Sept. 18, 1956 T. R. BETTS 2,763,849

ELECTRICAL CONNECTOR

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Fig. 1.

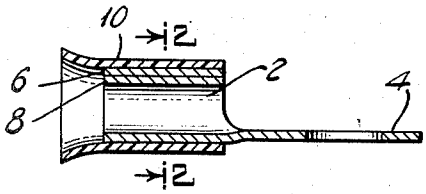


Fig. 2.

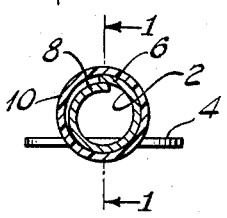


Fig. 3.

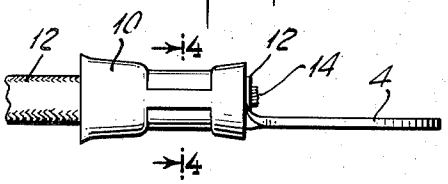


Fig. 4.

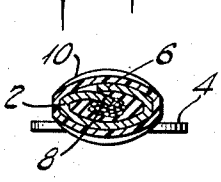


Fig. 7.

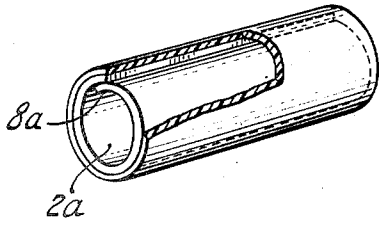


Fig. 6.

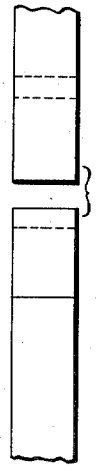


Fig. 5.

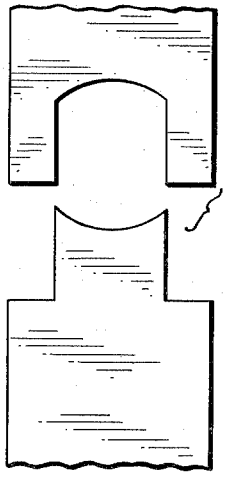
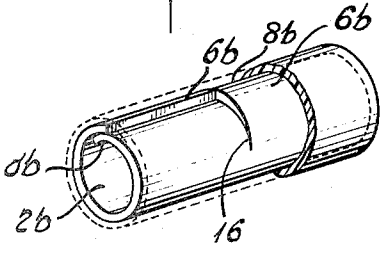


Fig. 8.



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Fig. 9.

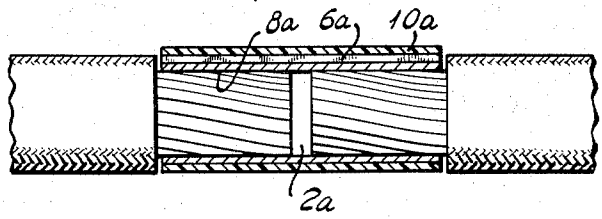


Fig. 10.

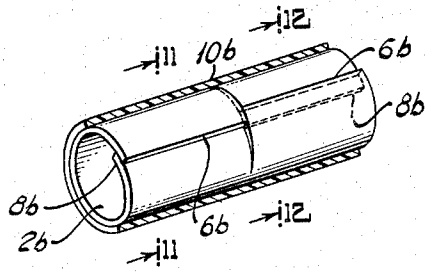


Fig. 11.

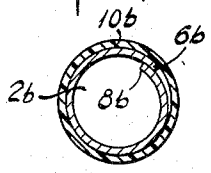
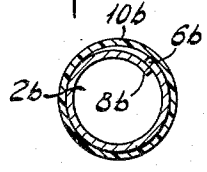


Fig. 12.



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ELECTRICAL CONNECTOR

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Application March 1, 1952, Serial No. 274,420

6 Claims. (Cl. 339—276)

This invention relates to electrical terminals or connectors of the insulation-piercing type. The invention further relates to terminals or connectors of the insulation-piercing type which are pre-insulated.

In the prior art connectors or terminals have been used which are manufactured with insulation over the tubular ferrule parts into which the bare wire is to be inserted before crimping, such, for example, as the terminal or connector shown in U. S. Letters Patent No. 2,410,321, granted October 29, 1946, to William S. Watts. These prior art insulated connectors have proved so advantageous that there has been a strongly felt need for insulated connectors of the insulation piercing type which will avoid the necessity of stripping the insulation from the wire at the point of connection before insertion of the wire into the ferrule for crimping, thus requiring extra time and work for this step.

