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METHOD OF MAKING ELECTRICAL CONNECTORS

Original Filed Sept. 25, 1942

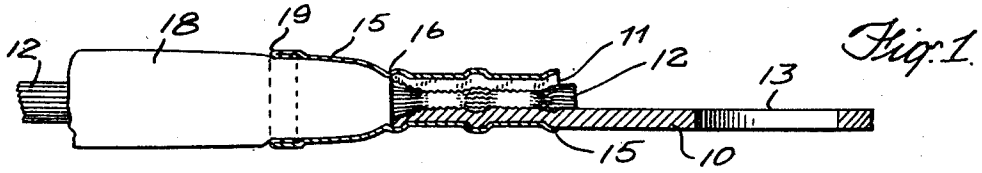


Fig. 1.

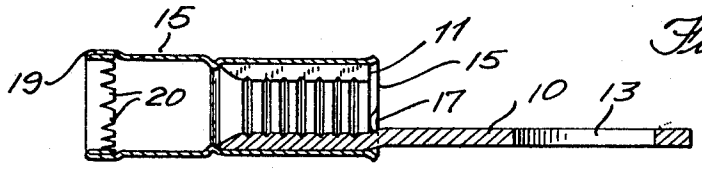


Fig. 2.

Fig. 3.

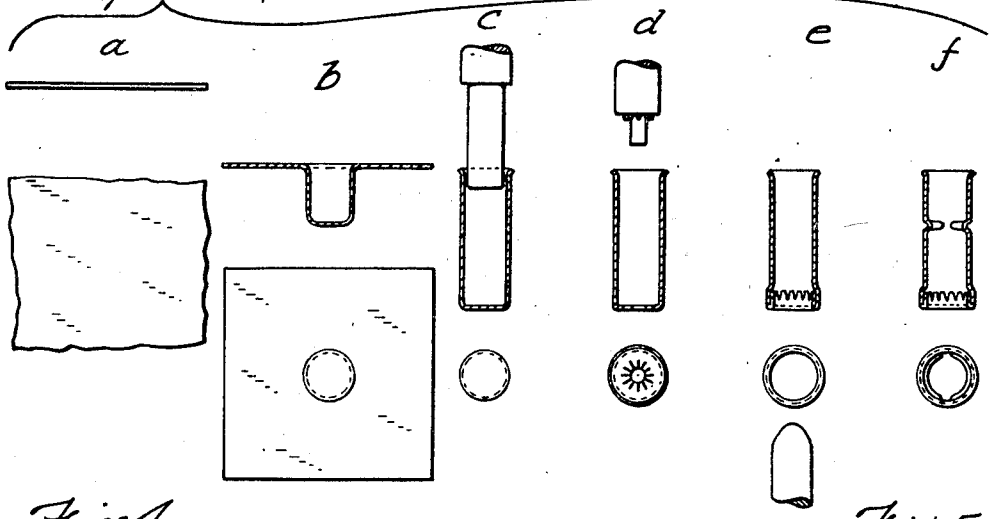


Fig. 4.

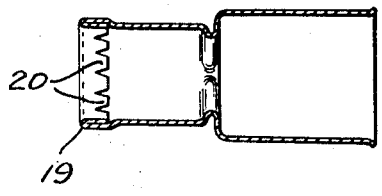


Fig. 5.

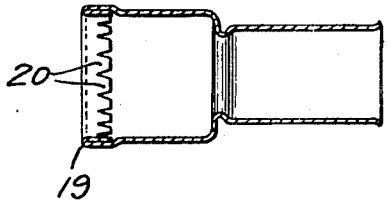
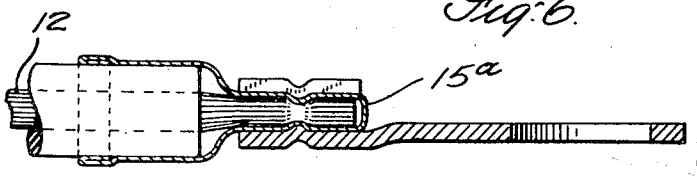


Fig. 6.



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METHOD OF MAKING ELECTRICAL CONNECTORS

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3 Claims. (Cl. 113—119)

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This invention relates to a method of making a terminal for electrical wiring. More particularly the invention relates to a method of making a terminal having means for supporting an insulated portion of the wire as well as for engaging and electrically contacting the central conductive portion of the wire. This application is a division of our prior application Serial No. 459,624, filed September 25, 1942, Patent No. 2,405,111, issued August 6, 1946.

Electrical connectors for use in connection with conductor wires are commonly made with a ferrule adapted to receive and engage and electrically contact the conductive portion of the wire. When these are applied to an insulated wire, the insulation is commonly stripped away from the end which is inserted into the ferrule so that the central conductive wire is supported near its end by the ferrule and beyond the end by the insulation, but for a short distance between the ends of the insulation and the ferrule the wire remains unsupported; and, if it is subjected to bending stresses, the strains tend to concentrate at this point. To overcome this in situations where serious bending stresses are encountered, it has been common practice to provide an extension on the ferrule with ears to wrap around and support the insulated portion of the wire, or to provide over the ferrule a longer ferrule of more or less rigid insulation material. The former construction is unsatisfactory in a number of respects, among which not the least important is that the cut edge of the metal ears gives a sharp concentration of stresses which may eventually cut the insulation. The latter is often precluded by expense of manufacture or by space considerations.

