June 15, 1954 R. C. SWENGEL 2,681,440

ELECTRICAL CONNECTOR

Filed Nov. 19, 1951

Fig. 1.

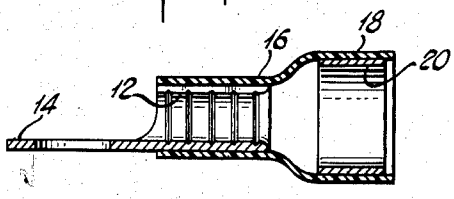


Fig. 2.

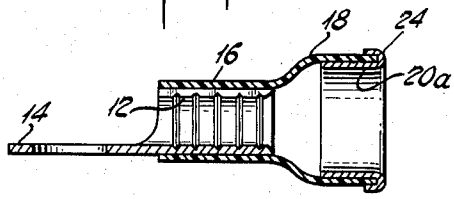


Fig. 3.

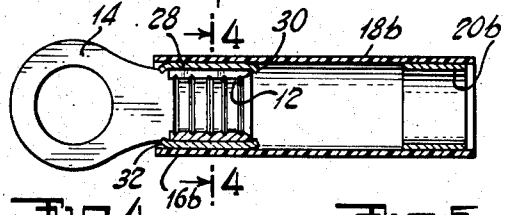


Fig. 3a.

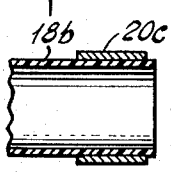


Fig. 3b.

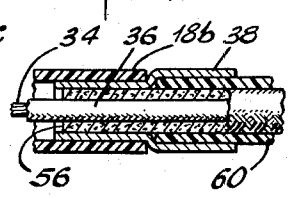


Fig. 4.



Fig. 5.

Fig. 6.

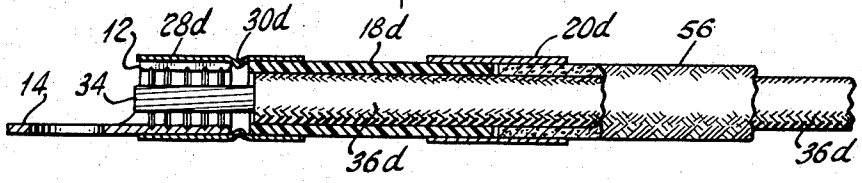


Fig. 7.

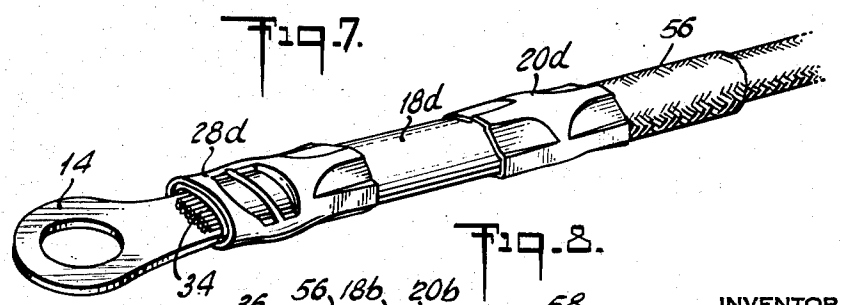
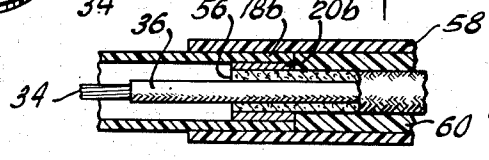


Fig. 8.



INVENTOR:
ROBERT C. SWENGEL.

BY
Curtis, Morris & Safford.
ATTORNEYS:

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ELECTRICAL CONNECTOR

Robert C. Swengel, York, Pa., assignor to Aircraft-Marine Products Inc., Harrisburg, Pa., a corporation of New Jersey

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11 Claims. (Cl. 339—223)

1

This invention relates to electrical connectors and particularly to improvements in such connectors whereby the conductive parts of the connectors are insulated, for the purpose among others of preventing flash-over between connectors. The invention further relates to insulated electrical connectors having particularly strong and secure engagement not only between the connector and electrical conductor but also between the insulating member or covering and the electrical conductor.

