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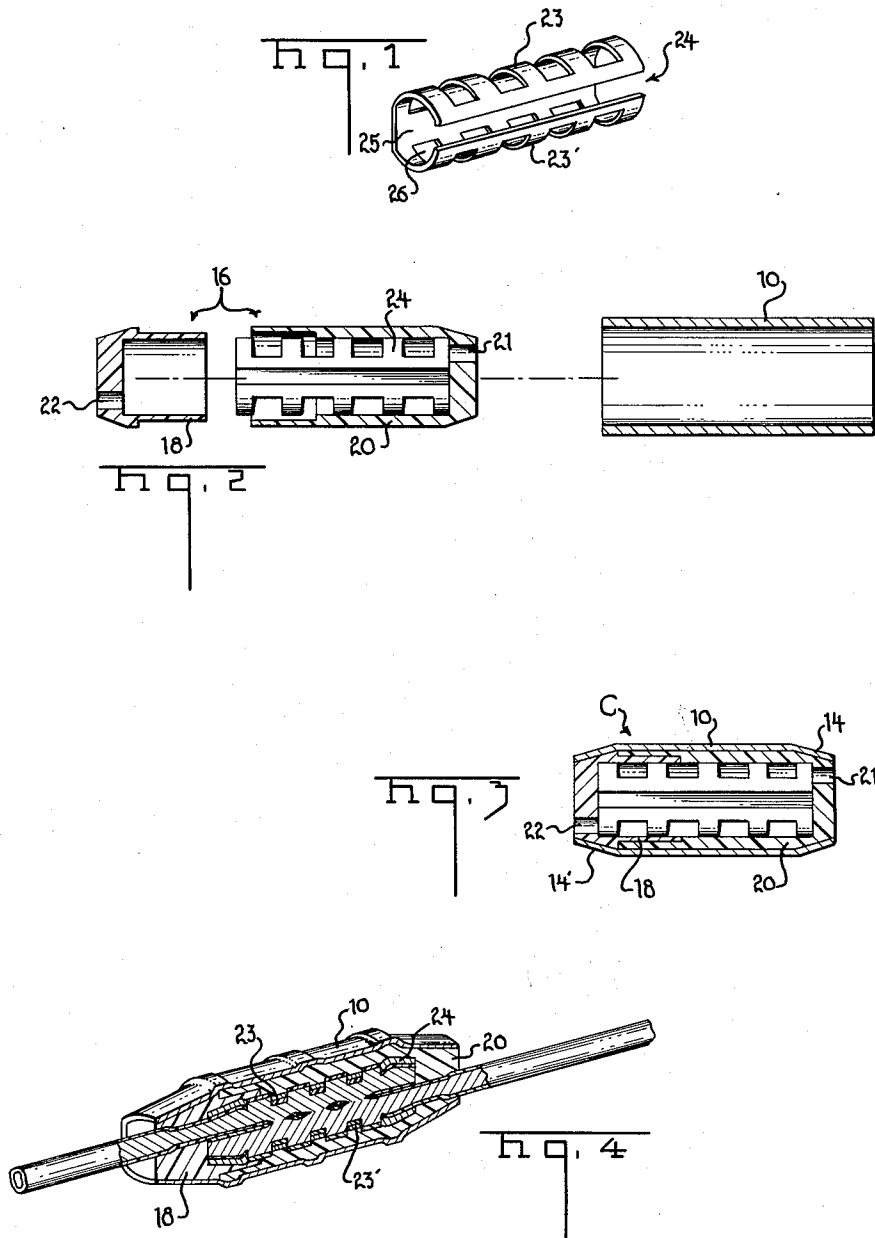
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METHOD OF SPLICING INSULATED CONDUCTORS

