Aug. 22, 1961 H. O. WOOLLEY 2,997,411

CLOSED END CONNECTOR

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Fig. 1.

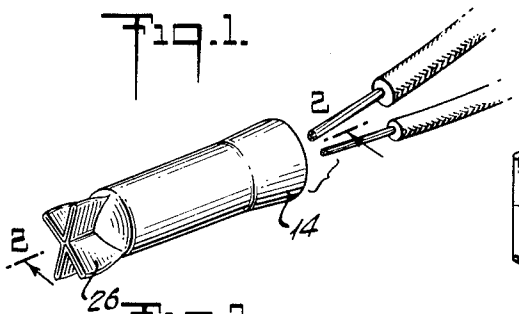


Fig. 2.

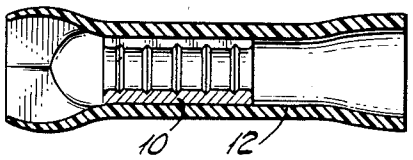


Fig. 3.

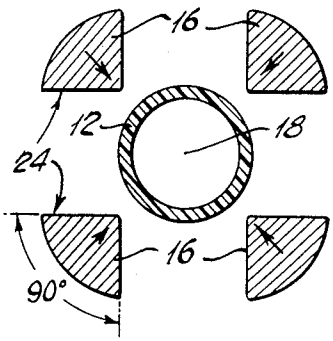


Fig. 4.

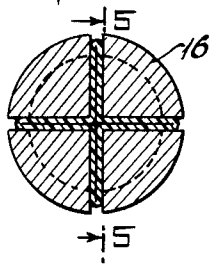


Fig. 5.

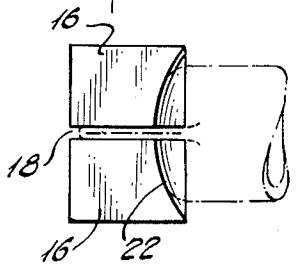


Fig. 6.

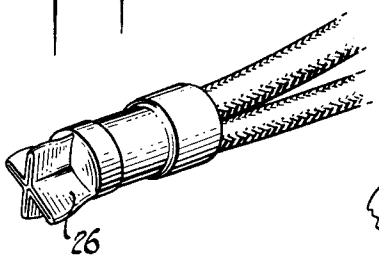
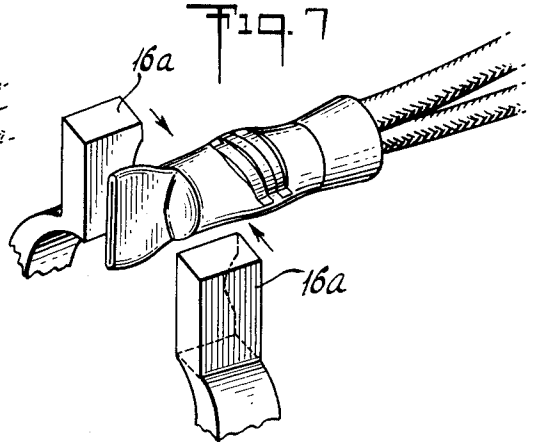


Fig. 7

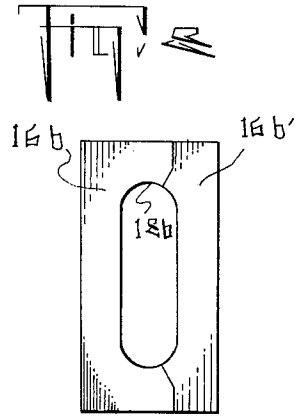


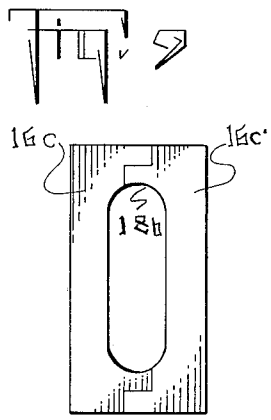
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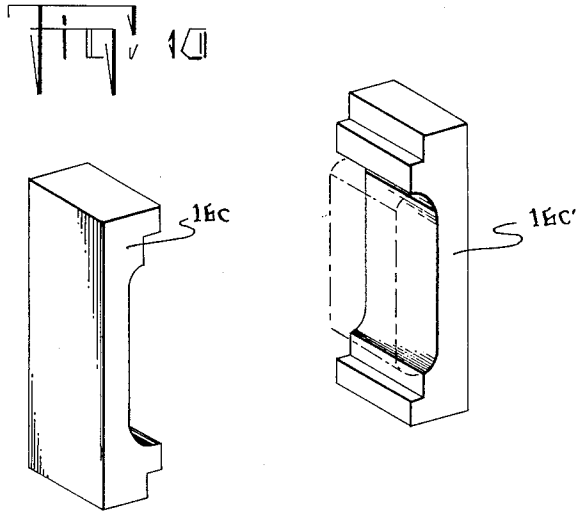
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CLOSED END CONNECTOR