It is an object of our present invention to provide a simple and inexpensive structure for supporting the insulated portion of a wire in its relation to a connector. More particularly, it is an object of our invention to provide strong support and secure engagement between the insulated portion of the wire and a connector with negligible increase in dimension and at slight additional cost. A further object of the invention is to provide an inexpensive method for the manufacture of such supporting structure.

With these objects in view, we have, according to our prevent invention, provided for the support of the insulated portion of the wire by means of a sleeve fitted to the ferrule portion of the connector with its outer end projecting beyond the ferrule and having the material thereof folded back within itself and slit so as to

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form engaging fingers or serrations which assist in holding the insulated portion of the wire. This sleeve may be made of any thin, high strength material having appreciable resiliency and preferably is made of a ductile material such as sheet metal which can be formed into shape by drawing and pressing by means of suitable dies.

In the accompanying drawings, we have shown a preferred embodiment of our invention as applied to a connector terminal of a type commonly used in low tension electrical wiring.

In these drawings,

Figure 1 is a view in longitudinal section showing an insulated wire with a connector terminal attached thereto and the insulation supporting sleeve secured in operative relation on the connector and insulated portion of the wire;

Figure 2 is a view in similar longitudinal section and partly broken away showing a connector and supporting sleeve ready for application to the wire;

Figure 3 shows successive stages in the formation of a supporting sleeve according to my invention by a suitable process and apparatus;

Figure 4 shows a modified form of sleeve;

Figure 5 shows another modified form of sleeve; and

Figure 6 shows in longitudinal section an alternative form in which the sleeve is fitted to the inside instead of the outside of the ferrule.

Referring to the drawings, the terminal connector 10 is shown of a type now widely used in which a ferrule 11 is formed with an internal diameter adapted to receive the conductor wire 12 and an extended portion 13 of suitable form is adapted to engage a binding post or other electrical connecting device. Tightly fitted over the opposite side of this ferrule 11 is sleeve 15 which is positioned thereon at the outer end by radially indented or crimped portions 16. These indentations are preferably substantially circumferential and of sufficient depth so that, as shown in Figures 1 and 2, they constitute a "funnel" portion over the ends of the ferrule 11 and thus serve to guide the wires of the electrical conductor 12 into the mouth of the ferrule. It is desirable also to indent or crimp the end of the sleeve at the opposite end of the ferrule as shown at 17 so that the sleeve is held securely in both directions, but this is not essential since the insulation 18 on the wire will itself engage the indented portion 16 when the connector is pressed onto the wire and thus hold the sleeve in the proper position and relation. Moreover, if as

indicated in Figure 1, the connector is of the solderless type which is secured to the wire by crimping of the ferrule 11, this crimping itself will serve to interlock and completely secure the sleeve 15 and the ferrule 11. To facilitate such crimping and a perfect connection in the crimped area, the ferrule and wire are advantageously of soft aluminum or copper with or without tinning. The sleeve may be of the same material or, being relatively thin, may be of a more resilient material such as brass or aluminum alloy or a harder copper, e. g., about "quarter hard." The parts may be tinned or silvered or otherwise treated to reduce corrosion without impairing conductivity.

Beyond the indentation 16, the sleeve 15 is of a diameter fitted to that of the insulated portion 18 of the wire and due to the formation of the outer end of the sleeve with its reentrant fold slit at intervals as shown so as to form fingers 20 projecting slightly into the interior bore of the sleeve, the insulation is locked by the sharp serrated edge of this fold or finger whereas the outer edge of the sleeve against which the flexing of the wire must occur is smoothly rounded and slightly flared due to its formation by folding inward of a portion of the material at 19. This folding protects the wire against chafing or cutting and also assists in threading the insulation into the bore of the sleeve. This latter function is served by folding back the edge either inwardly or externally, but as will be apparent from the drawings, the locking of the insulation by the folded-back portion can be had only if it is folded inwardly.

The outer portion of this sleeve may also be crimped and/or advantageously compressed, e. g. as set forth in the copending application of Vernon E. Carlson, Serial No. 455,033, filed August 17, 1942, Patent No. 2,359,083, issued September 26, 1944, so that the serrated edge is pressed into the insulation for secure engagement and, if desired, a perfect seal secured.

As will be clearly evident from the above description, the structure described provides ample support and a secure holding of the insulated wire with protection against injury with a minimum of increase in weight and dimensions and at a low cost. Because of the cylindrical form and the fact that the cylinder is tightly packed within by the insulated wire at one end and the heavier ferrule at the other, the metal or other material of this sleeve 15 need be of only very light material.