Filed May 29, 1959

2 Sheets-Sheet 1



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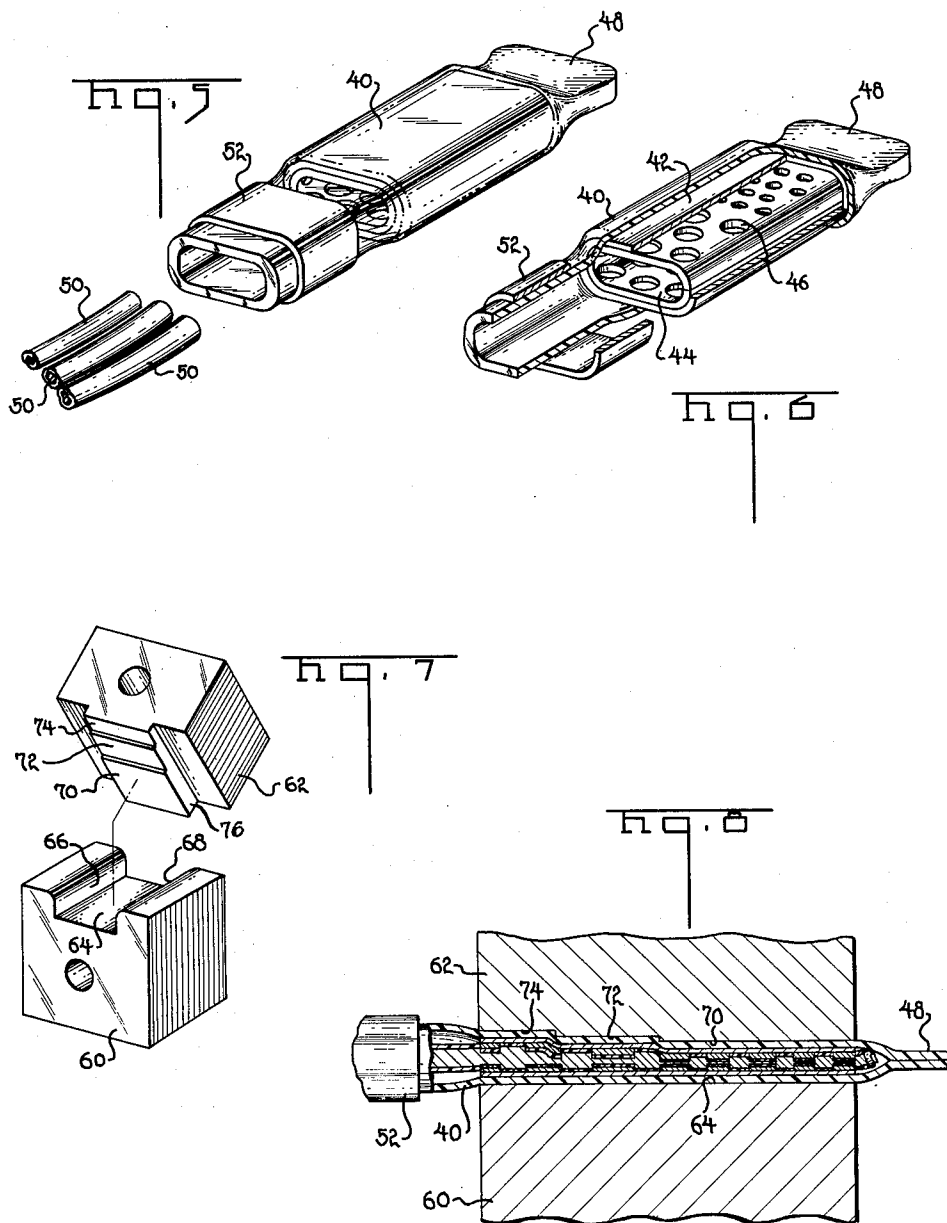
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METHOD OF SPLICING INSULATED CONDUCTORS

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METHOD OF SPLICING INSULATED CONDUCTORS

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3 Claims. (Cl. 29—155.55)

This application constitutes a continuation-in-part of my prior applications, Serial No. 606,733, filed August 28, 1956, now abandoned, and Serial No. 650,692, filed April 4, 1957, now abandoned.

In my prior applications, I have disclosed an electrical connector that may be crimped onto an insulated wire without the necessity of first stripping the insulation. This is accomplished by providing slots in a metallic member which is in the shape of a ferrule and then crimping the member onto the wire, thus causing the insulation to extrude into the slots.

The instant invention contemplates an improvement over the above-mentioned type of connector. The subject matter of this application further includes a pair of opposed plates which may be joined on one side to form a longitudinal opening running along the seam of the conductor gripping member. This assembly may be arcuate or C-shaped in cross section rather than a closed ferrule. The present application contemplates reducing the metal member from its C-shape to a substantially O-shape when it is finally crimped. This prevents buckling of the ferrule and reduces the crimping pressure required.

Furthermore, applicant has provided rectangular slots in the ferrule to increase the shearing edges which strip the insulation.

Another object of this invention is to pre-form the connector so that the ends of the connector taper toward the axis of the connector. When the connector is crimped to a wire, deformation begins at the outer ends of the connector and continues inwardly. This seals the ends of the connector so that the final crimping pressure on the central portion of the connector causes a high degree of extrusion of the insulation on the wire. This extrusion is increased to a degree wherein a plurality of insulated wires may be crimped together in metal-to-metal contact without initially stripping the insulation from the wire.