Filed Oct. 2, 1956 2 Sheets-Sheet 2







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United States Patent Office 2,997,411 Patented Aug. 22, 1961

2,997,411

CLOSED END CONNECTOR

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Filed Oct. 2, 1956, Ser. No. 613,545
5 Claims. (Cl. 154—2.23)

This invention relates to insulated electrical connectors of the type adapted for pressure application on a wire to make an electrical connection therewith. More particularly this invention relates to insulated closed-end connectors and a method for closing the insulation about one end thereof and constitutes a continuation-in-part of application No. 224,370, filed May 3, 1951, now Patent No. 2,803,695.

In connectors of the type adapted to permanently join two or more wires or the like, it is sometimes desirable to insulate the connector before pressure-forming. In connectors where the wires to be connected enter the same end of the terminal, it is also desirable to seal the insulation over the opposite end.

Heretofore when making insulated closed-end connectors for pressure application, it has been the practice to seal the end of the tough malleable plastic sleeve after application onto the connector ferrule by heating and spinning the sleeve against a tool so as to work some of the material of the sleeve over the end.

It is a primary object of the present invention to make a closed-end insulated connector that can be more easily and quickly formed, is certainly and perfectly sealed, and the closed end is reinforced against rupture.

It is another object to make an end closure that will not expand the circumference of the insulating sleeve.

It is a still further object to provide an end closure which seals and reinforces the insulating sleeve.

Another object is to provide for a long leakage path through the closed end of the insulation in the event of any hidden defect in the closure; so that the insulation will be fully effective notwithstanding such defect.

A further object of this invention is to provide a method of closing the end of a connector by confining the plastic sleeve during the closing operation so that the plastic does not extrude beyond the outside diameter of the connector.

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 is a perspective view of the connector according to the present invention;

FIGURE 2 is a section on line 2—2 of FIGURE 1;

FIGURE 3 is an end view of the closing jaws and a sleeve to be closed;

FIGURE 4 is a view similar to FIGURE 3 showing the jaws in full compressing position;

FIGURE 5 is a side view of the die used in FIGURES 3 and 4 taken along the line 5—5 of FIGURE 4;

FIGURE 6 is a perspective view of a connector similar to FIGURE 1 after crimping; and

FIGURE 7 is a perspective view of a further embodiment of the present invention showing a fragmentary view of the closure dies.

FIGURES 8–10 are views of closure dies embodying and illustrating the confining feature.

Referring to FIGURES 1 and 2, a ferrule portion **10** is surrounded by an insulating sleeve **12** which extends substantially beyond both ends of the ferrule portion—one end **14** of which forms the mouth to receive, embrace and support the insulation of the wires to be crimped (FIGURE 6) and the other end to be closed over and seal the opposite end of the connector. If desired, the metal ferrule **10** may be located on the outside of the plastic instead of inside; or it may be omitted altogether if the plastic is sufficiently rigid and malleable.

The insulating sleeve **12** is a tough, malleable, thermoplastic capable at room temperature of transmitting pressure sufficient to cold flow the metal of the ferrule without destroying the insulating properties of the plastic, and also capable of being formed itself by such pressure. Among such plastics, for example, are the slightly plasticized vinyl chlorides often referred to as "rigid vinyl chloride plastics," which will ordinarily have a few percent of vinyl acetate as plasticizer-copolymer. Others are molding nylon and vinylidene chloride (sold commercially as Saran).

Referring to FIGURE 3, four die jaws **16** are seen to be radially disposed at substantially equal intervals about the axis **18** of the ferrule when positioned for closing of its end. Each jaw face has an included angle of about 90°, a lower beveled face **22**, as shown in FIGURE 5, and corners **17** rounded to a small radius.

