finally withdrawing the pin, to thereby produce an expanded end having an elastic memory of its original extruded bore.

2. An electrical connector of the type adapted to be crimped onto a bared portion of an insulated wire which comprises a malleable metal ferrule adapted to have inserted therein said bared wire portion; a tough malleable extruded plastic insulating sleeve tightly embracing the outside of said ferrule; said plastic sleeve being composed of a stiffly flexible copolymer of vinyl chloride and vinyl acetate and as originally extruded, being of uniform bore throughout, said sleeve extending for a substantial distance beyond an end of said ferrule; said extended portion of said sleeve being of a substantially larger internal bore than the bore of said sleeve portion embracing the ferrule in order to have inserted

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therein the insulation of the wire adjacent to said bared wire portion; said extended portion of said sleeve having been expanded after extrusion to its larger bore by stretching said extended portion while it is maintained at an elevated temperature over a forming pin, then cooling said extended portion while still stretched over the pin and finally withdrawing the pin, to thereby produce an expanded sleeve portion which has an elastic memory of its smaller original extruded bore and will tend to shrink more tightly about said wire insulation.

JOHN R. VICKERY.

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