Figure 3 shows, by the series of diagrammatic figures representing successive steps of the metal drawing operation, one way in which the sleeve above described may be made in accordance with my present invention. As indicated in step *a*, the sleeve is drawn from flat sheet or strip stock. The first step, in one of several operations, is to draw this stock into the desired ferrule form; an intermediate stage in this drawing is indicated at *b*. When the drawing is completed to the desired form, the edge is trimmed, which may be, as indicated at *c* in Figure 3, combined with a final drawing operation, or it may, if desired, be combined with the following step illustrated at *d*. The step illustrated at *d* in Figure 3 is the piercing and scoring by which the center of the bottom of the drawn cup or ferrule is punched out and a series of radial cuts or deep scorings are formed at the same time by a suitable die at the base of the punch. In the step illustrated at *e*, a punch inserted in the opposite direction turns inwardly

and stretches to cylindrical form, what had previously been the rim of the bottom of the cup remaining after the step *d*. In the course of the stretching of this rim into the cylindrical form, the scored lines are torn open, or if already cut, are stretched apart, as indicated in the drawing, leaving serrations or fingers inwardly directed and spaced from the end of the ferrule. The final operation is the formation of the crimp or circumferential groove 17 by means of suitable dies pressed against the ferrule from opposite sides. This step may also be combined with step *e*, the crimping dies then serving to support the ferrule during the insertion of the final forming punch.

The above series of operations with tools as illustrated in Figure 3 results in a sleeve for use where the ferrule of the connector is of approximately the same thickness as the insulation on the wire. If the ferrule is larger than the wire, it is necessary to use in the preliminary drawing operation a stepped die in which the upper portion has a larger diameter than the lower portion with results such as illustrated in Figure 4.

If, on the other hand, the insulated wire is to be of larger diameter than the ferrule, then it is necessary to use in step *e*, a die of larger diameter than that used in the drawing of the initial cup, with the result that the lower portion of the sleeve is stretched to a diameter larger than that of the initially formed cup, as shown in Figure 5. If the difference in diameter is substantial this may require several dies of progressively larger diameter used in a series of drawing operations.

In Figure 6 is shown a modified form of the invention wherein the smaller end of the sleeve 15*a*, instead of being fitted to the outside of the ferrule of the connector terminal, is fitted to the conductor wire and adapted to be inserted into the bore of the ferrule as shown, whereupon the assembly will be secured together by crimping as in the case already described above. In this case, since the smaller end of the sleeve remains closed, it will not be possible to form the sleeve in the manner shown in Figure 3 and described above, but the outer edge may be turned inwardly by drawing or other suitable technique. It will be understood, however, that the end of the sleeve need not be left closed, but may be punched out as in the other embodiments, and, if desired, the end may be turned or expanded over the end of the ferrule, so that, in effect, the sleeve is riveted in place.

The use of an insulation supporting sleeve broadly, as well as the use of such a sleeve to hold closed a ferrule which is rolled up from flat stock, are described and claimed in a prior application of Stephen N. Buchanan, Serial No. 421,408, filed December 3, 1941, Patent No. 2,379,567, issued July 3, 1945.

The use of a thimble to seal the wire, as shown for example in Figure 6, is the invention of one of us, described and claimed in the copending application of Vernon E. Carlson, Serial No. 455,034, filed August 17, 1942, Patent No. 2,385,792, issued October 2, 1945.

We claim:

1. In the art of manufacturing a seamless sleeve for electrical connectors, the method which comprises: deep drawing a cup in a sheet metal blank until the depth of the cup is substantially greater than its diameter, making in the bottom of the cup a central opening and cutting at least part way through the bottom along lines radiating star-like from the opening and terminating

short of the side walls of the cup, drawing inwardly the remaining peripheral portions of the cup bottom and therewith the segmental portions between the radial cuts, pressing said portions against the adjacent surfaces of the cup side walls, and trimming excess blank material from the opposite end of the resulting sleeve.

2. In the art of manufacturing a seamless sleeve for electrical connectors, the method which comprises: deep drawing a cup in a sheet metal blank until the depth of the cup is substantially greater than its diameter, making in the bottom of the cup a central opening and cutting at least part way through the bottom along lines radiating star-like from the opening and terminating short of the side walls of the cup, drawing inwardly the remaining peripheral portions of the cup bottom and therewith the segmental portions between the radial cuts, pressing said portions against the adjacent surfaces of the cup side walls, and trimming excess blank material from the opposite end of the resulting sleeve, and drawing an upper portion of the cup to a larger diameter.

3. In the art of manufacturing a seamless sleeve for electrical connectors, the method which comprises: deep drawing a cup in a sheet metal blank until the depth of the cup is substantially greater than its diameter, making in the bottom of the cup a central opening and cutting at least

part way through the bottom along lines radiating star-like from the opening and terminating short of the side walls of the cup, drawing inwardly the remaining peripheral portions of the cup bottom and therewith the segmental portions between the radial cuts, pressing said portions against the adjacent surfaces of the cup side walls, and trimming excess blank material from the opposite end of the resulting sleeve, and drawing the lower portion of the cup side walls and the inturned bottom portions to a larger diameter.

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