Modern industrial and military electrical equipment creates a demand for electrical connectors offering the utmost in dependability, particularly among other things that the terminals be insulated, that is that the connector be insulated for a distance back along the electrical conductor. The purpose of this insulation, among others is to prevent creepage current on the surface of the insulation and flashover between adjacent connectors, which might otherwise result from voltage surges, ionizing conditions in the atmosphere or dampness etc., or from accidental movement of the connectors too close to one another or to other conductor elements. Such leakage from electrical connectors could, of course, result in failure of equipment at a critical time and this is of course particularly significant in connection with military equipment, railroad signal equipment, aircraft, etc. In the past even insulated connections have in some instances been subject to such failure.

The primary object of the invention is to provide an electrical connector having improved insulation characteristics. Another object is to provide a connector having improved attachment of the insulating member or material to the electrical conductor to provide secure engagement therewith, and with shielding thereon when used. Another object is to provide an increased insulated distance from the conductive parts of the connector, increased creepage distance and greater resistance to flash-over from the connector.

Although in the accompanying drawings I have shown a preferred embodiment of my invention and have described the same and various modifications thereof in this specification, it is to be understood that these are not intended to be exhaustive but, on the contrary, are chosen for the purpose 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

2

numerous forms, each as may be best suited to the requirements of its particular use.

Further objects and numerous advantages of the invention will become apparent from the following detailed description and annexed drawing wherein:

Figure 1 is an electrical terminal having an enlarged insulating tube and a supporting metal band within the tube.

Figure 2 is similar to Figure 1 but with the end of the metal band spun back over the insulating sheath.

Figure 3 is a sectional view of a preferred form of the invention wherein there is a metal supporting band spaced from the sleeve around the ferrule.

Figure 3*a* is a fragmentary sectional view showing a modification of Figure 3.

Figure 3*b* is a fragmentary sectional view showing another modification of Figure 3.

Figure 4 is a sectional view taken along line 4—4 of Figure 3.

Figure 5 is a perspective view of the form of the invention of Figure 3 crimped onto the end of a wire.

Figure 6 is a modified form of the invention applied to a shielded wire in a way to isolate the shielding from the terminal.

Figure 7 is a perspective view of the arrangement of Figure 6 crimped onto a wire.

Figure 8 is a fragmentary view in axial section of a connector similar to that of Figure 3, but with an extended wire supporting portion and with an insulated shielded wire in place therein ready for crimping.

As set forth in the foregoing objects, the invention seeks to provide an improved insulated connector, by reason among other things of providing a novel and improved manner and means of securing wire therein. In addition, the invention provides more appropriate and effective support for the insulation which normally is in the form of a sheath over the wire.

Referring to Figure 1 of the drawings, there is shown an electrical connector comprising a ferrule 12 and a connector tongue portion 14. The ferrule 12 is formed by material rolled into cylindrical form with longitudinal abutting edges which may be brazed together. Numeral 16 designates a plastic tube engaging ferrule 12 and advantageously cemented thereto, in accordance with the invention disclosed and claimed in my copending application Serial No. 251,466 filed October 16, 1951, now Patent No. 2,654,873, issued October 6, 1953. The end of tube 16 is enlarged

as shown at 18 to receive an insulated wire, the end of which is stripped and crimped in the ferrule 12, e. g., by a crimp of the type disclosed in the patents of Buchanan Nos. 2,379,567 and 2,554,813, or of the Carlson Patent No. 2,359,083, or of the Holtzapple application Serial No. 73,946 filed February 1, 1949. The portion 18 is enlarged to permit reception of an insulated (unstripped) portion of the insulated wire within the end portion of the insulating tubing and this may be crimped so that the tubing securely engages the insulation of the wire.

Within the enlarged portion 18 is a metal band 20 which when crimped securely engages the insulation of the wire. The type of crimp may be one well known in the art. The portion 18 is of somewhat larger diameter than the insulated wire and the preferred type of crimp is one wherein upper and lower portions of band 20 and portion 18 assume a curved contour and side portions are more or less parallel, as in said applications of Carlson and Holtzapple, respectively, thus providing secure engagement with the insulated wire. The band 20 serves the purpose of providing support for the insulating tubing 16 before it is crimped; and the tubing 16 being securely cemented to it, it helps to hold the exterior of the wire when the connection is crimped on. The band 20 enables the tubing to assume and retain the desired shape and to serve its intended purpose most effectively.

The plastic tubing 16 may be formed and applied in any of various ways according to the various methods used in the plastics art.

Figure 2 shows an arrangement similar to that of Figure 1 wherein the metal support band 20*a* within the enlarged portion 18 of the insulating tubing 16 extends back over the end of the tubing as shown at 24. As in Figure 2 band 20*a* is securely attached by crimping to the insulated wire and the insulating tubing 18 is cemented to the band. The turned over portion 24 further assists as a retainer for the insulating tubing 18, securing it in position and holding it against changing form in response to plastic memory, e. g., if the terminal should become overheated.