An object of the present invention is to provide a pre-insulated connector or terminal of the insulation-piercing type into which an insulated conductor may be inserted without the necessity for stripping the insulation and with which a good conductive connection may be made by merely crimping the previously insulated ferrule, without breaking its insulation, onto the insulated conductor. More particularly the invention aims to provide an improved insulation-piercing connector which is particularly adapted to have insulation permanently secured on the ferrule before it is applied to the wire.

With the foregoing and other objects in view, the invention is herein shown as embodied in an electrical terminal or connector which is adapted to be crimped by a single operation into conductive and connective relation to an unstripped insulated conductor and which comprises a ferrule into which the unstripped conductor may be inserted, said ferrule being formed of a rolled-up strip of sheet metal having one of its approximately meeting lips bent to a radius of curvature sufficiently shorter than that of the other lip so that it will penetrate the insulation and contact the conductor when the ferrule is crimped thereon. It will be understood, however, that the invention is not restricted to the illustrative embodiment and that other types of insulation-piercing connectors or terminals may be provided with insulation and applied to insulated conductors in the manner hereinafter set forth.

In the drawings:

Figure 1 is a longitudinal section, on the line 1—1 of Fig. 2, through an insulation-piercing terminal or connector having a ferrule and a connector tongue and provided with insulation in accordance with the present invention;

Figure 2 is a section on the line 2—2 of Fig. 1 looking in the direction of the arrows;

Figure 3 is a side elevation showing a terminal or connector of the present invention crimped upon an insulated conductor;

Figure 4 is a section on the line 4—4 of Fig. 3;

Figure 5 is a front elevation, with parts broken away,

of crimping dies such as are required to effect the crimping operation shown in Figs. 3 and 4;

Figure 6 is a side elevation of the dies shown in Fig. 5;

Figure 7 is an isometric view showing another embodiment of the invention adapted for use for conductively connecting insulated conductors, the ends of which abut each other near the center of the connector, one end of the insulating sleeve being cut away to show the end of the connector;

Figure 8 shows the connector portion of still another embodiment of the invention with the insulating sleeve removed therefrom.

Figure 9 is an axial sectional view of the connector of Figure 7 showing conductors inserted into the opposite ends;

Figure 10 is a perspective view of the connector of Figure 8 showing the connector in a slightly different position;

Figure 11 is a cross sectional view taken along the line 11—11 of Figure 10; and

Figure 12 is a cross sectional view taken along the line 12—12 of Figure 10.

Referring to the drawings, the connector shown in Figs. 1 to 4 inclusive comprises a ferrule 2 and a connector tongue 4, the connector being formed of sheet metal of the character usually employed in making such connectors such, for example, as copper or brass. As shown, the tongue portion 4 is left substantially in its flat condition and the ferrule 2 is formed by rolling up the metal as shown in Fig. 2 so that the edges instead of meeting or abutting, form outer and inner lips 6 and 8 which preferably overlap slightly, as shown, although this is not necessary, it being only necessary that the inner lip 8 be curved on a shorter radius of curvature than the outer lip 6. The ferrule is covered as shown with an insulating sleeve 10 of a suitable tough, flexible insulating plastic, such, for example, as an only slightly plasticized copolymer of vinyl chloride and vinyl acetate or a linear super polymer, hexamethylene diamine-adipic acid condensation product, and the insulation preferably extends, as shown in Fig. 1, at least beyond the rear end of the ferrule 2 so that it overlaps the insulation 12 of the conductor 14, or, as shown in Fig. 3, it may overlap both ends of the ferrule 2.

The construction of the ferrule is such that, when crimping pressure is exerted on the outer lip 6 applied thereto through the insulating plastic sleeve 10 by means of crimping dies such as shown in Figs. 5 and 6 it bends the inner lip 8 inward; and, as the connector is further compressed between the crimping dies, the lip 8 is driven under lip 6 into the wire. The inner lip 8 of the ferrule, by reason of its shorter radius of curvature, will curve in sufficiently so that it will pierce the insulation 12 of the conductor, as shown in Fig. 4, and be forced into conductive contact with the conductor 14. If, as shown in the drawings, the conductor 14 is a stranded wire, the lip 8 will ordinarily be forced against, and thus make contact with, a plurality of the strands thereof.

It will be understood that the plastic 10 utilized will be one of the tough but malleable, so-called "rigid" type plastics, now on the market, that will withstand the crimping pressures, will conform itself to the altered shape of the ferrule and will be subject only to such limited plastic flow as will avoid puncture and yet permit it to conform to the shape and size of the die cavity when the dies are closed down onto the ferrule and to retain substantially such size and shape. A plastic such as described in the Watts patent hereinabove identified has been found to be suitable for the purpose.