In one form of the invention the assembled ferrule, after assembly on the sleeve, is gently heated until the sleeve is rendered capable of molding without substantial elastic memory and is then positioned so the heated end is substantially centered on the axis **18** and extends only a short distance into the space between the surfaces **24** of the end-closing dies (FIGURE 3). The jaws are then closed radially toward axis **18** driving adjacent portions of the sleeve circumference together until the opposing faces of the adjacent portions meet and cohere to seal completely the end of the connector (FIGURE 4). Since the plastic was heated and softened, it may be easily shaped to the form and thickness desired and adjacent portions will readily cohere. The dies are then withdrawn leaving four radially disposed fins **26**, as the remnants of the folds first formed, closing the end of the insulating sleeve with the material driven inward from the sleeve by the dies **16** and extruded from between the surfaces **24** as the dies are closed together.

Alternatively, the assembled ferrule and sleeve is centered between the die jaws which in their expanded or rest position are maintained at an elevated temperature, of about 400° F., for example by gas flames (not shown). The heated dies are forced inwardly against the cold insulating sleeve, which is softened by the heat of the dies, until adjacent portions of the circumference are folded and flowed together to close the end of the insulating sleeve. When the dies are again withdrawn, the four radial fins are left closing the sleeve.

The wires to be connected are inserted through the open end **14** into the ferrule **10** and the connector is crimped, forging the ferrule portion onto the wires in any of the several ways well known to the art, while the end of the plastic sleeve overlying the wire insulation may be crimped also to tightly embrace and support the wire and, if required, to seal the connection.

Thus a simple, positive and tightly sealed end closure for a connector can be easily formed.

Of course, the assembled ferrule and sleeve may be inserted into a multi-die assembly, (similar to the four die assembly described above) wherein the total sum of the included angles of the die jaws equal 360 degrees, resulting in a multi-fin end closure.

Thus, any desired number of fins may be formed, but it should be noted that the parts of the plastic sleeve which are drawn toward the center form a "roof" or dome which reinforced by the fins and the material extruded down into the dome therefrom. However, with only two indents of approximately 180°, the flattening of the sleeve tends to give an end closure which has a greater diameter than the sleeve itself. This may be corrected by using dies which surround the end while it is being flattened. This confines the extrusion to a direction parallel to the axis, as shown in FIGURES 8–10. An illustrative embodiment of particular dies employed in forming a confined closure as shown in FIGURE 8 and includes a female die **16***b* which confines the softened end of the connector in a die nest **18***b*, composed of a concave surface. An opposing male die **16***b'* is forced horizontally toward the female die to close the end of connector within the die faces, which confines the extrusion of the plastic. Also the male and female dies may be made in the form of mirror images as shown in FIGURES 9 and 10 which cooperate to close the end of the connector while confining the extrusion of the plastic. Each of these dies, **16***c*, **16***c'*, is similar to die **16***b* of FIGURE 8. However, they are one-half as deep, so that each die acts as a confining member during the sealing process.

While there are given above certain specific examples of this invention and its application in practical use and also certain modifications and alternatives, it should be understood that these are not intended to be exhaustive or to be limiting of the invention. On the contrary, these illustrations and the explanations herein are given in order to acquaint others skilled in the art with this invention and the principles thereof and a suitable manner of its application in practical use, so that others skilled in the art may be enabled to modify the invention and to adapt it and apply it in numerous forms, each as may be best suited to the requirement of a particular use.

I claim:

1. In the art of making electrical connectors having an insulating sleeve closed at one end, the steps of, heating at least one end of said plastic and indenting the plastic in successive segments of the circumference of said end of the sleeve, and sealing said end of said sleeve by pressing together adjacent areas of adjacent segments of said sleeve while maintaining the diameter of the sleeve constant until a substantial portion of the material thereof is extruded axially.

2. The method of making electrical connectors of the closed-end type which comprises forming a cylindrical, highly conductive ferrule portion, surrounding said ferrule with a tough malleable plastic sleeve, confining said sleeve against radial extrusion, closing one end of said sleeve by applying a plurality of heated die jaws about the circumference of said sleeve, and forcing them substantially together at approximately the center of said sleeve.

3. In the art of making electrical connectors of the closed-end type the method of closing one end of a cylindrical insulating sleeve which comprises radially disposing at substantially equal intervals about the perimeter of one end of said sleeve four jaws, heating said jaws, and forcing said jaws inwardly until adjacent portions of said perimeter are folded together and sealed.

4. In the art of making insulated electrical connectors including the steps of: (1) forming a length of deformable plastic tubing, (2) positioning a metal ferrule centrally within the tubing, (3) closing and sealing one end of the tubing while simultaneously confining the tubing against extrusion.

5. The method as set forth in claim 4 wherein the sealing is effected by heating the plastic to soften it and then deforming the perimeter inwardly by a plurality of radially operating jaws.

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