Figure 3 is a view of another advantageous form of the invention which provides a very effective insulated connector. Numeral 12 indicates a ferrule having a connector portion 14. The ferrule is formed of pure electrical copper by rolling a blank stamped from the sheet material into cylindrical form such that a longitudinal butt joint is formed along the top thereof. Over the ferrule thus formed is fitted a seamless copper (or other metal) sleeve 28 which extends beyond the end of the ferrule. The sleeve 28 is necked or indented as indicated at 30, and crimped over at its opposite end as indicated at 32. Numeral 16*b* indicates a plastic sheath applied around the outside of sleeve 28 and extending beyond it for purposes of insulating the terminal. Inside of the extension 18*b* of sheath 16*b* near its end is a metal band 20*b* which serves as a support for the end of the sheath 16*b* and to which the sheath is securely cemented.

In use the ferrule 12 is crimped to a bare part 34 of an electrical conductor in a manner well known in the art and the extending portion 18 of the sheath 16 and the band 20 are crimped in a known manner to an insulated part 36 of the wire as shown at 37, the band 20 securely engaging the insulation. The sheath 18, being securely cemented to the band 20 maintains the same shape as the band. (I use the reference numerals generically to refer to the corresponding elements of the modified forms of Figures 2–8, as well as the form shown in Figure 1.)

Figure 3*a* shows a modification of the structure of Figure 3 in which the band 20*c* is on the outside of sheath 18*b* instead of inside, but provides support for it in the same manner as in Figure 3. The band is fitted on and cemented to the sheath 18*b* as in the previous embodiment.

Figure 3*b* shows another modification wherein a stepped band is used instead of the simple band 20*b*. The inner portion of this band is used like its counterpart 20*b* of Figure 3; while the outer portion 38 can receive an outer insulation, where used over the shielding. When the inner portion and the end of sheath 18*b* are crimped, e. g., as shown in Figure 5, for the embodiment of Figure 3, those two parts are interlocked, and the shielding is securely engaged. When the outer portion 38 is crimped it securely holds the outer insulation of the wire, holding it against pulling back so as to expose any part of the shielding and also avoiding any unsupported area where repeated flexing might cause a fatigue failure in the wire.

Figure 5 is a perspective view of a terminal as shown in Figures 3 and 4 when it has been crimped onto the end of an insulated wire. As will be observed, the conductor is shown of the multi-strand type (although it might be solid or single strand). The end of the ferrule 12 and the sleeve 28 and sheath 18*b* are crimped as shown to a more or less elliptical shape by a compression forging process as already known in the art. The crimping tool leaves twin indents on each side with a transverse ridge between each pair on the upper and lower sides respectively, as shown. The opposite end of the sheath 18*b* and band 20*b* are crimped onto an insulated part of the wire as shown at 37, preferably by a confined compression die of the type shown in said Carlson patent. The resulting construction is a thoroughly insulated connector wherein the insulation is firmly secured to the connector and cannot slip therefrom. The connector is furthermore fully protected from flash-over in that the metal band 20*b* secured to the outer end of the insulating sheath is not connected to any conductive part of the assembly.

Referring to Figure 6 of the drawings, there is shown another form of the invention applicable particularly to shielded conductors, wherein the connector itself is insulated from the shielding; yet the shielding is secured thereto without taping and shellacking. In Figure 6 the ferrule 12 and connector are secured to the plastic sheath 18*d* by cementing it to the sleeve 28*d* and/or crimping the latter thereon. Metal sleeve 28*d* engages the ferrule 12 and the outside of the end of sheath 18*d*. Sleeve 28*d* is necked or annularly indented as shown at 30*d*. The band 20*d* in this case extends beyond the end of sheath 18*d* to receive and engage shielding or other part of the wire.

The ferrule 12, sleeve 28*d* and sheath 18*d* can be crimped onto the wire 34 and insulation 36*d* in a manner corresponding to that of previous embodiments or in other ways known to the art. The wire of Figure 6 is of the type having braided metallic wire shielding 56 which is normally grounded. The metal band 20*d* is secured to the end of the sheath 18*d* as in the other figures, and after insertion of the wire into the connector this band is crimped onto the adjacent ends of sheath 18*d* and shielding material 56, e. g., as previously

described, so as to firmly secure the shielding to the connector.