Another object of this invention is to provide an electrical connector capable of joining a plurality of insulated conductors of varied sizes in an electrically conductive relationship.

It is also an object of this invention to provide a die set adapted to make a crimp of various degrees of compactness capable of joining a plurality of different sized conductors.

Other objects and attainments of the present invention will become apparent to those skilled in the art upon a reading of the following detailed description when taken in conjunction with the drawings in which there is shown and described an illustrative embodiment of the invention; it is to be understood, however, that this embodiment is not intended to be exhaustive nor limiting of the invention but is 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 it in various forms, each as may be best suited to the conditions of a particular use.

In the drawings:

FIGURE 1 illustrates a metal ferrule-forming member, embodying principles of the present invention;

FIGURE 2 is an exploded view of a connector, embodying principles of this invention;

FIGURE 3 shows the connector of FIGURES 2 and 3 in final assembly;

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FIGURE 4 illustrates the connector of FIGURES 1 through 5 as crimped onto a pair of wires;

FIGURE 5 is a perspective view of another modification of a connector constructed according to the inventive concept;

FIGURE 6 is a partially broken-away view of the connector of FIGURE 5;

FIGURE 7 is a perspective view of a pair of dies useful in crimping the connector illustrated in FIGURES 5 and 6;

FIGURE 8 is a sectional view of a crimped connection employing the connector of FIGURES 5 and 6 and the dies of FIGURE 7.

As shown in FIGURE 3, the connector, generally designated "C," constitutes an outer member 10, preferably metallic, which may be tapered as at 14, 14'.

In the illustrated embodiment, a deformable plastic insulating assembly 16 is disposed within the outer metal sleeve. The assembly actually comprises two telescoping parts which form a sleeve (see FIGURE 3). These telescoping parts, designated 18, 20, when assembled constitute a closed container or chamber with apertures 21, 22 in either end. An inner metal sleeve 24 is disposed within the plastic assembly 16.

The inner metal conductor gripping member 24 includes a pair of opposed plates 23, 23' connected by an integral strap 25. These plates are preferably made of copper or some other highly conductive metal and may be arcuate or C-shaped. Opposed surfaces of these plates are adapted to contain a plurality of conductors. Disposed in the opposed surfaces of these plates are rectangular slots 26.

The sleeve 24 may be stamped from flat stock or strip metal in progressive stages. After the stamping operation, the metal may be severed from the strip and formed into the conductor-embracing member, e.g. member 24.

In its final assembled form, the connector "C" constitutes the inner metallic member 24 surrounded by plastic insulation 16, which is, in turn, surrounded by an outer metal sleeve 10. When it is desired to splice a pair of electrical conductors, one conductor is inserted into one of the apertures 21, 22 and the other conductor is inserted into the opposite aperture. The connector and conductors are then pressure-forged into intimate electrical contact, whereby the insulation is removed from sections of the conductors to expose bare metal surfaces. The employment of rectangular slots presents a greater insulation shearing surface than other shapes.

A desirable method of making this connection is to deform the outer insulation gripping extremities of the connector before crimping the central conductor gripping portion. This provides a water-tight seal between the connector and the wire and also serves to increase the crimping thrust exerted on the conductors without increasing the required crimping pressure. By employing this method of operation, the increased thrust will serve more readily to strip the insulation from the conductors causing the insulation to be extruded through the rectangular slots 26. For this reason, the outer ends of the connector are originally bevelled as at 14, 14'. This pre-forms the connector so that it may be crimped onto the conductors with the outer ends of the connector securely deformed. As shown in the drawings, a sufficiently high degree of thrust is achieved actually to strip the insulation between the two conductors, as well as between the conductor and the connector. Thus, a wire-to-wire contact is achieved in addition to the wire-to-sleeve contact.

The use of a member noncontinuous in cross section, as at 24, enables a reduction of crimping pressure from approximately 6,000 pounds to a range of about 4,500 pounds without any loss in tensile strength or conductivity. In addition to this reduction in crimping pres-

sure, the insulation is stripped sufficiently to provide good electrical contact. This reduction in required crimping pressure is achieved by eliminating the "buckling" effect which occurs during the deformation of a closed ferrule since the ferrule must be collapsed. However, in the form shown in this application, the conductor gripping member is noncontinuous in cross section and is merely reduced.

The embodiment of the invention shown in FIGURES 5 and 6 includes an outer plastic sleeve 40 with an inner metal liner 42. Disposed within the liner 42 is an oval-shaped metal ferrule 44 with a plurality of apertures 46 of various sizes disposed therein. The plastic member may be sealed at one end 48, while the opposite end is opened to admit a plurality of conductors 50 of various sizes. An outer metal sleeve 52 surrounds the open end of the plastic sleeve 40.