In Fig. 7, as above set forth, is shown a modified form of terminal or connector which is not provided with a

connector tongue, such as shown in Figs. 1 to 4, but is intended for use in making a butt end connection between two conductors. In the form of invention shown in Fig. 7 the insulated conductors between which a connection is to be made by means of the insulated connector shown in Fig. 7 are inserted into opposite ends of the ferrule-like connector shown in Fig. 7 until the ends contact each other. While they are thus held in contact with each other, the tongueless ferrule **2***a* is crimped into insulation-piercing connection with each of the conductors so that the lip **8***a* of the connector comes into conductive contact with the conductor wire of each of the abutting conductors. It will be understood that even though the abutting ends of the conductor wires are not maintained in good electrical contact, a good conductive connection will be established between the two conductor wires through the lip **8***a* of the ferrule **2***a*.

In Fig. 8 is shown still another modification of the invention in which the tongueless ferrule is designed for use with two insulated conductors introduced into the opposite ends thereof. The ferrule **2***b* shown in Fig. 8 is provided with a transverse slit **16** part way through its midsection; and the thus slit metal sheet is so rolled up as to provide the equivalent of two ferrules integral at their bottom portions but each so bent up that the inner more sharply curved lip **8***b* of each operates in a direction opposite to that in which the corresponding lip **8***b* of the other ferrule part operates. This allows each to be crimped independently of the other; and also by giving opposing circumferential forces, if the two sections of the integral two-part ferrule are simultaneously crimped upon the insulated wire improves the piercing action.

Although my invention is directed particularly to providing an insulated connector for use on insulated wire, the inner metal connector portion **2** embodying my invention can be used without its insulating sleeve.

I claim:

1. An electrical connector adapted to be crimped into conductive and connective relation to an unstripped insulated conductor, said connector comprising a substantially closed cylindrical ferrule into which the unstripped conductor may be inserted, said ferrule being formed of a rolled-up strip of sheet metal having its lips in approximately meeting overlapping relationship to form an inner and an outer lip, with the inner lip being bent to a radius of curvature sufficiently shorter than that of the outer lip so that it will slide therebelow and penetrate the insulation and contact the conductor when the ferrule is crimped on said insulated conductor.

2. An electrical connector according to claim 1 having fitted over its ferrule in its uncrimped condition an insulating sleeve of a plastic of such toughness, flexibility and capacity for plastic flow as to permit crimping the ferrule therethrough with resultant conformance of the sleeve to the changed size and shape of the crimped ferrule.

3. An electrical connector according to claim 1 in which

transverse slits are so located as to provide two pairs of lips and in which the inner and outer overlapping lips of different radii of one pair are oppositely arranged in respect to the inner and outer overlapping lips of different radii of the other pair.

4. An insulated electrical connector adapted to be crimped into conductive and connective relation to an unstripped insulated conductor without piercing or destroying the connector insulation which comprises in combination, a ferrule portion having a pair of edges formed over into near abutting relationship to form a substantially smooth, continuous surface configuration, one of said edges having a radius of curvature slightly smaller than the other, and an insulation sleeve of a tough flexible plastic closely fitted about said ferrule portion and through which crimping pressure may be exerted upon said ferrule portion.

5. An insulated electrical connector of the type adapted to be pressure formed about an insulated conductor to form electrical and mechanical connection therewith without destroying the insulating characteristics of the connector, comprising a ferrule forming portion curled up from sheet metal having at least one pair of opposed edge portions bent over into overlapping relationship at the ends thereof, the inner end portion thereof having a radius of curvature slightly less than the outer end portion to cause said inner end portion to penetrate into the insulation of a conductor inserted therein upon crimping and an insulating sleeve of tough flexible plastic fitted about said ferrule portion so as to transmit therethrough the crimping pressure necessary upon the forging of the ferrule about a conductor inserted therein.

6. An electrical connection between a ferrule portion and a conductor having an insulation layer thereon, said ferrule portion being telescoped about said insulated conductor and being pressure formed into conductive and connective relationship with the conductor within said insulation layer comprising an electrical conductor, an insulation layer around said conductor, a substantially closed cylindrical ferrule formed of rolled-up sheet metal having first and second opposed edges curved over into overlapping relationship, said first edge being bent to a shorter radius of curvature and piercing the insulation layer and being forced into conductive contact with the conductor, said second edge being bent to a longer radius of curvature to overlap said first edge and to embrace the pierced insulation adjacent the outer surface of said first edge.

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