Figure 7 is a perspective view of the arrangement of Figure 6 after being thus crimped to a wire. As will be observed, the arrangement provides a very effective insulated connector particularly for insulated wires having shielding thereon, the arrangement thoroughly insulating the shielding from the terminal itself but all of the parts of the assembly being very securely attached to the wire.

Where the wire to be connected is composed of several coaxial layers the sheath 18 and/or the band 20 may be stepped in additional steps to support or secure successive layers. Thus with the structures of Figures 1 or 3, the plastic 18 may be extended farther and enlarged to a greater diameter to receive the next largest layer, with or without a corresponding extension and enlargement of the supporting band 20; or the band 20 may be thus extended and enlarged beyond the end of the plastic sheath 18. Or a larger tube of metal or insulating plastic can have one end fitted and secured to the outer end of such a connector and its other end of a size to receive and hold one of the layers of the wire.

This is illustrated by Figure 8 wherein a larger insulating sheath 58 is cemented onto the end of sheath 18*b* of Figure 3. This connector is shown assembled with, but not yet crimped onto a multilayer wire having a central conductor 34, insulation 36, shielding 56 and external insulating layer 60.

I claim:

1. In an electrical connector, in combination, a ferrule of malleable metal having an extending connector portion, said ferrule comprising malleable conductive material, a coating of flexible insulating material of the type adapted at room temperature to transmit without failure forces sufficient to forge said malleable metal together with a conductor into secure engagement, said coat being permanently secured on said ferrule, and a malleable metal band secured to the insulating coat near its end remote from said extending connector portion, the ends of said band being axially displaced from the near end of said coat and insulated from all conductive parts in contact with said ferrule.

2. In an electrical connection the combination as defined in claim 1 which further includes an insulated wire, said ferrule being forged onto a central conductor of the wire in electrical contact therewith and said band and the portion of the insulating sleeve secured to it being crimped into engagement with a portion of the wire where its insulation remains intact.

3. In an electrical connector, in combination, a ferrule forming portion of malleable metal having another connector portion extending therefrom, an extension of stiffly flexible insulating material secured to said ferrule at its open end, said insulation extending beyond all metal in conductive relation to the ferrule, and a malleable metal band secured thereto in an area at the end of said extension and spaced beyond said ferrule portion.

4. In an insulated electrical connection, in combination, a metal ferrule, a shielded, insulated electrical conductor having an end secured in pressure engagement in the ferrule, a coat of insulating material secured to the ferrule and extending therebeyond, the shielding material on said conductor terminating beyond the said ferrule and spaced by said coat from all parts in conducting relation with the ferrule, and a metal band secured to an end portion of the insulating coat and surrounding said shielding material and crimped to securely engage it.

5. In an insulated electrical connection, in combination, a metal ferrule, a shielded, insulated electrical conductor having an end secured in pressure engagement in the ferrule, a coat of insulating material secured to the ferrule and extending therebeyond, the shielding material on said conductor terminating beyond the said insulating coat and spaced from all parts in conducting relation with the ferrule, and a metal band engaged over adjoining portions of the insulating coat and shielding material.

6. In an electrical connector, in combination, a ferrule having an extending connector portion, an insulating coat engaged over the ferrule and extending therefrom, and a metal band secured thereto within said extending portion and spaced from all parts in conductive relation to the ferrule.

7. In an electrical connector, in combination, a ferrule having an extending connector portion, an insulating coat engaged over the ferrule and extending therefrom, the extending end of said coat being enlarged, and a metal band secured thereto within said enlarged portion and spaced from all parts in conductive relation to the ferrule.

8. The structure of claim 7 wherein the metal band extends beyond the end of said coat and back over its exterior.

9. In an electrical connector, in combination, a ferrule having an extending connector portion, an insulating sleeve engaged over the ferrule and extending therefrom, the extending end of the sleeve having a metal band fitting thereover and spaced from all parts in conductive relation to the ferrule, the band being secured to the sleeve.

10. The structure of claim 9 wherein the ferrule is securely crimped onto a bare portion of an electrical conductor and the tube and metal band are securely crimped onto an insulated portion of the conductor.

11. An electrical connector comprising a cylindrical malleable metal ferrule, a tubular insulator extending coaxially from one end of said ferrule, a coaxial sheath engaging adjacent portions of said ferrule and insulator securing said ferrule and insulator together, and a cylindrical malleable metal band surrounding said insulator at least near its end remote from said ferrule, said band extending beyond the remote end of said insulator.

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