The pair of dies as shown in FIGURE 7 are suitable for crimping a number of conductors of various sizes within the connector. The dies include a nesting die 60 and an indenting die 62. The nesting die comprises a flat, die-surface 64 with a pair of sides 66 and 68 disposed at right angles thereto. The indenting die has a flat working surface comprised of a plurality of step portions 70, 72 and 74. These step portions are disposed longitudinally along the working face of the die. The indenting dies are disposed to fit within the arms 66 and 68 of the nesting die, and a pair of shoulders 76 on the indenting die cooperate with the nesting die to limit relative die travel.

When it is desired to join the conductors 50, the ends of the conductors are disposed within the oval-shaped ferrule 44. The ends of the conductors are inserted within the full length of the ferrule. A pair of dies (FIGURE 7) are brought to bear upon the connector disposed within the arms 66, 68 of the nesting die 60 with the bottom surface of the connector adjacent to the working surface 64. The die 60 and die 62 are driven together so that the cooperation of the dies 60 and 62 crimp the connector therebetween. The working surface 70 of the indenting die 62 makes the most compact portion of the crimp, thus making the crimp tight enough properly to secure the smallest conductor therein and extrude the plastic on the smallest conductor into the apertures 46. The larger sized conductors may be over-crimped at this point, but since it is a terminal point, it does not affect the tensile strength of the connection. Similarly the intermediate working face 72 is designed to cooperate with the surface 70 to make a crimp of intermediate compactness. This causes the intermediate sized conductor 50 to be crimped therein and the plastic from the conductor to be extruded into the apertures in the ferrule. The largest sized conductor may be over-crimped and the smallest sized conductor may be under-crimped in this section but, since the connection of these conductors is made elsewhere, it is of no moment. The final stage 74 of the indenting die cooperates with the working surface 64 to crimp the largest connector therein. The design of the crimp accommodates the largest conductor so that the plastic insulation on the conductor, as well as some of the metal, is squeezed into the apertures 46. The intermediate and smallest conductors may not be properly crimped in this portion, but it is immaterial since they are each crimped in a succeeding portion. Over-crimping the conductors in areas not relied on for tensile increases the electrical conductivity of the connection.

It is noted that all of the conductors are squeezed between the upper and lower surfaces of the metal ferrule to extrude insulation and metals from the conductors into these apertures to effect a strong crimp having high ten-

sile strength and good electrical conductivity. Additionally, it permits a connection of insulated wires of various sizes without requiring prior removal of the insulation.

The outer sleeve 52 may then be deformed onto the conductors to secure them against vibrational failure.

Changes in construction will occur to those skilled in the art and various apparently different modifications and embodiments may be made without departing from the scope of the invention. The matter set forth in the foregoing description and accompanying drawings is offered by way of illustration only. The actual scope of the invention is intended to be defined in the following claims when viewed in their proper perspective against the prior art.

I claim:

1. The method of crimping a plurality of insulated conductors of various sizes within a connector including the steps of (1) inserting said insulated conductors into a ferrule-type connector having a plurality of apertures therein, and (2) deforming said ferrule-type connector onto said conductors so as to extrude insulation into the apertures, crimping said conductors in a plurality of zones with the zone of the tightest crimp closest to the end of the conductors to effectively crimp the smallest size conductor and said crimping zones becoming relatively less tight as they progress away from the end of the conductors to thereby effectively crimp the conductor at each crimping zone corresponding to the tightness thereof.

2. The method of crimping insulated conductors which includes the steps of (1) disposing said insulated conductors into a perforated metallic ferrule-like member, (2) crimping the opposed sides of said ferrule-like member to extrude the insulation of the conductors into the perforations, and making said crimp so that the one end of the crimped portion adjacent the ends of the conductors is under maximum compaction, and sections of the crimped portion disposed from said one end are less compacted whereby said conductors may be different sizes and the various degrees of compaction of the crimp will crimp the conductors therein and the conductor corresponding to the degree of compaction of the crimp will be effectively crimped thereat.

3. The method of crimping a plurality of different size insulated conductors together, including inserting said insulated conductors into a perforated ferrule, crimping said ferrule onto said conductors so as to extrude the insulation into the perforations, making said crimp of different heights ranging from a maximum height at one end calculated to properly crimp the largest size conductor and decreasing to a minimum height by increments at the other end of the crimp adjacent the ends of the conductors whereby each different crimp height is suitable for the size of the conductor corresponding thereto.

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